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History of the treatment of purulent dacryocystitis

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A HISTORY OF THE TREATMENT OF

PURULENT DACRYOCYSTITIS

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SENIOR THESIS

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UNIVERSITY OF NEBRASKA

COLLEGE OF MEDICINE

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by

FRED W. BECK
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>Treatment of Antiquity</td>
</tr>
<tr>
<td>Etiology of Dacryocystitis</td>
</tr>
<tr>
<td>Roentgenological Examination of the Sac and Duct</td>
</tr>
<tr>
<td>Significance of Intact Canaliculi</td>
</tr>
<tr>
<td>Treatment of Stenosis</td>
</tr>
<tr>
<td>Medicamental Treatment of Chronic Dacryocystitis</td>
</tr>
<tr>
<td>Treatment of Chronic Dacryocystitis with Antivirus Besredka and Vaccines</td>
</tr>
<tr>
<td>Treatment of Acute Purulent Dacryocystitis</td>
</tr>
<tr>
<td>Treatment of Chronic Dacryocystitis by Medicamental Destruction of the Mucous Membrane of the Sac</td>
</tr>
<tr>
<td>Dacryocystectomy</td>
</tr>
<tr>
<td>Dacryocystorhinostomy</td>
</tr>
<tr>
<td>Conclusions</td>
</tr>
<tr>
<td>Bibliography</td>
</tr>
</tbody>
</table>

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INTRODUCTION

Thought has been given to the diseases of the lacrimal apparatus ever since the human race acquired knowledge concerning it. The pathology of this subject has been studied as long as we have records. It was especially the suppuration of the lacrimal sac and its fistula formation that called urgently for help. These diseases were combated and healed by the ancients by means of various operations.

The obliteration of the lacrimal tract by surgical measures is a relatively modern therapeutic acquisition. Regardless of some timid attempts -- quickly given up during the eighteenth century, surgical measures were not adopted until the middle of the nineteenth century. By this, it is not intended to convey the idea that destruction of the lacrimal tract had never been done before; quite the contrary, this was an operative result obtained by surgeons in all ages, but unwittingly, because although Celsus, Ambroise Pare and later Master Jean, Pellicier de Quengay and J. L. Petit cured lacrimal fistula in spite of very different therapeutic measures employed, these all tended to the same unrecognized result, namely, obliteration of the lacrimal tract.

It is stated by Cunston (1) that in the period which extends from antiquity to the eighteenth century, surgeons were ignorant of the anatomy and physiology of the lacrimal tract or at least they were not inspired by knowledge obtained by dissection and clinical observation. Nevertheless it is not exact to maintain that the ancient practitioners
had only false ideas as to the secretion and excretion of tears, as
many are wont to uphold, because even in the second century, Galen,
in his work, "De usu partium", makes it evident that although his
physiological knowledge may have been wanting he at least possessed
fairly precise notions on the anatomy of the lachrymal tract. It
was only after Anel that the lachrymal duct was taken seriously
into consideration in morbid processes arising in the greater angle
of the eye. In reality, before Anel, the lachrymal tumor -- to
which the name of ankylopol had been given on account of its peculiar
situation -- was looked upon as a vulgar mucous cyst which by
suppuration could be transformed into an abscess (apostema) resulting
in a fistula, in which circumstances the tumor was called oegilops.
The surgical treatment of these morbid processes was confined to the
use of the potential or actual cautery, the skin having first been
incised or the fistula dilated.

Strange as it may appear, this empirical and rudimentary treat-
ment was far from being always ineffective. The use of the cautery
and solid or liquid caustics resulted after a time in obliteration
of the structures, during which abundant suppuration of the region of the
lachrymal sac continued. In point of fact, the ultimate outcome was
identical with the results which are obtained today, in a much shorter
time, by destruction of the sac with the thermo-cautery.
TREATMENT OF ANTIQUITY

The Code of Hammurabi (2), which dates back to about B.C. 2250, is an ancient Assyrian-Babylonian code, the oldest book on law in all the world, and the oldest document of any kind to mention matters pertaining to medicine or ophthalmology. Parts of the code related to dacryocystitis are: 215) "If a physician open an abscess (in the eye) of a man with a bronze lancet and save that man's eye, he shall receive ten shekels of silver (as his fee). 216) If he be a freeman, he shall receive five shekels. 218) If a physician open an abscess (in the eye) of a man with a bronze lancet and destroy the man's eye, they shall cut off his fingers. 220) If he open an abscess (in his eye) with a bronze lancet, and destroy his eye, he shall pay silver to the extent of one-half of his price."

The Egyptian Papyrus-Ebers (2) (3), which is almost modern by comparison with the Code of Hammurabi, relates to Egyptian ocular therapeutics of 1500 B.C. It states that "For the driving away of a swelling on the nose, (no doubt meaning dacryo-cystitis) use antimony, myrrh, and dried honey, rubbing it into the eyes for four days."

In fistula of the lacrimal sac, Celsus, a Greek-Roman physician and encyclopedist who lived from 25 B.C. until about 50 A.D., recommended the excision of the entire diseased tissue down to the bone, and the bone to be burned with a red-hot iron for the purpose of causing a thick sequestrum to fall away. Meller (4), believes that if, as is not improbable, this communication with the nasal cavity was made chiefly for the purpose of effecting a drainage for the secretion of the wound, there may also have been the idea
that, in the case of an incomplete removal of the mucous membrane, a recurrence of the exterior fistula would thus be prevented, and, in the future, would also provide an outlet for the tears. It is also probable that the deciding object of this method was the removal of the entire mucous membrane, even if, owing to the limited knowledge of anatomy at that time, this object was but dimly surmised. And so, the history of that time shows us that, as in a nutshell, the one operation included the two which, in the extirpation of the sac and in dacryocystorhinostomy, appeared many centuries later as new operations along with other methods.

A century later, Galen, 131 to 210 A.D. (1) (4) (5), knew the anatomy of the nasolacrimal canal. He quotes his teacher Lykias (120-160 A.D.) thus: Lykias mentions that a canal goes from the eye toward the palate. Even before Galen, Aristoteles knew that if colored substances were put into the eye they would appear in the saliva, or would be blown out through the nose. Galen mentioned three operations for lacrimal fistula: 1) Incision, boring of holes into the bone toward the nose and putting in caustics. 2) Scraping of the bone and burning with hot iron. 3) Incision, then a small metal funnel is put upon the bone and melted lead is dropped in. It was only towards the end of the seventh century that Paulius of Aegina, 625 - 690 A. D. raised his voice against trephining the bone, declaring it to be unnecessary, but nobody, it seems, joined in this opinion.

At about the year 550 A. D. Aetius (1), gives more precise details in the description of oegilops and its surgical treatment in his "Medici graeci contractae ex verterbus medicinae tetabiblos".

The Arabs (1), whose medical writings are translations from the
Greek writers but with many original additions of considerable value in many instances, some centuries later took up the same procedures of cauterization. Avicenna, at the commencement of the eleventh century, employed both the actual and potential cautery and Rhazes warns the operator against injuring the nasal branch of the ophthalmic nerve in operation for lachrymal fistula. In the surgical writings of Albuscasis, in which the very free use of cauterization is highly extolled, there is a figure of a cautery used in that day for the cure of "fistula in the angle of the eye." Cauterization by means of melted lead applied to the parts by a specially constructed funnel for the purpose, was also used. The cauterization was applied "once on the middle of the head, twice on the temples and twice on the neck" and not to the lachrymal sac, because the old Arabian surgeon believed that in chronic lachrymation "the cause is in the veins and arteries which lie on the surface of the head and that it is evident that this affection is due to the cold, thick and pituitary humors."

Means (3) tells us that the Arabian physicians were the first to recommend compression of the tear sacs with instruments, the injection of medicine and the dilatation of the nasal ducts by sounds.

In spite of the important treatise on surgery by Guy de Chauliac (1), in the fourteenth century, the science of medicine made little progress in any branch during the greater part of the sixteenth century although it had awakened from the deep sleep into which it was plunged during the medieval period. It would seem that the precise notions of Galen and Aetius had even been forgotten, and it is curious to find this ignorance reflected in the passage of the immortal Rabelais.
Ambroise Pare (1) offers no other explanation of lachrymal fistula in his description of the eye.

Berengarius (5), (1470-1530), often named Carpi after the place of his birth, described the lacrimal points for the first time in history. During the Renaissance Vesalius (1514-1564) and Fallopian (1513-1562) described the anatomy of the excretory apparatus, but these discoveries remained without practical results. They still maintained that the tears coming from the brain flow toward the eye by way of the lachrymal orifices.

The honor of the first exact description of the anatomy of the lachrymal tract is due to Carcanus (1), of Milan, a pupil of Fallopian. In 1574, he gave the true position of the lachrymal gland, described both the lachrymal ducts and lachrymonosal duct and at the same time showed the exact route taken by the tears. Nevertheless, in spite of all this progress in anatomy of the parts, the treatment of lachrymal fistula continued the same.

In the seventeenth century anatomy progressed but surgery in no way profited by it. In 1652, Marchetti published a very excellent description of the lachrymal gland as well as of the lachrymal apparatus, while Stensen, in 1662, completed the work done by Carcanus many years before and attempted to disprove the then reigning opinion that the tears came directly from the brain. He satisfactorily demonstrated that they formed in the lachrymal gland "which separated them (the tears) from the blood."

In 1655, Huck refers to total obliteration of the lachrymal ducts, the result of caustic applications, but he doesn't offer any therapeutic conclusions and it may be said that all surgeons of this epoch merely followed the teachings of Pare in the treatment of lachrymal
Morgagni (1718) gave an exact description of the lacrimal organs, illustrated with drawings of the tear sac and the naso-lacrimal duct. He also mentioned that no true valves existed in this canal so that fluid can travel without hindrance from above downward.

It was only in the eighteenth century that any decided improvement over the lachrymal surgery of antiquity began to be apparent. This was, in part, the result of the anatomical discoveries of Carcamus and Morgagni, but it was due in very much greater degree to the improvements in lachrymal theory and practice made by Cearly Ernest Stahl (5), whose book entitled "Program de Fistula Lacrimale" (1702) was the first work of consequence on the subject in question since the time of Claudius Galen. The theory which Stahl laid down was, in brief, that the so called lachrymal fistula was not -- as all had hitherto supposed from the earliest ancients down to Stahl's time -- owing to some affection of the lacrymal caruncle, but, very differently, to diseases of the canaliculi, the lacrymal sac, or the lachrymonasal canal, resulting in complete or partial stenosis of one or another of these passages.

In 1713 Anel (1) (5) performed catheterism of the duct for the first time, thus inaugurating a completely novel procedure which put an end to the brutal destruction of the sac by caustics, or its radical excision by the hot iron. His procedure -- the most important ever devised for the treatment of these parts -- was carried out as follows: Through the upper canaliculus he daily passed into the sac, and on down into the nose, a golden, or silver sound of about the thickness of a hog's bristle and furnished at its distal end with an olive-shaped knot. Then, through the lower canaliculus, he injected
by means of his syringe an astringent preparation into the sac, and, when possible, on down into the nose. The procedure was repeated daily, until the fluid ran into the nose with ease.

The importance of Anel's discovery does not need to be emphasized to ophthalmologists. The Anel sound, the Anel syringe, and even the Anel procedure are (with numerous modifications) in use at the present day. Anel may be called the father of systematic probing through the canaliculi.

At about this time, Master Jean began to render an exact understanding of lachrymal morbid processes, and during ten years, beginning in 1734, the famous French surgeon, Jean Louis Petit (6) contributed much to show that these processes were caused by some obstruction to the flow of the tears and from this time on all surgical treatment was directed toward reestablishing permeability of the lumen of the lachrymonasal ducts.

Theoretically, the point to be attained was to restore the working of an hydraulic machine that was out of order. This machine, whose anatomical makeup was known, as well as the immediate cause of the disorder which prevented the tears from flowing into the nasal cavity, had to be dealt with. It was thought that the tears were retained in the lachrymal sac, dilating and distending it; that they there produced tension, inflammation, rupture and resulting fistula — the cause of all being occlusion of the lachrymal siphon. To do away with all these affections, all that was necessary was to clear the siphon so that the tears might flow off into the nasal cavity. This would put a stop to lachrymation and retention of the tears, therefore obviating the occurrence of inflammation, rupture and the resulting fistula. Consequently the treatment with the
cautery fell into discredit.

Petit even remarked that it was rather astonishing that the cautery had ever been able to give any good results, but, although absorbed in his conception of the siphon action, he nevertheless reconciled his theory with facts by supposing that the ancient therapeutic procedure had as a result the reaction of an artificial route conducting the tears to the nose.

All the operative procedures of the eighteenth century inspired by Petit's theories can be conveniently placed under two headings. In the first are comprised all the methods which had in view the re-establishment of a normal communication between the nose and the lachrymal sac. This result was aimed at, if not obtained, by various types of catheters -- algales as they were called -- canulae or setons, introduced and left for a long time. They were introduced either from the sac towards the nasal fossa through the obstructed nasal duct, or from the nasal fossa towards the sac, by performing permanent retrograde catheterization. The first of these procedures was successfully employed and described by Saint-Yves, Gendron and Joubert, while the second was introduced by Laforest and underwent some changes at the hands of Cabanis.

In the second category, resorted to especially when necrosis of the unguis existed or complete occlusion of the lachrymal duct was present, the re-establishment of a normal course for the tears was given up and in its stead an artificial route was created by perforating the bony septum separating the sac from the nasal fossa, with a trocar or actual cautery. This method was advocated and practised by Master Jean, Petit, Pellier de Quenguy, Dionis, Guerin and Saint-Yves. The multiple cauterizations combined with the numerous repeated traumata that all these
procedures necessarily inflicted on the lacrimal tract, resulted in complete destruction of the mucosa, hence the greatly dreaded complete and permanent occlusion could only be the final result.

During this period of infatuation for conservative procedures, a book appeared in 1748 from the pen of Angelo Mannoni of Florence (1), in which he states that having observed that recoveries from lacrimal fistula with complete stenosis of the duct did not necessarily bring about incoercible lachrymation, he returned to the ancient procedure of cauterization with caustics.

His son, Lorenzo Mannoni, employed the actual cautery, but both obtained encouraging results; however, their tentatives were overlooked or forgotten, not to say derided by those maintaining the mechanical theory of the times.

The great anatomist and surgeon Scarpa (1), whose merit repose upon a kind of foresight into the inflammatory theory of lacrimal morbid processes, was very harsh in his criticism on the essay made by his compatriots of Florence and he says thus, "to destroy, occlude, and entirely harden the sac is, strictly speaking, merely exchanging one affection for another equally troublesome, such as continual lachrymations," etc.

However, when instances of either spontaneous or surgical occlusion of the lacrimal tract continued to multiply, the procedures of destruction by means of caustics or the actual cautery were at length resorted to again in the nineteenth century in most countries, and from 1850 all the classic works on ophthalmology discuss this procedure while many opuscules appeared advocating its use.

Andel's endeavour to make the natural passages once more pervious led to the experiment of allowing cannulae to seal in the duct, or of
inserting threads which were allowed to remain. Benoit Mejan (5), at Montpellier (1750) treated some six hundred cases of lacrimal fistula. He took a gold probe with an eye at the upper end in which a thread was placed, etc.—Threads were inserted and allowed to remain. In 1833 Dupuytren left in a gold tube permanently after opening the sac from the outside, and Scarpa in 1821 a lead style. These methods, forerunners of the permanent probes, were again all abandoned.

"These methods never did what they should, they only demonstrated what sick people would stand and what the sick body can stand in the way of ill treatment. However, not always; eight days after introduction of a Scarpa style a fifty year old man developed tetanus which ended fatally." From a remark in Arlt’s text-book (4) (5), to the effect that "Verily, all these methods do no credit to art and science", it will be seen, even in Arlt’s time, into what disrepute fell all these attempts to secure a permanent drainage by the introduction of cannulae (of gold, silver or lead), through the duct or through an artificial opening in the nasal bone. The styles, however, have not passed into the historical museum where they belong, for just within the last few years (1923), Callahan and others have been warmly advocating the method of introducing silver cannulae into the duct and allowing them to remain there for a few months, and Hemmann, of Essen, the introduction of glass tubes through the lower canaliculus into the nose to be left there permanently.

The second half of the nineteenth century saw an improvement on Anel’s method, made by Bowman (4) (5). He endeavored to attain permanent success by means of his sounds for the tear duct — probes of gradually increasing thickness, which are still used today. The history of the subject has thus taught us that one method or a limited
number of methods left many cases unrelieved.

Celsius and Galen practiced extirpation of the sac, although they were unaware of the fact. From the beginning of the 18th century extirpation was done intentionally. John Thomas Woolhouse (4), a celebrated ophthalmologist of the late 17th and early 18th century, and one of the greatest charlatans of all times, seems to be the instigator of removing the sac. He also drilled a hole through the bone and introduced a gold cannula into the nose. Platner (7), in 1724, seems the first to have surgically extirpated the sac, but he also made a false passage into the nose and perhaps for that reason he had few followers. An unsuccessful attempt to revive the operation was made by Rosas in 1830.

Finally, in 1868 Berlin (8), a well-known oculist of the time, first performed a methodical excision of the lachrymal sac. He was followed by Meller, who developed the techniques of extirpation in their details and raised them to an anatomically exact operation.

Probing with Bowman's sounds, as long as there remained any hope of restoring normal conditions and, when this hope was gone, extirpation of the sac, were the two prevailing methods at the end of the nineteenth and the beginning of the twentieth century.

In 1909 Hirschberg (9) said: "In the first three decades of the nineteenth century ophthalmology first broke away from the delusive method of forming an artificial opening into the nasal cavity".

But even before these words appeared in print, words that proclaimed the general opinion of that time, the reinstalment of this very method, this so-called delusion, was completed. It is true that it had never fallen entirely into oblivion, and again and again there were surgeons who tried to make a new passage for the tears into the
nose when the natural channel could no longer be restored.

In the year 1897 the American author Kyle (4) (10) published, as he thought, a new method, after which, on slitit the canaliculus, he inserted a small trocar in the internal canthus and pushed it down towards the conjuction of the lacrymal bone with the maxilla, thus producing with the nasal cavity a new connection with an outlet under the upper turbinate bone. A short silver canula about ten mm. long, with short narrow lips bent at right angles, was then passed into the new opening, and the wound carefully treated until all inflammation had passed away. On this, Hirschberg remarked that already, 670 A. D., this method had been rejected by Paulinus. In 1901 Hess did not regard extirpation of the tear-sac with too much favour, and endeavored to turn the attention of the oculists to the simple and harmless method of boring through the ethmoid bone followed by treatment with permanent probes.

The importance of Toti's (4) dacryocystorhinostomy, first published in 1904, was greatly under-estimated by Hirschberg, for he devoted only five words to his operation: "Toti clinica moderna Firenze 1904". Toti defended his method against the remarks of Hirschberg mentioned above, with the statement that the formation of an artificial opening into the nasal cavity was not a delusion, but a thousand years old correctly formulated problem from which oculists had no need to break away, and which, in his opinion, is finally solved by his dacryocystorhinostomy.

Some years later Polyak and West reported on their endonasal methods, and then an undreamed of competition arose in the developing and perfecting of these methods and in publishing of the most different modifications, the number of which has become so great that today a complete surveyance of them all has become almost an
impossibility. Meller feels that the champions of the new school became somewhat too zealous in their overestimation of this fistulation method, so that now the voices which still venture to rise in favour of the conservative methods, and especially of extirpation of the tear-sac, have become very chary and rare.
ETIOLOGY OF DACRYOCYSTITIS

A consideration of the etiology of this very troublesome and disagreeable disease is necessary in order to understand the various attempts which are made to correct the condition.

Means (3) gives a summary of the causes, as follows:

2. Stenosis — may be caused by:
   A. Acute swelling of the mucous membranes of the duct, or only of the mucous membrane surrounding the outlet of the duct into the nose.
   B. Chronic inflammatory processes such as trachoma.
   C. A cicatricial or osseous obstruction due to direct or indirect trauma.
   D. Erosions, ulcerations or abscesses from nasal catarrh or diseases of the nasal sinuses (ethmoid cells and antrum of Highmore).
   E. A tubercular process of the nasal duct or lachrymal sac occurring in both children and adults.
   F. Syphilis, in children and adults, may cause inflammation and scar formation in the nasal sac or duct.
   G. Actino-mycosis of this region has been reported by Von Schroeder and Nagel.
   H. Gonococcal infection, of infrequent occurrence.
   I. Foreign bodies, such as beard of wheat, rye and hair and rarely concretions.

Concerning congenital atresia, Benedict and Barlow (11) say that stenosis of the duct in infants seldom results in suppurative affection.
of the sac but may often cause collections of large amounts of secretion that distend the sac, producing a mucocele and often a permanent fistula through the skin. Such a mucocele may extend backward, involving a part of the ethmoid labyrinth, or even extend into the orbit. Obstruction in children may follow edema and secondary inflammation of the duct from syphilitic periostitis, without other obstruction. The lacrimal sac in such cases may become secondarily infected and produce a purulent secretion. They draw the conclusion that chronic suppurative dacryocystitis in children is more often the result of disease of the structures about the lacrimal duct and sac than of congenital or acquired anatomic obstruction to the patency of the system.

Haizinga (12) mentions catarrhal conjunctivitis and sometimes the extremely irritating qualities that tears themselves occasionally possess. Lester (12a) adds uncorrected accommodative asthenopia of any kind, and careless correction of refractive errors as common causes, together with the various toxemias that react on the general health of the patient.

Primary disease of the sac, that is from foreign material having become lodged in the sac or duct, producing stenosis and permitting secondary infection, according to Benedict and Barlow (11), may become so extensive as to occlude the entire duct and set up a periostitis and disease of the contiguous accessory sinuses. This is seen frequently in cases of traumatism of the nose and orbit from a kick in the face by a horse, or other accident, in which the head has suffered a crushing injury. On attempting to sound such a duct the sounding instrument will encounter bare bone, loose pieces may be felt to move, and the instrument may be passed beyond
the lacrimal fossa into the opened cells of the accessory sinuses, and even into the nasal cavity beneath the nasal mucosa. Yankauer (12 B), also mentions injuries during operative procedures upon the maxillary antrum, which may occur not only when the sinus is curetted from the canine fossa, but also from the intra-nasal operation.

Wurdemann (12 C) tells us that it is generally agreed that direct propagation of nasal disease into the lacrimal passages is uncommon, but in the majority of cases diseases of the lacrimal sac are nasal in origin through continuity of the mucous membrane of the nose and of the tear passages. He also mentions the fact that ethmoid and antrum suppuration may be secondary to suppuration in the lacrimal sac.

Yankauer (12 B) mentions the fact that the ethmoid cells in particular have been emphasized by some writers as a cause of suppurative dacryocystitis, but says that although he has opened the ethmoid cells a number of times in these cases, he did not meet with a case of dacryocystitis in the numerous cases of suppuration of the anterior ethmoid cells which he saw. Davis (13) has only seen two cases of ethmoidal suppuration which affected the lacrimal sac. In both cases there was a perilacrimal abscess but no lacrimal obstruction. This is in accord with the findings of Stokes (14), who in over 300 cases of dacryocystitis has not found a single case in which the ethmoids were diseased, except in those instances where previous probing had been the source of secondary infection. Benedict and Barlow (11), on the other hand, say that we have been slow to recognize the primary disease as being in the accessory sinuses, the ethmoids in particular, because of the difficulty of diagnosing
disease in these areas. They believe that a suppurative ethmoid may, by its close relation to the lacrimal groove, set up an inflammatory process in the duct or sac which sooner or later may become purulent. The ethmoiditis may be of very low grade, and give no intranasal manifestation of its presence, but in time the presence of the pus may cause inflammatory reaction in the lacrimal duct which in turn may lead to stenosis, predisposing to a suppurative condition in the sac.

Codero (15), from a study of 78 cases, found a frequent coexistence of inflammatory processes involving the lacrimal sac and paranasal sinuses. In 46% it was certain, while in 33% there was a strong probability. In general the sinuses were affected by a simple inflammatory process, more or less accentuated. Only rarely was free pus found in the nose, a sign of inflammation in a strict sense. The sinuses most often affected were the ethmoid, either separately (22%) or together with the other periorbital cavities (51%). In acute or phlegmonous dacryocystitis sinus involvement is more frequent than in the chronic forms.

Diggle (16), in 1927 concludes that it would appear from the present investigation that the incidence of nasal abnormalities, deformities, and diseases, in cases of established lacrimal obstruction, is a rarity. The failure in relieving the lacrimal obstruction following the rectification of such nasal lesions as were found, with the exception of suppurative ethmoiditis, which is in itself rare, seems to preclude them as etiological factors in lacrimal obstruction. The absence of a history of nasal trouble in the majority of cases, as also the rarity of the incidence of nasal disease, would seem to render the nasal origin of lacrimal obstruction "non-proven". That
there is a nasal cause would seem to be undoubted, but its exact pathology and incidence still needs further investigation.

Burch (17) and Stokes (14) feel that too little consideration has been given to the anatomic defects causing stenosis of the duct. As Schaeffer (18) says, "The plane of the nasolacrimal canal must conform to the plane of the facial skeleton, is rarely vertical and the thickness of the bone between the duct and the maxillary antrum varies from papery thinness to 2 or 3 mm., at the juncture of the sac and duct in most instances, although no arbitrary division between duct and sac is usually perceptible". Also, "Instead of merging in linear fashion, the sac and duct may frequently be found joined side by side in an indirect continuity, the fornix of the duct lying at the side of the sac". Again, "It is generally believed that the walls of the duct are always regular, and the larger number of ducts do have regular and uniform walls with minor irregularities due to mucous membrane folds, but many ducts present lumina of very irregular contour, some are exceedingly tortuous in course, while congenital diverticula are not uncommon." He suggests the clinical importance of these anomalies in that they readily retain infectious material, are the true explanation of the false passages made in using the probe, and contribute to the chronicity of pathologic conditions of the lacrimal sac and duct.

Whitnall (19) and Sonderman (4) come to the same conclusion, and Sonderman found constrictions even in the lacrimal canaliculi. It is generally admitted that the more frequent affliction of the female is due to the peculiar anatomy of the nasal bones in this sex, whereby the lumen of the lacrimal canal is narrower than in the male.
Santos (20) calls attention to the greater diameter, directness and shorter course of the lacrimal passages in the negro, which explains the comparative freedom from lacrimal disease exhibited by the colored race. Meller (4) says that roentgen examination of the lacrimal canals of negroes has given us this same information, which Santos obtained from his anatomic studies.

Williams (21) says that in the ultra modern mode allergy stands out in the etiology; that we must consider the nose generally, the ethmoids in particular, which last are next to the eyes in causal relationship.

From the above statements it would appear that the anatomical defects of the lacrimal canal are the most constant precursors of dacryocystitis, that the nasal origin of this disease has not been proven, and that an associated ethmoiditis is a rarity.

**ROENTGENOLOGICAL EXAMINATION OF THE SAC AND DUCT**

Roentgenological photographs of the lacrimal sac were first made by Ewing (4), in 1909; Aubaret (22) reported on a series of findings in 1911, and in 1914 v.Szily (4) gave the subject full appreciation. Various substances were given as filling or contrast agents; at first bismuth paste, thorium oxide, barium sulphate, later, because it was superior to all others, lipiodol.

The Roentgen method was the first to give us a good perspective of normal and pathologic conditions of the sac and duct in a living person. Knapp (23) and Meller (4) tell us that fluoroscopy after the injection of lipiodol will readily demonstrate the location and degree of the stenosis, size of the sac, alterations in the bone, control of the width of the duct after probing, and fragments of the sac after extirpation.
SIGNIFICANCE OF INTACT CANALICULI

In previous years, slititig of the canaliculi, particularly the lower one, was, so to speak, an everyday occurrence for the ophthalmologist, as the operation was a preparatory measure to facilitate probing. But nowadays, as Meller (4) says, because of the new physiological view-point on the significance of intact canaliculi, this operation is performed rather infrequently. The theory which was first propounded by the Englishman Hounauld in 1736, and later particularly expounded by Weber and Hasner, that attributes the mechanism of the conveyance of tears to the aspiratory action of the rarefied air in the nose during inspiration, is further evidenced by the faultless conveyance after a successful dacryocystorhinostomy. Mosher (24), in 1923 wondered whether the passage of the air through the inferior meatus in the normal case does not by suction help to empty the nasal duct and the sac.

Spaeth (25) observed the functioning of the canaliculi and of the tear sacs in a leper colony, and concludes that the canaliculi and their integrity are far more important in the conduction of the tears from the culdesacs than is the sac itself and any function that has been ascribed to it. The observations consisted in timing the rapidity of the appearance of a 15% aqueous solution of mild silver protein in the inferior meatus of the nose under varying conditions: a) with the normal anatomy intact; b) after slitting of the canaliculi; c) after a stab puncture of the sac with a stylet or an artificial fistula in the sac; and, d) with the use of positive and negative air pressure in the sac through the stylet. The canaliculi continued to drain in spite of changes of pressure in the sac.
Burch (17) stresses the desirability of preserving the canaliculus intact, especially the lower canaliculus, on account of need of preservation of the natural capillarity and suction mechanism at the proximal end of the passages. Slitting the canaliculi often nullifies the otherwise good results of dacryocystorhinostomy operations with perfect openings into the nasal fossa. When tears reach the sac, natural gravity is sufficient to secure drainage providing the nasolacrimal duct is not obstructed.

Hanger (26) summarizes the opinion by saying that the capillary attraction of the canaliculi, the action of the ciliated epithelium of the mucous membrane which lines the lacrimal passages, and the action of the orbicularis palpebrarum and Horner's muscles, to say nothing of gravity, explain fully the drainage of the tears into the nose. His views are upheld by King (27), Knapp (23), Gradle (28), and partially by Whitnall.

Whitnall (29), Means (3), Fuchs (30) and Schirmer's ideas are all similar in that they believe the action of the lacrimal sac to be a highly important factor in the aspiration of the tears.

Gradle (28) believes that capillarity is the actuating force, and reminds us that Molinelli suggested that theory as far back as 1773. He believes that the theory of Duke-Elder, which is a combination of the theories of v. Arlt (1855) and Roser (1851), is probably correct as far as it goes, but says that other forces undoubtedly participate, such as the capillarity mentioned above. Duke-Elder's description is "On closure of the lids, the upper part of the sac remained unchanged or became distended, while the lower part of the sac and the upper part of the duct became compressed, while on opening the lids these movements become reversed. It
appears, therefore, that the passage of the tears from the canaliculus is assisted into the dilated upper part of the sac by aspiration, while the fluid which is already present in the lower part of the sac is expelled down the duct by compression of this part. On opening the lids, again, the collapse of the upper and the expansion of the lower part of the sac drives the fluid downwards, leaving an empty space for the next consignment from the eye."

Although there is still division of opinion as to the exact mechanism of the drainage of the tears, as seen from the above descriptions, it would seem that the majority of ophthalmologists recognize the importance of preserving the canaliculi intact to prevent epiphora. Meller (4) says that slitting the lower canaliculus is indicated today only in incipient ectropion of the lower lid, and Stokes (14) adds, the presence of obstruction of the canaliculus. In all cases one must avoid slitting the canaliculus as far as the canthus, for then constrictions of the canaliculus readily develop which can even undo the result of a dacryocystorhinostomy.
TREATMENT OF STENOSIS

Although congenital occlusion of the nasal duct is not very frequent it is by no means rare. The congestion of tears in the sac soon occasions an inflammation of its mucous membranes with a purulent secretion, which upon pressure is expelled from the canaliculi into the conjunctival sac. As the nasal duct is almost always occluded at the nasal orifice by a mass of epithelial cells exclusively, applying the thumb suddenly and forcibly on the filled sac is often sufficient to spring the occlusion toward the nose.

When this method does not achieve permeability of the passage, probing will bring about a rapid cure. After the lower canaliculus is dilated in superficial narcosis with the conical probe, Bowman's probe No. 1 is introduced. This procedure is very easy in the case of the newborn infant. When the sound has reached the floor of the nose, it is moved backwards and forwards a number of times, so that the passage is thoroughly opened. This one probe operation usually suffices to cure the pathologic manifestation of the disease. Slitting the lower canaliculus is superfluous, for even in the infant it may be dilated with a conical probe. Probing itself is easy and without danger.

Stenoses acquired later in life -- Bowman (31) had abandoned the style by 1857 because it was found necessary to continue it for periods varying from six weeks to six months, and some patients seemed to wear it permanently. He devised his set of probes, concerning which Teale (32), in 1860, remarked, "Although a course of treatment which sometimes extends over months may appear prolonged, it is still short compared with all former modes. However, we find a few who still cling to the use of the style, such as Lester (12 A). Burch (17) says
that its value is overestimated, and that it is of use only for patients who refuse better treatment by operation or in those living at a distance who can be seen only occasionally. It is useless in suppurative dacryocystitis.

Concerning Bowman's method of probing, Arganaraz (33), Knapp (23, Dean (34), and Mosher (24) agree that it would be an ideal procedure because we obtain not only a cure of the dacryocystitis but also a return to permeability of the lacrimal passages -- but probing cures only about 6% of chronic dacryocystitis.

Meller (4) says that a trial in probing, and a waiting for its results, occasion neither injury nor loss of valuable time, and agrees that in probing one either attains the end very quickly, or not at all.

Pressure syringing: --- The first procedure in determining the permeability of the lacrimal duct is syringing the lower canaliculus by means of Anel's syringe. The pressure required on the plunger of the syringe is small when the duct is clear. The narrower the duct, the greater the pressure required on the plunger, and the more delayed is the passage of the fluid. It can happen that the fluid injected into the sac can leave it via the upper canaliculus, particularly when the resistance in the constricted nasal duct is great. In these cases the fluid may be expressed through the duct by the so-called method of pressure syringing. The method consists of occluding the upper canaliculus with a conical probe, so that the fluid is compelled to find its exit through the nose. Pressure syringing is contra-indicated when there is a purulent secretion in so far as infectious germs could be forced into the tissue, and further, after probing, where there has been an injury to the mucous membrane or a false passage formed. We are thus occasionally able without the help
of probes to improve the permeability of the passage rapidly and consideroably, and, as a consequence, alleviate the ailments of the patient.

Meller (4) mentions the method of LaGrange, who used probing by electricity, and of Dowling, who is more radical; he incises the sac and introduces a thick sound with galvanic current into the canal.

Theobald (35) in 1877 directed attention to the importance of using much larger probes than had previously been employed, saying that with probes of less size, the strictures are seldom completely dilated, or the normal calibre of the canal restored. From anatomic measurements he concluded that the nasal duct in its normal condition, has commonly a diameter of about 4\(\frac{1}{2}\) mm., and that it seldom measures less than 3 mm. He claimed that there were but few cases in which a permanent cure might not be accomplished.

Ziegler (36) (37) devised a dilator in 1890, with which he practiced rapid dilatation of the tear duct in order to secure a permanent patulous lumen with free drainage. The value of this procedure lies in the rapidity of dilatation, the avoidance of repeated probing and the retention of capillarity in the duct. He later improved the dilator by enlarging it, and made the point ovoid or bellied so as to make it impossible to make a false passage.

In 1918 Thompson (38) introduced his method of curetting the sac and stricture, instead of dilating. He claimed it was applicable to all cases of dacryocystitis except the lacrimal abscess.

Fowler (39), in 1927, combined the two operations of Thompson and Ziegler. He dilates the canal to its maximum, uses a Theobald No. 14 or 16 or 4 to 4.5 mm., at the same time curetting the sac and duct if need be with dental burrs.

Caldwell (40), back in 1893, said, "The passage of too large
lacrymal probes is doubtless responsible for many cases of complete bony closure of the nasal duct. The repeated bruising and lacerating of the periosteum lining the canal results in formative periostitis, and in ivory-like exostoses which finally close the canal permanently. In others, contracting cicatrices form a dense fibrous structure which readily closes after each dilatation. Bony obstructions from fracture of the superior maxilla are occasionally met. These objections to the use of large probes are reiterated today by Hanger (41), Burch (17), Dean (34) and Mosher (24), the last of whom mentions that the procedure easily becomes brutal.

The use of canulae in the lacrymal duct, which was introduced by Dupuytren in 1833, is not generally in use today, although Kyle (10), in 1897 advocated its use, and the use of silver canulae was advocated by Callahan (42) in 1923, Dean (34) in 1929, and Williams (21) in 1934. Meller (4) tells us that Hermann prefers the use of a glass tube. He reports five cases in which he succeeded in creating a permanent connection between the conjunctival sac and the nasal cavity after a failure in sac extirpation by Toti's and West's operation.
Chronic dacryocystitis, with more or less copious secretion, can occasionally be favourably influenced, or even cured, medicamentally. The favourite medicament of the old Viennese ophthalmological school, even at the time of Arlt, was silver nitrate, which, with the help of an Anel syringe, is used in a 1/4% solution to syringe the sac. After probing, such a syringing may be undertaken only when the mucous membrane has suffered no injury, and the duct is permeable enough to permit the fluid to pass without the application of much force. When such is not the case the solution could infiltrate the tissue around the sac and produce symptoms of inflammation. Though such a mishap has no serious consequences, yet the patient naturally feels resentful against the physician. In order to get the solution into intimate contact with the mucous membrane and the entire lacrimal passage Meller (4) uses a hollow probe, which he slowly withdraws during the irrigation, so that all folds and pockets in the duct are syringed. Syringing must be continued a long time to attain permanent results. But often the cure is only apparent, and after a longer or shorter period of time secretion appears anew.

Fano (43), in 1863, first introduced the use of iodine tincture in the treatment of chronic dacryocystitis. He diluted it with equal parts of water and injected it through the canaliculi into the sac. Because this operation often irritated the conjunctiva markedly, Vermueil in 1872 punctured the sac directly with a Pravaz syringe, aspirated the contents with this instrument, removed it from the cannula which remained, filled it with iodide tincture and attached it to the cannula again. Then four or more drops of the undiluted tincture were injected. This method was forgotten for a
long time, but was resurrected in 1913 by Wessely, who obtains good results, especially in closing fistulae of the lacrimal sac, and in ulcus serpens. Cobb (44) in 1914 reported on the use of iodine to secure obliteration of the lacrimal sac.

Meller (4) says we must admit that with all these methods and medicaments we attain not only temporary but occasionally permanent cures, yet we are far removed from curing a case of chronic dacryocystitis with certainty. The occasional results, however, should stimulate us to practise such medicamental therapy first before we proceed to radical measures. The patient is in no way injured, nor does the delay in any way spoil the chances of success in a subsequent operation.

THE TREATMENT OF CHRONIC DACRYOCYSTITIS WITH ANTIVIRUS BESREDKA AND VACCINES

Vaccines have been used, especially by the Russians, being instilled either into the conjunctival sac or into the lacrimal sac with a hollow probe after the canaliculus had been slit and probed. De Rosa injected the preparation into the tissue around the sac.

Although some few apparently good results have been obtained, there is no idea that this method of treatment has a fundamental influence on the disease. Meller and others believe that the treatment is very uncertain and of a temporary nature in its effect, and that the discharge reappears when the treatment is discontinued.
TREATMENT OF ACUTE PURULENT DACRYOCYSTITIS

The therapeutic procedure which has been tested for ages, and which most ophthalmologists practice in cases of acute purulent dacryocystitis, consists of the attempt at the beginning, before the tissue around the lacrimal sac has softened, to abort the condition by applications of damp, warm antiseptic solutions (Burow's solution, lead lotion, etc.). But when softening has already taken place and perforation is close at hand, the abscess is opened by a downward incision reaching into the sac, which is then drained. Then one waits for the healing process, which takes place either with or without the formation of a fistula. Meller (4) says that only after the cessation of all acute inflammatory edema, the hyperemia and the pain, is it permissible to execute an operative measure. Otherwise such a measure, particularly the correct extirpation of the sac, is not only impossible because of the severe hemorrhage, but if carried out it could infect adjacent tissue which, when the orbital tissue is involved, could have disastrous consequences.

Meller (4) cites the method of Shimkin for suppressing the acute purulent dacryocystitis at the very beginning. He introduced a 5% cocaine-adrenalin tampon into the nose, which apparently contracts the mucous membrane of the lower end of the nasal duct adjacent to that of the nose, so that the lumen, previously occluded by the swollen mucous membrane, is now clear. This allows the pus to drain off, and the acute inflammation which its congestion occasioned disappears. Sondermann attempted to rapidly end the acute suppuration in the lacrimal sac by draining off the pus via the canaliculi. When this failed, he punctured the lacrimal sac
and immediately afterward probed down into the nose. Meller mentions the possibility of infection of the adjacent tissue with this operation.

Stillson (45) in 1900, advocated a measure similar to that of Shimkin, in which he rendered the nose patent with extract of suprarenal capsule and cocaine, and then into the lower nasal meatus at the mouth of the infundibulum inserted a pledget of cotton impregnated with a mixture of glycerine, bichloride, salicylic acid, iodine and oil of eucalyptus. Also at the inner canthus the above ingredients made into a paste by being mixed with kaolin, are applied on cotton.

Mende (46) recommended a pressure bandage on the lacrimal sac region for from one to three days. After twenty-four hours one finds that the pus has been drained off either toward the conjunctiva or toward the nose. This pressure bandage method is one of the oldest in the treatment of incipient dacryocystitis, for the ancient Arabs practised it. Even Fabritius ab Aquapendente invented a special apparatus for compression.

Verhoeff (47), in 1913, reminds us of the operation first devised by Agnew (48), in 1871, in which the incision is made through the conjunctiva between the caruncle and inner commissure of the eyelids. It involves cutting through the least possible depth of tissue, and not only gives adequate drainage but insures constant irrigation through the incision. He claims that these acute cases thus treated do not develop into a chronic dacryocystitis.

In 1921, Ball (49) rebelled against the age-old method as recommended and practised by most ophthalmologists, and said that such advise is wrong, illogical, and that it leads to needless suffering and to unnecessary tissue necrosis. His procedure is as follows: under local anesthesia the upper canaliculus is cut, the knife being carried into and beyond the sac. A dilator is passed through the
strictured lacrimonasal duct, the withdrawal of which is followed by
the escape of a few drops of thick creamy pus. A No. 9 Theobald
probe is then passed through the duct. Relief of pain, in his case,
was almost immediate. He advances the belief that dacryocystitis
should be treated as modern surgeons treat abscesses -- at the
earliest possible period.

According to Meller, we must, in a case of acute purulent
dacryocystitis, advise against every form of radical measure intended
to cure the disease of the sac. To extirpate the sac during acute
inflammation is irrational, for, even apart from the risk of propa-
gating the infection to the vicinity, it is technically impossible
to dissect out the mucous membrane neatly. That such a measure can
precipitate thrombo-phlebitis orbitae with exitus lethalis is only
natural. Such a disaster must be charged to the physician. Equally
reprehensible, though it has already been done, is the undertaking of
an internal or external dacryocystorhinostomy during the time of acute
inflammation.
Various caustics have been used for the treatment of this affection. According to Meller (4), Jocqs, Morgano and Pascalin used 50% ZnCl; Jeandelize and Bywater used a 1:50 chromic acid solution; and Berger preferred the use of Ammonia trichloride. Prince (50), in 1898, used monochloracetic acid for the obliteration of the sac, but has since changed his technic. Gifford (51) first cut into the sac and packed it, then after cocainization, swabbed it out with trichloracetic acid. Green (52) preferred curettage to extirpation because extirpation resulted in the destruction of the physiologic function of the structure.

Meller (4) brings out the fact that even these methods do not always totally destroy the sac, for if they did there would be such a solid cicatrization of the region around the sac that permeability of the passages would be impossible. He adds that there is no doubt but that these operations can cure chronic dacryocystitis.
Although some success is acquired through the conservative methods of treatment above mentioned, it is generally admitted that no healing can be obtained in a great majority of cases. Therefore, the question of operation is resorted to, and those which hold the spotlight at present are extirpation of the sac and dacryocystorhinostomy.

Meller (4) tells us that in the operating theatres of the majority of clinics extirpation of the sac is still the ruling practice; there, in the midst of practical life, the question has not yet been so definitely settled in favour of dacryocystorhinostomy as to cause extirpation to be regarded as obsolete. There the question of indications and relative values has by no means yet been finally solved. He says that even if the old and tried methods are not in every respect followed with perfect success, one is not necessarily a reactionary in not deserting them and in failing to turn with exaggerated enthusiasm to the new.

Meller is an ardent adherent of extirpation, and it was he who developed the techniques of extirpation in their details and raised them to an anatomically exact operation. He renders the field of operation entirely bloodless and anesthetized, which allows the exact anatomical preparation, almost the same as with a corpse. "The incision is short, about half an inch in length. Starting from this incision, the superficial fascia and the fibres of the orbicularis muscle are separated, pushed aside, and the deep fascia thus laid bare is then opened directly behind the crista lacrymalis anterior, thereby exposing the bluish shimmering wall of the sac. The sac is now delicately peeled out of its bed, the fossa sacci lacrymalis, like a fruit out of its rind. The spot where the canaliculi entered the sac is clearly and distinctly
to be seen and they can be separated from the sac with a sharp clip of the scissors, so that not the slightest remnant of mucous membrane is left adherent to the canaliculi. The sac can be loosened down to the beginning of the duct, where the latter is entirely surrounded by bone, and cut off so far down that no pocket of mucous membrane remains in the wound. The rest of the mucous membrane lying within the bony duct can easily be entirely removed with the sharp spoon, as the bony wall provides sufficient resistance on all sides, where no particle of mucous membrane can escape the action of the spoon. At the end of the operation the fossa sacci lacrymalis lies there clean, bounded towards the orbita by the strong, white, deep fascia, which is firmly attached to the crista lacrymalis posterior. Accordingly, the field of operation lies entirely outside the orbita. No orbital fat becomes exposed, for the deep fascia attached to the crista lacrymalis posterior forms a strong partition. Two or three sutures close the wound, and a compressive bandage for the purpose of pushing back the fascia into the lacrymal fossa and thus preventing an accumulation of blood ensures a rapid primary healing. After three to four days the stitches may be taken out, and the healing is completed without leaving any visible traces behind." Meller admits the difficulty of the technique, and says that even an expert operator occasionally finds himself face to face with a difficult decision, because of the great variation of anatomical details.

The indications for the removal of the lacrimal sac are given as chronic blennorrhea or mucocele with markedly thickened sac walls, total obstruction of the nasolacrimal duct, or fistula; when an operation necessitating opening of the globe is required, in ulcer serpens or other purulent infection of the cornea in which there is constant rein-
fection from the sac; when prolonged treatment with the sound is impossible or when probing has not effected results. Burch (17) adds tubercular or lupoid involvement, polypoid disease, incurable fistula or malignant growth, certain cases of trachomatous infection and atrophy of the sac, or some cases of perilacrimal disease from caries of adjacent bony structures; also possibly ozena.

The importance of this operation lies in the fact that a cure is attained in a few days, with a short, quick, harmless operation, which is especially important for working people, for they particularly are subject to chronic dacryocystitis.

Meller (4) states that out of 302 cases of extirpation, Paparcone found only four patients who complained of troublesome epiphora. He emphasized the fact that after a correct and effective removal of the tear-sac constant and troublesome epiphora is not the rule, but the exception. He states that lacrimation after sac extirpation may be quite a common symptom only if a small particle of mucous membrane has been left behind, and that once the tear-sac has been removed in toto, no trace of mucous membrane is ever again, either clinically or anatomically, to be found.

Meller does not claim that this is an ideal treatment for dacryocystitis, for an ideal result can only be spoken of if not only the symptoms of the disease and the dangers threatening the cornea have been removed, but also a faultless conduction of the tears has been obtained.

Greenwood (53) in 1920 presented a method of extirpation which he considered most simple and speedy. He thought it unnecessary to dissect out the structures as recommended by Meller. His guide throughout the operation was the lip of the lacrimal fossa. He incised l
or 1\frac{1}{2} \text{ mm.} \ above \ the \ triangular \ ligament \ and \ cut \ directly \ down \ to \ the
bone \ and \ followed \ along \ the \ crest \ as \ close \ to \ the \ lip \ as \ possible
downward \ and \ outward \ nearly \ 2 \ \text{cm.} \ \text{in} \ length. \ \text{This} \ \text{exposed} \ \text{the} \ bone
all \ along \ the \ lacrimal \ crest. \ \text{Then} \ \text{the} \ \text{periosteum} \ \text{is} \ \text{incised} \ \text{from}
above \ downward, \ following \ as \ close \ to \ the \ edge \ of \ the \ crest \ as
possible. \ \text{The} \ \text{sac} \ \text{is} \ \text{then} \ \text{exposed} \ \text{by} \ \text{a} \ \text{nick} \ \text{of} \ \text{the} \ \text{knife} \ \text{through}
the \ \text{periosteum} \ \text{which} \ \text{lies} \ \text{over} \ \text{the} \ \text{sac}. \ \text{The} \ \text{sac} \ \text{is} \ \text{freed} \ \text{from} \ \text{its}
bed, \ \text{cut off as low down as possible, lifted out of its bed, the}
\text{canaliculi} \ \text{cut} \ \text{and} \ \text{the} \ \text{dome} \ \text{of} \ \text{the} \ \text{sac} \ \text{separated} \ \text{from} \ \text{the} \ \text{upper}
part \ \text{of} \ \text{the} \ \text{fossa}. \ \text{He} \ \text{sometimes} \ \text{curets} \ \text{the} \ \text{lacrimal} \ \text{canal} \ \text{before}
closing \ \text{the} \ \text{incision} \ \text{in} \ \text{the} \ \text{skin}.

Although \ there \ are \ many \ who \ prefer \ to \ extirpate \ the \ \text{sac}, \ \text{there}
\text{seem} \ \text{to} \ \text{be} \ \text{just} \ \text{as} \ \text{many} \ \text{who} \ \text{are} \ \text{opposed} \ \text{to} \ \text{this} \ \text{type} \ \text{of} \ \text{operation}.
Burch (17) \ \text{says} \ \text{that} \ \text{most} \ \text{ophthalmologists} \ \text{living} \ \text{in} \ \text{the} \ \text{northern}
latitudes, \ \text{at} \ \text{least}, \ \text{have} \ \text{discovered} \ \text{the} \ \text{fallacy} \ \text{of} \ \text{the} \ \text{oft} \ \text{quoted}
dictum \ \text{that} \ \text{after} \ \text{extirpation} \ \text{lessened} \ \text{reflex} \ \text{activity} \ \text{of} \ \text{the}
lacrimal \ \text{gland} \ \text{results} \ \text{and} \ \text{epiphora} \ \text{will} \ \text{cease}. \ \text{Although} \ \text{the} \ \text{in-
fection} \ \text{is} \ \text{often} \ \text{abolished}, \ \text{lacrimation} \ \text{continues} \ \text{and} \ \text{is} \ \text{almost} \ \text{as}
conspicuously \ \text{annoying} \ \text{after}, \ \text{as} \ \text{it} \ \text{was} \ \text{before}, \ \text{removal} \ \text{of} \ \text{the} \ \text{sac}.

Even \ \text{though} \ \text{the} \ \text{palpebral} \ \text{gland} \ \text{be} \ \text{resected}, \ \text{under} \ \text{favorable}
weather \ \text{conditions} \ \text{tearing} \ \text{persists}. \ \text{Cirincione} (54), \ \text{Gilbert} (55),
\text{Mosher} (24), \ \text{Lester} (12 A) \ \text{and} \ \text{Knapp} (23) \ \text{are} \ \text{among} \ \text{those} \ \text{who}
\text{agree} \ \text{with} \ \text{the} \ \text{above} \ \text{statement}, \ \text{and} \ \text{prefer} \ \text{other} \ \text{types} \ \text{of} \ \text{operation}.

\text{Gilbert} (55), \ \text{from} \ \text{a} \ \text{study} \ \text{of} \ \text{45} \ \text{cases} \ \text{from} \ \text{the} \ \text{Massachusetts}
Charitable Eye and Ear Infirmary, \ \text{concluded} \ \text{that} \ \text{the} \ \text{operation} \ \text{of}
cystectomy, \ \text{while} \ \text{of} \ \text{great} \ \text{value} \ \text{in} \ \text{removing} \ \text{a} \ \text{source} \ \text{of} \ \text{infection},
\text{leaves} \ \text{a} \ \text{troublesome} \ \text{epiphora} \ \text{in} \ \text{most} \ \text{cases}. \ \text{Mosher} (24) \ \text{says}
\text{that} \ \text{because} \ \text{extirpation} \ \text{of} \ \text{the} \ \text{sac} \ \text{is} \ \text{admittedly} \ \text{an} \ \text{illogic} \ \text{and}
\text{not} \ \text{a} \ \text{physiologic} \ \text{operation}, \ \text{it} \ \text{should} \ \text{be} \ \text{reserved} \ \text{for} \ \text{the} \ \text{old}
and feeble. Hangar (41) says that removing the sac is easier than performing a dacryocystorhinostomy, but that extirpation will be chosen only if the ophthalmologist is considering himself only, and seeking the way of least resistance, his own ease and comfort, and not the interest and ultimate well-being of the patient. Benedict and Barlow (11) state that to remove or to destroy a sac is to admit inability to cope with the disease of the tissues involved, and that the function of a stenosed and diseased lacrimal sac can often be restored by an operation no more difficult to perform than that of extirpation of the sac.
DACRYOCYSTORHINOSTOMY

The attempt to lead tears off into the nasal cavity had never been given up entirely, not even in those decades when extirpation of the lacrimal sac was in favour. Meller (4) says that the key to the whole problem of reaching the ideal, i.e., attaining a permanent connection between the sac and the nose, lies in thorough rhinologic knowledge of the anatomy and pathology of the parts, while at the same time mastery of rhinologic techniques is taken for granted.

Butler (56) tells us that Pott in 1758 anticipated Toti in attempting to make an artificial communication between the nose and the lacrimal sac. His principles were forgotten, and lacrimal surgery passed through a retrograde stage. According to Bryan (57) the establishment of a new path from the sac into the nose had some vogue from 1840 to 1860, and then fell into oblivion.

Caldwell (40) in 1893 reported a new operation for the radical cure of obstruction of the nasal duct. He passed a probe into the duct as far as the stenosis, removed with an electric trephine part of the inferior turbinate as far back as the nasal duct, then followed the duct in an upward direction until the probe was reached and drainage was established. West (58) states that Killian in 1899 advocated the removal of the anterior part of the inferior turbinate and the entire nasal wall of the nasolacrimal duct.

Toti is given the credit for performing the first modern operation for the establishment of a permanent communication between the sac and the nasal cavity, through which the tears and any abnormal secretion may flow freely. To obtain this, the bony partition separating the two cavities must be removed, and the
internal wall of the lacrimal sac, with a corresponding piece of the mucus membrane of the nose, must be resected. Toti (69) describes his procedure as follows: Cut down at the inner side of the orbit, close to the inner margin of the sac, remove a portion of the inner posterior wall of the sac, turn back the periosteum, and work one's way through the ethmoidal cells to the nasal cavity, and finally remove the portion of the nasal mucus membrane equal to, and certainly not less than, the opening in the sac. It may be necessary in some cases to remove part of the turbinated bone before one can be certain of obtaining a permanent and sufficient tunnel.

The indications for this operation, as given by Toti, are cases in which repeated abscesses of the sac have occurred and a fistula has formed. The obstacles of the operation are that the frontal process of the maxilla is hard and thick; there is possibility of tearing the nasal mucus membrane; the ethmoid may be opened into instead of the nose; an enlarged middle turbinate requires removing; and granulations may form on ill-fitting wound margins. Hangar (26) objects to this operation because it leaves a scar at the side of the nose, and in many cases the opening in the bony wall slowly closes and the old cystitis recurs.

Baia (60) (61) reports good results with Toti's operation, but not a 100% relief from epiphora. He has been troubled with hemorrhage during the operation, and adds that a perfect result is obtained only when the nasal cavity is normal and the canaliculi have not been dilated with probes or excised.

Traquair (62) reports that of 117 operations according to the Toti technic, no watering was reported in 71%. Of 48 excisions, no watering was reported in 44%. He concludes that the operation can be done by anyone who has experience of excision of the sac, and that
both sides may be done on the same occasion, even in nervous female patients.

Girincione (54), in 1904, first performed on the living subject an operation which he had devised and carried out successfully on the cadaver: he isolated the sac with the canaliculi but preserved them carefully in situ, bored an aperture through the nasal process of the superior maxilla just anterior to the lacrimal ridge, made sure of its freedom of communication with the nose and into the bony canal thus constructed he pushed the lower portion of the sac. The chief points wherein his operation differs from Toti's are that he removes the sac and its intro-osseous continuation; he leaves only a small part of the anterior wall, just where the canaliculus opens into it, and he makes his new bony canal farther forward in the nasal portion of the superior maxilla alone. He considers the utilization of the mucous membrane of the sac as a lining for the artificial canal excavated through the bone, as the element of superiority over the Toti operation.

West (58) is given credit for introducing modern dacryocystorhinostomy executed from within the nose, in 1908. The previous intranasal operations had involved the removal of a part of the inferior turbinate, and he devised the more conservative intranasal procedure — a window resection of the lacrimal duct above the inferior turbinate, leaving this structure, a physiologic organ, intact — and secured the same result as the more radical procedures. The operator is able to do more accurate work than was formerly possible because of the ability to control hemorrhage by the use of adrenalin. His description of the procedure is: "The operation suggested consists in resecting, under local anesthesia (cocain and adrenalin), a window from the nasal duct in the upper part of the
nose above the inferior turbinate, and involves the removal of part of the lacrimal bone and also a piece from the superior maxilla. This removes a stricture in the upper part of the duct, but leaves a stenosis in the lower part untouched. It is, however, immaterial whether the lower part of the duct is stenosed, so long as the tears can drain through the artificial window. Previous to operation a probe is passed into the duct to act as a guide. The canaliculus may be slit or, preferable, as suggested by Dr. Randolph, a fine probe is passed through the dilated punctum. In no instance can the operation make the previous condition worse, and the result is either a complete cure or considerable improvement. Care must be taken in operating that the antrum is not opened up.

Indications for the operation, as given by West (63) (64) are, "All the various clinical conditions caused by dacryostenosis: that is, in dacryocystitis with or without dilatation of the sac, in lacrimal fistula, in phlegmonous conditions, and also in epiphora of nasal duct origin and in ulcus serpens with dacryocystitis. Also, chronic blepharitis combined with suppuration of the sac, often practically incurable by other methods, such as the external extirpation of the sac, followed by treatment directed to the conjunctiva, usually disappears after nasal drainage is restored by the internal method. The operation is indicated also in cases of dacryocystitis or epiphora due to traumatic stenosis of the canal, following injuries of the nose or resulting from operations on the maxillary antrum. Many patients suffering from epiphora consequent to the external extirpation can be cured by the intranasal procedure. Finally, in cases of cataract and the like, which require an intra-bulbar operation and which are complicated with a dacryocystitis,
it is safer to remove the lacrimal sac by the nasal route than to extirpate it externally.

The advantages of the operation are:

1. The internal operation is more reliable as a cure for suppuration of the sac than is the external procedure.

2. The physiologic function of the lacrimal apparatus is reestablished so that not only a dacryocystitis, a lacrimal fistula or a phlegmon is cured, but subsequently the tears drain off into the nose, and the troublesome epiphora usually following external operations is avoided.

3. As a result of the reestablishment of drainage from the eye into the nose the pathogenic bacteria disappear from the conjunctiva, which is very important when future intrabulbar operations are indicated.

4. A prolonged, usually painful, and in most cases unsuccessful treatment with probes is avoided.

5. Removal of the lacrimal glands is rendered unnecessary.

6. An external incision or curettage necessitating an external bandage and other disadvantages is avoided.

7. In cases of fistula and phlegmon the patient is spared the troublesome and painful changing of dressings necessary after the external incision.

8. The entire treatment is usually completed in about a week.

9. The operation is not trying to the patient and is performed under local anesthesia in children as well as in adults, and an external bandage is unnecessary.

West, in 1926, had done more than 1600 intranasal operations, all under local anesthesia, and at ages ranging from 5 to 74 years. He
claims 90% reestablishment of nasal drainage. All ectasies and phlegmons were cured.

Diggle (65), in 1931, reported on 63 West operations, and claimed 73% complete cures, while 17% were absolute failures. 10% were moderate cures in that there was persistent epiphora out of doors. Henry (66) in 1933 reported that during the years 1915 to 1931, 108 such operations had been performed by Dr. J. S. Fraser with perfect clinical results in 78%, compared with only 73% in 1925.

Diggle (65) gives the contraindications for a West operation as being the presence of active lupoid or syphilitic disease of the nose, and uncorrected suppuration in a nasal sinus. Although a single attack of acute dacryocystitis does not prejudice a successful issue, yet recurrent inflammations producing thick-walled sacs, perhaps loculated with malformation, kinking, or inflammatory stenosis of the canaliculi, though not a definite contraindication, are not so likely to yield successful results.

In 1911 Higgens (67) described a modification of Toti's operation, in which he turned a flap carrying the lachrymal sac outwards from the nose, excised the inner wall of the sac and cleaned out the periosseum of the lachrymal fossa, then removed the bone of the fossa; with a probe inserted through the nose he then pushed the nasal mucosa through the hole in the bone and excised the protrusion; then the skin flap was replaced and pressed into place and sutured. He claimed that the pressure on the operation site from within and without the nose secured adhesion of the outer wall of the lachrymal sac to the nasal mucosa, and a new track for tear drainage was thus secured.

Yankauer (14), in 1912, presented an operation which he had perfected after some experimenting along the same lines as those of Toti and West. His operation is more radical than many of them
inasmuch as it removes all the organic effects of the disease process, but yet is more conservative than any, because it preserves intact the anatomical relations of the parts, permitting thereby a complete restoration of the function of the lacrimal passages. He makes a temporary elevation of the mucous membrane of the outer nasal wall and resects the bony wall of the duct. Then he slits open the entire membranous canal from below its nasal orifice up to and including the sac, thereby dividing all strictures and destroying the venous plexus surrounding the canal and evacuating the pus. Finally, the mucous membrane of the outer nasal wall is replaced. The end-result of the operation is the enlargement of the bony and membranous passages, and the reestablishment of drainage in the manner originally designed by nature.

Hangar (26) thinks the Yankauer operation is a good one, but that the technic is too delicate; also, that he takes too many pains to preserve the nasal duct for drainage purposes.

In 1915, Hangar (26) (68) published a method which he began using in 1913 and which could be performed in the office. The lacrimal sac is injected with a 20% solution of cocain and adrenalin, a moistened probe with pulverized cocain is then passed into the sac and the cocain worked down in the nasal duct as far as the stricture. Probes of increasing size are passed until Theobold's No. 13 can be passed without pain. This is left in situ and serves as a guide during the operation within the nose. The inferior turbinated bone and the site over the nasal duct are then cocainized and adrenalinized, after which the front attachment of the inferior turbinated bone is severed and about one-third of the bone cut away. The lower end of the probe, which is the guide, is now seen in the lower meatus. The lacrimal probe or guide is now slowly withdrawn upward, while the inner wall of
the nasal duct is bitten away with a punch-forceps up beyond the stricture. This converts the duct into an open gutter, which may be extended up into the sac, if necessary. The operation is performed painlessly and bloodlessly by any operator who possesses only a slight degree of skill. The nose is packed with a strip of gauze for 24 hours, and the lacrimal sac is irrigated for a few days.

By 1925 Hangar had performed 16 such operations, and failed to cure only one case. He claims that the removal of the inferior turbinate bone seemed to make no difference to the patient as far as regular nasal function was concerned; and that the passage of air from the nose to the eye remains permanent in only a few cases, which is regarded as a mere bagatelle by the patient.

Kuhnt (69) in 1914 reported 7 successful operations with a modification of the Toti technic. He preserves the portion of the nasal mucous membrane corresponding to the median sac wall which has been removed, and from it forms a flap the base of which lies on the resected margin of the frontal process in its entire extent. He sutures the membrane edges.

Prince (70) in 1915 published an operation which, according to him, would enable every oculist, unassisted by the rhinologist, to drain the sac into the middle meatus, at the same time avoiding the handicap of the external operation of the face which sometimes resulted in a scar. It could be executed in the presence of an active phlegmon. After locally anesthetizing the sac and corresponding area in the nose, the punctum was opened and a canaliculus knife passed into the sac. A lacrimal grooved director was then passed through the sac and into the nasal canal and directed toward the nose, and with a cataract knife along the groove the approach to the sac was slit; this opening was then stretched with a large
lachrymal probe. A gouge was passed to the bottom of the sac and pressed toward the nose to enter the middle meatus so as to be seen from below. The gouge was removed, a strip of sheet lead introduced, and then observed from the nose as it was withdrawn until it almost disappeared; the nasal wall of the sac and the corresponding portion of the lachrymal bone rested on the lead plate, so that by grasping with a forceps all three were removed at once. Permanent drainage was thereby established.

Prince states that it is unnecessary to remove any portion of the middle turbinal, for the opening is not obscured by this structure. The after treatment consists of passing a large probe while the outer nasal opening in the sac is healing.

Benedict and Barlow (11), in 1919, described an intranasal operation which restores function of the sac and provides adequate drainage of diseased ethmoid cells in the neighborhood of the duct, should any be present. They indicated that it should be performed by one who is familiar with intranasal technic. Two or three drops of 1% cocaine solution are instilled into the eye, and the intranasal anesthesia obtained by blocking the sphenopalatine ganglion and the anterior ethmoidal nerve. A lacrimal probe is introduced through the lower punctum without slitting the canaliculus, into the sac and duct and allowed to remain there to serve as a guide while working in the nose. The mucous membrane of the agger nasi is now elevated and resected and a flap 1 cm. in diameter is removed just in front of the attachment of the middle turbinate. With a small chisel the bone is now removed to make a window slightly smaller in diameter than that of the mucosal opening. Thus the inner wall of the lacrimal sac and upper part of the duct are exposed, and any diseased ethmoid cells which are discharging their
contents into the duct can be easily broken down at this time. The lacrimal probe is slightly withdrawn to produce a tenting of the sac wall into the opening made through the bone; the sac is incised and removed. After removing the probe, the sac is irrigated through the punctum to be sure that adequate drainage into the nose is obtained.

In 1920 Burch (17) presented a modification of the Cirincione, Toti and Kuhnt operations, which he had performed three times with good results. A crescentic incision about 3 cm. in length is made directly over the lacrimal crest, and all tissues on the median side of the sac and over the crest incised down to the periosteum. The sac and periosteum are undermined from the anterior median wall (not as in Toti's operation from the posterior lacrimal crest forward), separating it from its fossa down to the beginning of the duct. On the orbital side the sac is freed entirely from the fossa as high as the internal ligament, but is left attached to the fascia covering it. A lacrimal probe is placed in the sac, the duct is freed from its bony canal in its entire circumference downward for a distance of 5 or 6 mm., and the anterior lacrimal crest over the beginning of the canal is chiseled down. The duct is thus dissected free, and is then incised with scissors from the median side obliquely downward, and lifted from its canal, which is packed with adrenalin and cauterized later. The sac and duct are retracted well upward and outward to permit making the bony window, which includes part of the crest and lacrimal sulcus anterior to where the superior maxilla unites with the lacrimal bone and as far below it as possible. The window lies almost entirely in the nasal process of the superior maxilla and really includes very little of the lacrimal bone itself. The nasal membrane is slit on its nasal side from its lower and upward
into the sac for a short distance, and duct and sac are tucked through the opening in the bone. A lead style or catheter is used for one week to aid in holding the duct in place in the bony window until healing has taken place.

The advantages as claimed by Burch are that it is the least difficult of the cystorhinostomy operations, is suitable for those not accustomed to intranasal work and is directly under the eye. There is no danger of involvement with any of the sinuses, and less probability of granulation formation. A mucous lining is provided for the bony window by use of the lacrimal duct, none of the sac is sacrificed and no cul-de-sac is left wherein infectious material can collect. There is the least disturbance of the nasal mucosa and little or no after treatment is required.

In 1920 Sauer and Wiener (71) advocated a technic of passing a probe from the punctum through the sac, into the nose and of using it as a guide for the intranasal surgery. The opening was enlarged upward, exposing the entire nasal wall of the sac and affording excellent drainage.

It is apparent that this operation is of no value if there is stricture of the canaliculus or any other form of obstruction to the tear passage from the eye to the sac. Wood (72) objects to this operation in that it is a partially blind procedure, there is danger of orbital abscess, and a tedious and sometimes prolonged post-operative care is necessary. The commendable features are that it is a comparatively simple procedure, attended with relatively little shock, can be done under local anesthesia, and if it fails a more radical operation can be done later. However, if it succeeds, all the main features of an ideal result are obtained.
Corbett (73) describes an operation which Dupuy-Dutemps and Bourguet (74) introduced in 1920, by which a direct anastomosis of the tear sac is made with the nasal mucous membrane. An incision is made as usual, care being taken to avoid the sac. The cut is made into the bone, the periosteum stripped back, and the lacrymal bone and enough of the nasal bone are chiseled away to expose a square or rectangular section of the nasal membrane. This is cut into two flaps, lower and upper, then the sac is cut into two corresponding flaps. The upper and lower flaps are sutured together, the wound is closed with silk sutures, and an ordinary eye bandage applied. Sutures are removed on the fifth day, and the bandage is discontinued on the eighth day.

In 1925, Dupuy-Dutemps claimed total relief in 97% of about five hundred operations.

According to Knapp (23) and Weeks (75) this operation is indicated for the relief of all cases of chronic dacryocystitis, whether a mucocele is present, empyema, simple lacrimation, or a chronic fistula when the lacrimal canal is obstructed. The contra-indications are obstruction of the puncta or canaliculi, active infection of the sac, and a high deflected septum.

The advantages are that the mucous membrane of the nasal cavity and lacrimal sac are not destroyed, healing is by first intention, the physiologic function is reestablished, pus rapidly disappears from the sac after the operation, fistulous openings from the sac close readily after drainage is reestablished, probes and drains are unnecessary, and the postoperative treatment consists merely of removal of the skin sutures plus one or more irrigations of the sac through the canaliculus. The complications
reported by Weeks (75) are hematoma of the orbit, delay due to bony fragments of an anterior ethmoid cell, difficulty in uniting the nasal mucous membrane flaps because of a limited amount of space, and a congested, friable nasal mucous membrane due to pressure of a high nasal septal deviation.

Ellett and Rychener (76) report twelve operations on eleven patients, the ages ranging from eight to seventy-six years, resulting in twelve complete cures, using the Dupuy-Dutemps operation.

MacMillan (77) (78) in 1921 decided that if one could incise the lacrimal sac transversely just above the obstruction and transplant its end into the nose through a new opening in the lacrimal fossa, one would have an epithelial lining to insure patency. A skin incision is made following the direction of the anterior lacrimal crest, the orbicularis muscle is split to expose the sac covered by fascia, the sac is well exposed and freed anteriorly and posteriorly by dividing the fascia. The sac is now freed down to the entrance of the canal, where it is cut completely across. A stout silk suture is then passed through the fascia and the outer wall of the sac and the sac is lifted upward to expose the lacrimal fossa, through which an opening is now made into the nose. The lacrimal bone is perforated high up near the median palpebral ligament, and the opening enlarged for admittance of the sac. Both ends of the silk suture can now be passed through the opening into the nose and picked up by a pair of nasal forceps; then it is drawn firmly and the sac is inserted into the new opening. By tying the two ends of the suture over a piece of gauze, inserted into the nostril for the purpose, the sac is held in the opening. Three skin sutures are inserted, a pad of gauze is placed over the
incision, and a firm bandage applied.

MacMillan concludes that this is a more simple procedure than the external methods described. Less bone is removed and there are no flaps of mucous membrane to deal with. It is quite in the field of ophthalmology, so that no profound knowledge of nasal work is required, as in the intranasal operation. Finally, if after the operation is started the procedure cannot be accomplished successfully, the sac may be removed through the same incision.

Mosher (79) (24), in 1921, presented a combined internal and external operation on the lachrymal sac and the nasal duct for the relief of both infection and epiphora. The operation was inspired by Toti, but the technic is markedly changed. First, he removes the anterior end of the middle turbinate. Then the sac is exposed by a nearly straight incision which parallels the bed of the sac, after which it is turned from its bed by entering the orbit above the sac and elevating the periosteum of the orbit from above downward. Next, the lachrymal bone is broken down in front of the crest and bitten away, then the posterior edge of the ascending process of the superior maxilla where this makes the anterior one-half of the bed of the sac, is removed. The bone opening into the nose is made to at least equal the height and width of the sac. Now the inner wall of the nasal duct is bitten away to the level of the upper rim of the inferior turbinate. After this the inner one-half of the lachrymal sac and the inner wall of the soft tissues of the nasal duct are removed.

Mosher states that the combined operation differs from the Toti operation in that the anterior end of the middle turbinate and the overlapping anterior ethmoidal cells are removed as a routine, and all obstructing deviations of the septum are first
corrected. Also, the first opening into the nose is made through the thin lacrimal bone rather than the ascending process, and the nasal mucous membrane is not saved until the bony opening is completed. The bony internal wall of the nasal duct and the inner membranous wall of the duct are removed down to the upper edge of the inferior turbinate. The nearly straight incision results in a flat, invisible scar in the majority of cases.

The indications for the Mosher-Toti operation, as given by Davis (13) are a dilated sac, definite lacrimal obstruction with regurgitation through the puncta, suppuration of the sac, peri-lacrimal suppuration or a fistula. The only contraindication for this operation is where there is stenosis of the common duct of the canaliculi at its entrance into the sac, which is an advantage over the internal operation in that it is not fitted to deal with the complicated cases with permanent fistulae or with partially removed sacs.

In 1923, two years after his first report, Mosher reported a cure of pus in over ninety per cent, and the epiphora in 76%. Jones (80), out of twenty-two cases, had entirely satisfactory results except for two cases. Martin and Cordes (81) and Spaeth (26) are very enthusiastic about this operation. Davis (13) states that about 25% of his operations failed.

In 1925, Kofler and Urbanek (82), of Meller's clinic, reported great success with their trans-septal modification of the West operation; the advantage is that it is unnecessary to work in the darkness.

According to Meller (4) the para-nasal methods of v. Eicken, Veis and Kutvirts are disapproved by Kofler and Urbanek.

Hollos (83) presented, in 1929, a method designed to prevent
hemorrhage during or after operation, and to promote primary healing. After removal of the sac and trephining, a folded strip of gauze is inserted in the trephined opening, a small portion of which is withdrawn daily through the nose and cut off. He states that it is applicable to every type of external dacryocystorhinostomy.

Killen (84), in 1929, published a method by which, after opening the sac, dissecting the muco-periosteum from the lacrimal fossa, chiseling away the bone of the lacrimal fossa and as much as possible of the inner wall of the nasal duct, and removing the nasal muco-periosteum thus exposed, he pushed a strip of gauze into the nose through the lacrimal sac and tied the ends together. This was left in place for several days to ensure patency of the opening from the sac to the nasal cavity.

In 1934 Stock (85) reported on a method which he has been using since 1929 with good results. He makes the skin incision as for removal of the sac, cuts the lower end of the sac and retracts it, thus exposing the bone. A special trephine produces an opening into the nose and the sac is pulled into this opening. Two sutures to the lower end of the sac hold the sac in place. These come out through the nostril and are held against the cheek by adhesive.

Stock states that of forty cases, thirty-four were completely cured, while six showed no improvement.

Stokes (14) now advocates a method which is similar in principle to those of Cirincione, MacMillan, Burch and Stock. He uses a block anesthesia of the supratrochlear, infraorbital and infraorbital nerves. The incision is made higher and straighter, about 12 to 14 mm. from the inner canthus, and the trephine is smaller than the one Stock uses, being an 8 mm. size rather than the 10 mm. of Stock. He trephines through the inferior portion of
the nasal process of the superior maxillary bone.

Stokes has had complete cures for over a year, in ten cases, with no failures. He feels that this is a more logical operation than those previously described, and that it will be widely accepted as the method of first choice.

If, on exposure, the sac is found to be atrophic, Stokes does an extirpation; if there is an associated ethmoiditis, he performs the Toti-Mosher operation.

All of these various operations are alike in principle, and vary only in technic. From the number of proposed modifications it is seen that the method has great difficulties to be overcome. Wood (72) lists the features that an ideal operation should embody, as follows:

1. Permanent cure of epiphora.
2. Permanent cure of suppuration.
3. Pressure about the inner canthus should not express mucous or any other abnormal discharge through the canaliculus and punctum towards the conjunctiva.
4. Permanent cure of mucocele or any other cystic tumor formation in the sac regardless of its character.
5. No unsightly scar.
6. Cure of recurring attacks of acute dacryocystitis.
   All subjective symptoms of eye consciously, pain, swelling, etc., should disappear permanently.
7. Short unobjectionable post-operative care.

In endeavouring to form an estimate of the success of an operation, of which the opinion of the patient is the sole criterion, one is confronted immediately with the difficulty that different
patients have different views as to what constitutes a satisfactory result -- in this case absence of watering or discomfort in connection with the eyes. Some patients express themselves as cured and delighted although the eye still waters a little; others, especially private patients, are disappointed if any watering at all remains. Patients who have experienced one or more attacks of acute dacryocystitis are more easily contented with a watery eye, since they have the assurance that the inflammation will never occur again, than those who have had only a mild chronic catarrh of the sac with epiphora, and hoped to have no more watering after the operation. Thus it would appear advisable to trust to one's own experience rather than the reports of others.

The advantages of the endonasal operations are the possibility of drainage when phlegmon of the sac is present, and the absence of external scar. The objections are that it involves nasal surgery which may be avoided, and must sometimes be done solely for the purpose of obtaining a better working field.

The only disadvantage of the external route is the scar. The advantages lie in its simplicity, a full view of the operative field, easier access to the nasal fossa through the bone at the logical site, with less probability of penetrating the ethmoidal cells or antrum, less traumatism of the nasal structures, and little likelihood of adhesions.

The results of either the intranasal or external operation are apparently about equal, each has its proponents, and the question resolves itself into which method is easiest to do, many ophthalmologists preferring extirpation to either, though readily admitting the advantages of preservation of function of the tear passages.
It is readily seen that no one method of treatment has proven successful in obtaining the ideal result, the restoration of normal conditions, in the treatment of chronic dacryocystitis. The ophthalmic surgeon at present must remain contented to pursue a less ambitious, though equally practical, aim; namely, the permanent comfort and contentment of his patient, which is most easily and most reliably attainable by either excision of the sac or drainage into the nose by one of the methods of dacryocystorhinostomy.
CONCLUSIONS

(a) Anatomical defects of the lacrimal canal are the most common cause of dacryocystitis; the nasal origin of lacrimal obstruction is "non-proven".

(b) Intact canaliculi are necessary for the prevention of epiphora.

(c) In acute purulent dacryocystitis no radical measures should be used.

(d) The treatment of chronic purulent dacryocystitis is ultimately surgical.

(e) The ideal result of treatment is the restoration of normal conditions.

(f) The proposed number of modifications of operations indicates that the ideal of dacryocystitis treatment has certainly not been reached.
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