The fact that deficient lacrimation may produce disturbances of the cornea and conjunctiva has long been known (Wagenmann, 1893). Comparatively recently (Fuchs, 1919) it began to be suspected that the decreased function of the lacrimal gland might be a manifestation of systemic disturbance. In 1933 Sjögren's classic monograph appeared, and his name is given to the syndrome of Keratoconjunctivitis sicca, Laryngopharyngitis sicca, and enlargement of the parotid gland.

**Etiology**

Sometimes the cause of the diminished lacrimal secretion is obvious. Congenital absence of the lacrimal gland has been reported by Duke-Elder and others. Lisch reported deficient lacrimation in three generations of one family: of 13 examined, only two were free of the disease. Surgical removal of the gland has been found responsible for this condition by Wagenmann, Avizonis, P. Knapp, and Engelking. In a case reported by Wagenmann, lacrimation ceased after a fracture of the base of the skull. Tearing has been found to have diminished after excision of the gasserian ganglion in cases reported by Engelking and Verhoeff.

In most of the cases no such obvious cause as these has been found, and, as noted by Sjögren, the condition seems to be part of a general systemic disturbance. Because of the accompanying diminished naso-ocular reflex, catarrh of the upper respiratory tract, achylia, suppression of sweat excre-
tion, and bilaterality of the symptoms, the Dalsgaard-Nielsen\textsuperscript{10} ascribe the condition to a disturbance of the sympathetic nervous system. They consider the parotid swelling the result of a secondary infection. Spector,\textsuperscript{11} however, believes that the sympathetic nervous system is intact. von Grösz\textsuperscript{12} regards the syndrome as due to a disease of the hematopoietic system, caused by avitaminosis, but this is refuted by Lisch.\textsuperscript{5} P. Knapp\textsuperscript{6} believes the condition to be a result of acute rheumatic fever. Sjögren\textsuperscript{3d} points out that there is no evidence to support the theory of allergic-anaphylactic disturbance, and states that the condition is due to an infection carried by the blood stream. That the endocrine system may play a rôle in the production of the symptoms has long been suspected. In 1919 Fuchs\textsuperscript{2} reported a case presenting swollen parotid glands and diminished flow of tears and saliva, which he considered manifestations of the menopause. Hollos (quoted by von Grösz\textsuperscript{12}) removed the lacrimal glands from a rabbit, but keratitis did not appear until the ovaries were also removed. Krasso\textsuperscript{13} (quoted by von Grösz\textsuperscript{12}) reported the onset of keratoconjunctivitis sicca following oöphorectomy. Spector\textsuperscript{11} believes that the entire picture is due to endocrine disturbance. The onset of the menopause has also been considered responsible by Isakowitz\textsuperscript{14} and Hauer.\textsuperscript{15} Lisch,\textsuperscript{5} however, points out that the signs of gland involvement may antedate the appearance of subjective ocular symptoms by several decades, and that the association of the menopause with the appearance of the eye symptoms may be merely coincidental. In this connection it should be observed that several of my cases were under the age of the climacteric, and that two of Spector's\textsuperscript{11} cases were males. Bossalino\textsuperscript{16} believes the syndrome to be due to suprarenal insufficiency. In short, as Albrich\textsuperscript{17} points out, there is no satisfactory explanation for the condition.

Syphilis and gonorrhea were reported only once, and then in the same patient (Sjögren\textsuperscript{3d}).

The method by which keratoconjunctivitis sicca is pro-
duced has been attributed to actual desiccation of the structures involved. Sjögren\textsuperscript{sa} disagrees with this theory. He believes, on the basis of histologic studies, that the absence of lacrimal secretion places the task of supplying moisture for the eye upon the conjunctiva. This causes chronic edema, which leads progressively to hydropic degeneration and atrophy of the epithelium.

**Symptoms**

*Ocular Symptoms.*—The patients complain of burning, pricking, and smarting of the eyes, and sometimes of diminished visual acuity. Frequently, but by no means invariably, these symptoms are accompanied by dryness. Photophobia is often present. The patients are sometimes aware of the characteristic stringy mucoid discharge and have difficulty in irrigating it away. Where the mucus is adherent to the bulbar conjunctiva, it stains with argyrol or rose bengal, and can readily be seen.

*Ocular Findings.*—In severe cases of long standing corneal filaments are sometimes found. This occurred in only two of my 14 cases and in none of Spector’s series of seven cases, all of long standing. Indeed, Spector\textsuperscript{11} believes that the filaments that were previously reported were strings of mucus, and points out, with some reason, that a dry cornea should not be expected to form vesicles. In most cases the principal finding is a diffuse, irregular, superficial staining of the cornea. Often clear regions can be seen between deeply stained areas. Sensitivity is usually diminished. The eyes may look dry, and be flecked with meibomian secretion, but more often, as has been stressed by Sjögren\textsuperscript{sa} and Engelking,\textsuperscript{8} absence of moisture is not apparent on inspection. An almost constant finding is a thick, stringy, mucoid discharge which can be removed in the form of elastic strings. The conjunctiva may appear to be almost normal, but is usually congested. A foamy secretion is often found at the canthi. The bacterial flora is generally normal.
Complications are rare. Sjögren\textsuperscript{3a} saw a case of pannus formation and another of perforating ulcer. One of my cases developed a dense corneal opacity.

Associated Symptoms.—In the typical Sjögren syndrome the parotid glands, first one and then the other, swell gradually. The swelling is usually firm, but only occasionally tender. Recessions, as a rule, occur in periods varying from a week to several months, but occasionally the swelling is permanent. The mouth is dry and filled with a viscid, mucoid secretion. In severe cases fissures may develop on the tongue and lips. The dryness extends to the nose, pharynx, larynx, and nasal sinuses. The skin is dry, and seborrhea of the scalp is frequently observed. The patients are most uncomfortable, but the keratoconjunctivitis, which may not appear until several years after the onset of the other symptoms, seems to cause them the greatest distress. One of my patients stated that her symptoms were worse during menstruation, but in Spector’s\textsuperscript{11} experience the reverse of this was true.

However, the classic picture is not always present, and, as von Grösz\textsuperscript{12} pointed out, the ocular condition may be the only sign of a wide-spread systemic disturbance.

Arthritis, usually of the extremities, is frequently present. This was first described by Mulock Houwer,\textsuperscript{18} but has also been reported by Sjögren\textsuperscript{3a} (17 out of 22 cases), Clegg,\textsuperscript{19} Isakowitz,\textsuperscript{14} Beetham,\textsuperscript{20} and Wissmann.\textsuperscript{21} Arthritis is often absent (Medunina,\textsuperscript{22} Sjögren\textsuperscript{3d}) and was present in only 50 per cent. of my cases.

The presence of dental caries is marked. Falling out of the teeth has been reported by Sjögren,\textsuperscript{3d} Deutschmann,\textsuperscript{23} Betsch,\textsuperscript{24} Wissmann,\textsuperscript{21} and Lisch\textsuperscript{5}).

Anemia was observed by Sjögren,\textsuperscript{3d} who called it simple anemia with lymphocytosis, but attempted no qualitative examination. The blood picture was said by Mulock Houwer\textsuperscript{18} and von Grösz\textsuperscript{12} to indicate the presence of pernicious anemia, and by Weber and Schlüter\textsuperscript{25} was believed
to be due to hypochromic anemia. The anemia was said to be
gastrogenic by Wotzka (quoted by Lisch⁵).

The sedimentation rate is often increased (Sjögren,³ᵈ
Lisch⁵), and very high values were found in some of my cases.

Sjögren³ᵈ also reported prolonged periods of subfebrile
temperature, and reduced carbohydrate tolerance with nor-
mal fasting values. In a similar case Lisch⁵ observed poly-
dipsia with no trace of disturbance in the carbohydrate
metabolism.

Cyanosis of the hands and feet was reported by Weber and
Schlüter.²⁵ This finding was noted in two of my cases.

Achylia was reported by Sjögren³ᵈ and by Weber and
Schlüter.²⁵ In the one case of my own examined for this
symptom, the test was positive.

Achlorhydria was reported by Lisch⁴; and “indigestion”
was complained of by several of my cases. Cystitis and
cholecystitis were also found in a few patients.

Pathology

The microscopic pathology has been carefully studied by
Sjögren.³ᵃ, ć, e, f

Conjunctiva.—There is early destruction of elastic tissue
and hydropic degeneration of the epithelium is present.
Keratinization is not demonstrable. The cells are elongated.
Sometimes no outlines can be observed, and the epithelium
has a hyaline appearance. Where this occurs, goblet cells are
lacking, but are present in large numbers in the lower fornix.
Scrapings may show the presence of eosinophiles.

Cornea.—The epithelium is normal in some areas, and
thinned or absent in others. Where fibrils occur, they may
be formed of the external portions of the cells or of whole
desquamated epithelium. Connective tissue may grow in
from the limbus between the epithelium and Bowman’s mem-
brane, eventually rupturing the latter. Degenerative foci ap-
pear in the parenchyma and sometimes in the sclera.

Lacrimal Glands.—These present atrophy with connective-
tissue changes. Sometimes the ducts show cyst-like dilata-
tion, whereas in other cases the parenchyma exhibits round-
cell infiltration with some fairly well-preserved tubules. Sjögren\textsuperscript{3d} was unable to find giant cells in any of the cases that he examined.

\textit{Parotid Glands}.—When these glands were involved, the primary and characteristic finding was disintegration of the glandular parenchyma. Similar changes were found in the nasal, pharyngeal, and laryngeal glands. Sjögren\textsuperscript{3e} points out the similarity of this finding to those reported by Yudkin and Lambert\textsuperscript{28} in the early stages of A-avitaminosis.

\textbf{Differential Diagnosis}

1. \textit{Xerophthalmia Due to A-Avitaminosis}.—In most of the cases studied there was no obvious dietary insufficiency. In my most typical case, biophotometry failed to reveal any lack of vitamin A.

2. \textit{Chronic Inflammations}.—Many of these, as von Grösz\textsuperscript{12} pointed out, are merely cases of incomplete Sjögren syndromes. However, in most of them pathologic bacteria are found and there is no decrease in the lacrimal flow.

3. \textit{Senile Atrophy of the Lacrimal Glands}.—This condition is likely to produce a keratoconjunctivitis sicca, and, as the treatment in both diseases is the same, the diagnostic point need not be stressed.

When parotid swelling is present, the diagnostic picture is more complicated, and among the diseases to be differentiated are:

4. \textit{Mumps}.—According to Weber and Schlüter,\textsuperscript{25} this is often the first diagnosis made. The history and subsequent course make the differential diagnosis simple.

5. \textit{Calculus in Stensen’s Duct}.—This is readily ruled out by the absence of associated symptoms and by the x-ray.

6. \textit{Mikulicz’s Disease}.—In the Sjögren syndrome the lacrimal glands do not swell and there is no leukemia.

7. \textit{Uveoparotid Fever}.—In this condition the corneal signs
are absent and lacrimation is normal. Cases of Sjögren's syndrome do not have iritis.

8. Tularemia.—Here the systemic signs are different. The history and agglutination tests should establish the diagnosis.

9. Parinaud's Conjunctivitis.—The history and appearance of the two conditions are quite dissimilar, and lacrimation is normal.

10. Benign Lymphoma.—As Beetham\textsuperscript{20} has stated, it is impossible to rule this growth out. However, most lymphomata yield to x-ray therapy, and the systemic picture is somewhat different from that encountered in the Sjögren syndrome.

11. Boeck's Sarcoid.—With the exception of purpura, skin lesions do not occur in Sjögren's syndrome. In all five of my cases with parotid enlargement the tuberculin test was negative.

Measurement of Lacrimal Secretion

This is carried out by a method suggested by Schirmer\textsuperscript{27} in 1903. Strips of filter paper 5 mm. in width and 25 mm. in length are used. One end is placed in the lower culdesac at the inner angle, covering the punctum, and the remainder of the strip is allowed to protrude between the lids. When lacrimation is normal, the strip rapidly becomes moist, and the moisture is measured in millimeters from the lid margin in from one to five minutes.

This test is not particularly satisfactory. I have found that many varieties of filter paper, and often different sheets of the same lot, vary in absorbability when tested in my own eyes or in those of my assistants. In any case, this test should always be made to establish a normal measurement for each new lot of paper. It may be that the time interval of five minutes, employed by Beetham\textsuperscript{20} is too long. In my experience the normal eye will moisten the strip in from one and one-half to three minutes. When filter paper is not available, the blotting paper used in the Tallquist hemoglobin books
provides a good substitute, and Spector\textsuperscript{11} advocates the use of ordinary cigarette paper. Wide variations in the amount of lacrimation exist in health and in disease. Some fairly dry eyes are free from symptoms and others have been cured by treating them as dry eyes, even though the blotting paper test revealed very little diminution in the lacrimal secretion. It should be remembered that the blotting paper is an irritating foreign body, and may excite lacrimation beyond that which is usually present.

In general, however, it is the best test that we have, and it should be employed until a better one is found. In evaluating the findings, experience is the best guide, and if one's own eyes are adopted as normal, little difficulty will be found in detecting the presence of diminished lacrimal secretion.

**TREATMENT**

Local applications are unsatisfactory. Fibrolysin was suggested by Marchesani,\textsuperscript{28} 2 per cent. sodium salicylate by Meisner,\textsuperscript{29} and egg-albumen by Weve (quoted by von Grösz\textsuperscript{12}). von Grösz advocated the use of atropin (to increase the lysozyme concentration of tears), liquid paraffin, physostigmin (because the symptoms resemble those of atropin poisoning), and acetylcholin. He also advised the use of artificial tears, as suggested by Gifford, and urged that gum arabic be added to the formula. I have used lysozyme, but without effect. Oguchi (quoted by von Grösz\textsuperscript{12}) believed that 1 per cent. asparagin combined with 0.1 per cent. benzoic acid stimulated the secretion of tears. Local exposure to the x-ray was recommended by Schall\textsuperscript{30} and Krasso,\textsuperscript{13} but was decried by von Grösz\textsuperscript{12} and Beetham.\textsuperscript{20} Löhlein\textsuperscript{31} uses contact glasses.

General treatment is without effect. Liver, iron, and arsenic were advised by Medunina,\textsuperscript{22} and ovarian and follicular hormones by von Grösz\textsuperscript{12} and Spector.\textsuperscript{11} Fever therapy was suggested by Flodgren (quoted by von Grösz\textsuperscript{12}). One of Spector's cases was benefited by pancreatin.

The most satisfactory local treatment is occlusion of the
puncta, as suggested by Beetham in 1935. It should be borne in mind, however, that while closing the canaliculi is a simple matter, keeping them closed is not so easy. Any procedure that is less complete than a thoroughgoing destruction of the canaliculi will almost certainly prove temporary in effect. Just sealing the puncta is of no value except as a temporary diagnostic occlusion. Furthermore, closure of all four canaliculi is necessary. The upper puncta are regarded as of little importance, but I have found that unless they are closed, a cure will not be effected.

The canaliculus should be dilated, the diathermy or galvanocautery needle inserted as far as the entrance into the sac, and the current turned on. The amount of coagulation is dependent upon the current used, but experience is the best guide as to when the epithelium of the canaliculus has been destroyed. Too little exposure will be followed by recanalization of the canaliculus, whereas too active treatment will produce a somewhat disfiguring widening of the internal commissure. If properly carried out, the treatment will usually result in almost instantaneous and permanent relief from the ocular symptoms.

Case Reports

Case 1.—M. N., a Jewish housewife, aged fifty years, was seen on the Medical Service of the Presbyterian Hospital on November 14, 1928. She stated that her mouth had been dry for three and one-half years, and that for the last two and one-half years she had had "swellings in front of her ears." These had been growing, with minor recessions, for one and one-half years, but in the last year had not increased in size.

The family and personal history was irrelevant. Diet was adequate and well balanced.

Examination revealed a firm, non-tender, non-fluctuant swelling of both parotid glands, the left being somewhat larger than the right, and measuring 6 x 6 cm. at its most prominent area. The submaxillary glands were palpable. The lips and tongue were dry and cracked. Except for paronychia on the second and fifth fingers of the left hand, physical examination was negative, as was also the report of the neurologic consultation. Wassermann and tuber-
culin tests were negative, and the blood picture showed merely a mild anemia.

After 24 x-ray treatments applied to both parotids, the swelling gradually disappeared, although the mouth still remained dry.

In April, 1929, she returned to report that her menses had become irregular, and that at times her fingers were cold and numb. At this time the dermatologists drew attention to the dryness and scaliness of her skin. Tests for tinea were positive, and a diagnosis of trichophytosis of the fingers was made.

X-rays of the skull and chest were negative, and the basal metabolism rate was normal. Spinal fluid was normal.

**TABLE 1.—SJÖGREN SYNDROME**

| Case:       | M. N. | F. S. | E. T. | E. A. (died) |
|-------------|-------|-------|-------|-------------|
| Present age | 61    | 40    | 44    | 34          |
| Age at onset| 49    | 38    | 43    | 30          |
| Lacrimation |       |       |       |             |
| Dry mouth   | ++    | +     | ++    | +           |
| Parotid enlargement | +    | +     | +     | +           |
| Arthritis   | +     | 0     | 0     | +           |
| Ovarian function | M    | N     | D     | D           |
| Tuberculin  | neg.  | neg.  | neg.  | neg.        |
| Teeth       | 0     | F     |       |             |
| Conjunctival flora | N    | N     | N     | N           |
| Corneae     | Fil.  | S. K. | S. K. | S. K.       |
| Visual impairment | +    | +     | ++    | 0           |
| Effect of ocular treatment | I    | C     | C     | C           |

Fil. = Filaments  
M = Menopause  
D = Dysmenorrhea  
F = Fair  
I = Improved

S. K. = Superficial keratitis  
N = Normal  
P = Poor  
C = Cured

When next seen, in December, 1930, she reported that her parotids had been swelling intermittently, and both glands were enlarged at the time of this examination. A palpable cervical gland was found under the angle of the left mandible. Marked seborrhea of the scalp was also observed. The mouth was still dry, and a biopsy specimen of gingival tissue from the lower alveolar ridge showed that the upper layer of the squamous epithelium was keratosed, and the stroma thickened. The blood vessels were dilated, and the connective tissue was edematous. There was round-celled infiltration under the epithelium. About this time an acute Eustachian salpingitis developed, but no specific mention of dryness was made by the ear, nose and throat consultant. Nearly a year later, however, she developed acute pansinusitis, a peritonsillar abscess, furuncles of the auditory canal, and finally an acute
right mastoiditis. At this time the ear, nose and throat consultant observed that the pharynx was very dry. A simple mastoidectomy was performed. A thickened gray mucosa with a small amount of pus was found, and the patient recovered uneventfully. Purpura of the lower extremities was present, and the patient stated that the spots had appeared long before the onset of the sinusitis.

On April 29, 1931, I saw her for the first time. She complained of constant burning and smarting of the eyes. Examination revealed dry conjunctivae, with stringy, mucoid discharge and foamy secretion in the canthi. The corneae were moderately insensitive and stained throughout in a finely stippled fashion. Local treatment by patching, dionin, silver nitrate, Ringer's solution, local application of cod liver oil, liquid paraffin, lysozyme, and even removal of the epithelium proved unavailing. On May 5, 1934, typical filaments appeared for the first time on the right cornea and later on the left.

In January, 1936, the filter-paper test showed almost complete absence of the lacrimal secretion. The lower canaliculi were sealed, but improvement was slight, and the upper canaliculi were then also closed. Improvement was dramatic: the keratitis disappeared, and, although reclosure had to be done on several occasions, the puncta are now permanently sealed and the eyes, while dry, are quite comfortable, and the corneae do not stain.

On November 3, 1938, physical examination revealed that the liver could be palpated four fingers below the costal margin. It was quite smooth. The spleen was felt three fingers below the costal margin. The patient reported that she had had several attacks of purpura on her lower extremities since her last examination. Serum studies on October 31, 1938, were as follows:

| Substance                  | Value       |
|----------------------------|-------------|
| Serum CO₂ (content)        | 60.0 vol. % | 25.4 meq./l* |
| Cl (as NaCl)               | 610.0 mg. % | 104.3 "      |
| Inorganic protein          | 3.4 mg. %  | 2.0 "        |
| Protein                   | 8.9%        | "            |
| Albumin                   | 2.7%        | 7.5 "        |
| Globulin                  | 6.2%        | 11.7 "       |
| Euglobulin                | 2.9%        | 150.19       |
| Non-protein nitrogen      | 24.0 mg. % | "            |
| Sodium                    |            | 135.4 meq./l |
| Potassium                 | 4.1 "      | "            |
| Calcium                   | 8.5 mg. %  | 4.3 "        |
| Sugar                     | 74 mg. %   | "            |
| Cholesterol               | 184 mg. %  | "            |
| Bilirubin (color +)       | mg. %      | "            |
| Phosphatase               | 7.5 Bodansky units |
| Acid phosphatase          | 1.6 Bodansky units |

* Meq. = Milliequivalents per litre.
On June 28, 1939, the physical condition was unchanged. Laboratory reports included: Hemoglobin, 11 gm.; red blood corpuscles, 3,590,000; white blood corpuscles, 4,800; urine albumin +; bromsulfalein retention after five minutes, 85 per cent.; after half an hour, 140 per cent.; phosphatase, 10.5 Bodansky units; calcium, 8.8 mg. per cent.; non-protein nitrogen, 25; bilirubin, faint trace; protein, 8.3 per cent.; albumin, 2 per cent., and globulin, 6.3 per cent.; cholesterol, 149 mg. per cent.; venous pressure, 60–65 mm. Questionable ascites was noted.

Since then her status has remained approximately unchanged.

Case 2.—F. S., a married woman, aged thirty-nine years, was first seen on May 7, 1937, complaining that her mouth was dry. She had always found it necessary to drink fluids with her meals, but for the last two years the dryness had become more marked. Two months ago the parotid glands became swollen; her temperature rose to 101° F., and she believed that she had mumps. In six weeks the swellings subsided, but two weeks ago the left parotid swelled again.

Her family and previous history were negative, her menstruation regular, but profuse. She noticed that her mouth became much drier at the menstrual period. Her diet was adequate. She stated that her teeth decayed easily and that ordinary fillings would not hold; gold inlays, however, were retained. She had had an attack of pansinusitis and threatened mastoiditis three and one-half years ago, and observed that after these conditions had subsided her mouth was drier.

Examination revealed that the eyes were dry. The mouth was red and dry, and a small erosion was seen in the left gingivolabial sulcus. The teeth were carious, and there were many gold fillings. Both parotids were enlarged and firm, but not tender or fluctuating. Clear secretion was expressed by massage, and from this a culture of hemolytic Staphylococcus aureus was obtained. The submaxillary nodes were palpable but not tender. Otherwise physical examination was negative.

X-ray of the sinuses, lungs, and parotid regions showed all these to be normal. Basal metabolism and the Wassermann and tuberculin tests gave negative results.

The blood picture was as follows: Hemoglobin, 90 per cent.; red blood corpuscles, 4,500,000; white blood corpuscles, 6,500; polymorphonuclears, 57; lymphocytes, 27; mononuclears, 2; eosinophiles, 4; sedimentation rate, 56 mm. in an hour; slight anisocytosis and polychromasia.
Dark adaptation was tested by Dr. Selig Hecht, who reported that the vitamin-A content and utilization were apparently normal.

On December 7, 1937, there was renewed swelling of both parotids, which subsided after four treatments with diathermy. The physical condition was otherwise unchanged.

Her eyes were first examined on March 17, 1939. She was then forty years old. She stated that her eyes had been red and sore for about two years, but she did not complain of dryness until specifically questioned, when she admitted that her tears were scanty. Vision was 20/15 — in each eye with her mixed astigmatic correction. On inspection the conjunctivae did not appear particularly dry, but by the Schirmer test very little lacrimation was found. Stringy mucus was seen in the lower retrotarsal folds, and white foamy secretion was present at all canthi. The corneae stained irregularly and superficially with fluorescein. No filaments were seen. The conjunctival flora was negative. The puncta were temporarily occluded, and three days later she returned to report what she called an “amazing” recovery. In a few days the puncta became patent again, and all were then sealed permanently. When she was last seen, on January 12, 1940, she was free of ocular symptoms.

**TABLE 2.—Sjögren Syndrome**

| Case | Hemoglobin | Red Blood Cells | White Blood Cells | Polymorphonuclears Per cent. | Lymphocytes Per cent. | Mononuclears Per cent. | Eosinophiles Per cent. | Erythrocyte Sedimentation Rate | Platelets | Morphology |
|------|-------------|-----------------|-------------------|-----------------------------|----------------------|-----------------------|-------------------------|--------------------------------|-----------|------------|
| M. N... | 76           | 3,590,000       | 4,800             | 78                          | 15                   | 5                     | 0                       | 121                            | 89,000    | Polychromasia Anisocytosis |
| F. S... | 90           | 4,500,000       | 6,500             | 57                          | 27                   | 2                     | 4                       | 56                             | .         | Polychromasia Anisocytosis |
| E. T... | 98           | 4,470,000       | 7,550             | 78                          | 20                   | 3                     | 2                       | 24                             | 290,000   | Achromia Anisocytosis |
| E. A... | 79           | 3,800,000       | 3,000             | 42                          | 47                   | 6                     | 1                       | 76                             | 199,000   |                        |

**Case 3.** — E. T., a single woman, aged forty-four years, was seen first on January 4, 1940. She complained that two years ago both parotid glands had swollen simultaneously for no apparent cause, and that her mouth had become very dry. One year ago the eyes became red, sore, and dry, and lately her vision was becoming blurred. Local treatment had proved unavailing.

Recently she had noticed indefinite pain in the joints of her ex-
BRUCE: Keratoconjunctivitis Sicca

tremities. Her menstrual flow, previously normal, had become scanty for the last month or so, and she had uterine pain between periods. Her teeth had lately become "soft" and retained fillings poorly.

Examination revealed that she had a firm, not particularly tender, bilateral and equal swelling of both parotids. Her tongue and pharynx were red and dry. Otherwise investigation gave negative results, and the patient stated that a complete examination in the diagnostic clinic and at Mount Sinai had also proved fruitless.

Her blood picture was as follows: Hemoglobin, 98 per cent.; red blood corpuscles, 4,470,000; white blood corpuscles, 7,550; polymorphonuclears, 78; lymphocytes, 20; mononuclears, 3; eosinophiles, 2; sedimentation rate, 24 mm. in an hour; platelets, 290.

Examination of the eyes showed: V.R.E. = 20/100; L.E. = 20/100, unimproved. The conjunctiva was dry and congested. Sticky, elastic mucoid strings were present in the lower retrotarsal folds. The corneae stained irregularly and superficially over their entire surfaces, but no filaments were seen. Lacrimal secretion was markedly diminished. Bacteriologic examination revealed the presence of normal flora.

On January 9, 1940, all canaliculi were sealed throughout their length by the actual cautery. The next day the eyes were moist, and two days later the vision in each eye was 20/20. There has been no recurrence of the ocular symptoms.

Case 4.—E. A., a woman, aged thirty-two years, was first seen on December 5, 1936. For the last two years there had been recurrent purple blotches on her feet and ankles. These appeared suddenly, reached a maximum in twelve hours, and passed away in seventy-two hours without leaving any trace. The onset was marked by burning, but not by itching. For seven years she had experienced recurrent swelling of the parotid glands, first on one side and, shortly after, on the other. Sometimes during these attacks she would run a low-grade fever. Since the first attack the mouth had been dry, but during the attacks it was much drier. Each attack lasted only a few days. Her nose, throat, and skin were so dry that she had to apply oil to them in order to be comfortable. Her eyes had been red and sore for several years. She was unaware that they were dry until recently, when, following the death of her dog, she cried hard, but no tears appeared.

The family history was irrelevant. The personal history revealed what she called "poor digestion," but was otherwise negative. Except for mild discomfort between periods—"Mittel- schmerz"—menstruation was normal.
Examination disclosed an irregular violaceous macular rash extending from the hips to the feet on both legs. Most of the maculae were 2 x 4 mm. in size, but many were confluent, the largest being 8 x 10 cm. in area. The anterior patellar and lateral knee regions were tender to pressure. The throat was dry and congested; the tonsils were cryptic and adherent. The sense of smell was found to be defective, and there was some post-nasal dripping. The teeth showed numerous fillings, but were in good condition. The physical examination was otherwise negative.

Laboratory findings were as follows: Blood: Hemoglobin, 61 per cent.; red blood corpuscles, 3,700,000; white blood corpuscles, 4,500; polymorphonuclears, 42; lymphocytes, 52; sedimentation rate, 76 mm. in an hour; platelets, 143. Slight achromia and anisocytosis.

| Serum CO₂ (content) | 57.8 vol. % | 24.3 meq./l |
|---------------------|-------------|-------------|
| Cl (as NaCl)        | 632.0 mg. % | 108.0 "     |
| Inorganic protein   | 2.8 mg. %   | 1.6 "       |
| Protein             | 8.0 %       | "           |
| Albumin             | 3.9%        | 10.7 "      |
| Globulin            | 4.1%        | 7.8 "       |
| Euglobulin          | 1.5%        | 152.4 "     |
| Non-protein nitrogen| 33.0 mg. %  |             |

Wassermann test was negative in both antigens; electrocardiogram was normal. Throat culture: Staphylococcus aureus and pneumococcus, type 21, equally distributed. Streptococcus agglutination test positive 1:160.

On December 5, 1936, her eyes were examined. V.R.E. = 20/20; L.E. = 20/40, corrected to 20/20 in each eye with glasses. The parotids were full, but not definitely swollen, and not tender. Her mouth was slightly dry. The Schirmer test showed marked diminution of lacrimal secretion. The conjunctivae were congested. Much sticky, stringy mucus was found in each retrotarsal fold below. The lid margins were reddened, but there was no desquamation. The corneae were somewhat insensitive, and stained widely in an irregular fashion over their entire surfaces. No vesicles or filaments were seen. The interiors were normal. Conjunctival smears were essentially negative.

The puncta were occluded temporarily, and when she reported improvement they were closed permanently. Later she returned
to report that she was free of ocular symptoms for the first time in years. When last seen in the Eye Department on July 8, 1937, her symptoms had disappeared entirely.

On May 23, 1938, she returned to her physician complaining of pain in her knees and wrists. The blood picture at this time was: Hemoglobin, 84 per cent.; red blood corpuscles, 4,120,000; white blood corpuscles, 5,180; polymorphonuclears, 27; lymphocytes, 66; mononuclears, 7; sedimentation rate, 80 mm. in an hour. Physical examination was negative.

On June 26, 1938, she entered the hospital with an acute ileus, and died three days later with Bacillus coli septicemia.

Autopsy unfortunately did not include the lacrimal or parotid glands. The picture was clouded because of the septicemia, but, since this is the first autopsy recorded in a case of the Sjögren syndrome, the findings are abstracted here:

Peritoneal Cavity: About 1,000 c.c. of blood-tinged fluid was removed. The liver was at the level of the xiphoid, and the spleen above the costal margin. The intestine was markedly dilated, covered with yellowish exudate in the suprapubic region, and adherent to the anterior abdominal wall. Mesenteric glands were not enlarged.

Thoracic Cavity: There was 250 to 300 c.c. of clear brown fluid in each hemithorax. No pulmonary embolus was found.

Heart: A few milk plaques on the anterior surface of the right ventricle constituted the only unusual finding.

Lungs: Inferior lobes compressed, firm, and red.

Spleen: Weight, 80 gm., measuring 10.5 x 7 x 3.5 cm. Capsule violaceous and wrinkled; consistency soft and boggy. Trabeculae and malpighian follicles prominent. The cut surface had a brick-red color.

Liver: Weight, 1,450 gm., measuring 26 x 22 x 7 cm. There were light yellow areas scattered through the tissue beneath the capsule.

Gallbladder and Pancreas: Normal.

Adrenals: Normal in size, shape, and position. The cut surface showed decrease in cortical lipoid.

Kidneys: The right weighed 140 gm., and measured 11.5 x 6.5 x 3.5 cm.; the left weighed 160 gm., and measured 12.5 x 7.5 x 4.5. They were pale and turgid, and disclosed dilated venules on the surface. The vascular markings of the cortex were increased, and there were occasional tiny hemorrhagic areas at the junction of the cortex and medulla.
Pelvic Organs: Normal.

Alimentary Tract: Normal to a point 16 cm. proximal to the ileocecal valve. Here there was partial necrosis of the bowel, with the serosal surface covered by thick yellowish exudate. The process extended to the ileocecal valve.

Neck Organs, Bone Marrow: Normal.

Brain: Moderate congestion of the small leptomeningeal vessels over the convexity bilaterally. Otherwise normal.

Bacteriologic Report.—Heart’s blood, Bacillus coli.

Microscopic Examination.—Heart: Increased deposition of collagen about the muscle bundles. In one capillary necrosis of the wall, fibrin production and mononuclear wandering cells were seen.

Lung: In the interstitial tissues, chiefly about the bronchioles and larger vessels, there were noted engorgement of the vessels and infiltration with round cells and some polymorphonuclears. There were areas of patchy pneumonia, characterized by collection of fibrin and red cells in the alveoli. Both gram-negative and gram-positive bacilli were found, the former large and single, the latter smaller and in pairs. A few gram-positive cocci were also seen.

Spleen: The pulp was engorged with red cells, which were chiefly confined to the sinuses, but occasionally infiltrated the surrounding tissues. The malpighian bodies were diffuse, invaded by collagen fibers, and contained a few lymphocytes and an occasional polymorphonuclear.

Liver: Except for diffuse vacuolization in the areas near the portal radicles, the liver was essentially normal.

Pancreas: Normal.

Adrenal: Marked decrease in the cortical lipoid material.

Kidney: Many of the glomerular tufts showed slight thickening of the basement membrane, and between them and the capsule there was protein precipitate. There was cloudy swelling, but there were no casts.

Ovary, Uterus, Thyroid: Normal.

Ileum: The essential lesion was a necrotizing ileitis affecting the lower two or three feet of ileum.

Vertebrae, Sternum: Normal.

Brain: Except for congestion of the parenchyma of the frontal lobe, corpus striatum, the leptomeninges, and the vessels on the floor of the fourth ventricle, the brain was essentially normal.

Case 5.—M. C., an Italian housewife, aged thirty years, was seen first on March 10, 1939. She complained that eighteen months ago she began to have generalized headaches and noticed that her
fingers became numb and pale when exposed to cold. She had also experienced mild migratory joint pains, particularly in the wrists and knees.

The family and previous history were essentially negative.

Physical examination was practically negative. The spleen was barely palpable. The fingers were found to become blanched and painful when placed in cold water, and dusky and painful when placed in warm water.

The laboratory findings were as follows: Urine, negative; Kline, negative. Basal metabolic rate, -5; antistreptolysin titer, 250; streptococcus agglutination, negative; Mantoux, slightly positive; intracutaneous Brucella vaccine and Frei test, negative. Blood: Hemoglobin, 12 percent.; red blood corpuscles, 4,700,000; white blood corpuscles, 8,850; polymorphonuclears, 79; lymphocytes, 17; mononuclears, 4; sedimentation rate, 74 mm. in an hour. The electrocardiogram showed no significant findings. Serum protein, 8; albumin, 4.3; globulin, 3.7; euglobulin, 7; nonprotein nitrogen, 26. Agglutination for B. abortus, and B. melitensis, negative. Throat culture negative; skeletal x-ray negative.

| Case:         | M. C. | S. C. | C. F. | S. K. | L. G. | P. K. | M. R. | W. D. | G. M. | B. E. |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| Present age   | 31    | 71    | 62    | 56    | 38    | 52    | 68    | 68    | 20    | 61   |
| Age at onset  | 30    | 68    | 55    | 53    | 35    | 48    | 65    | 65    | 17    | 60   |
| Lactation     | -     | -     | -     | -     | -     | -     | -     | -     | -     | -    |
| Dry mouth     | +     | 0     | +     | 0     | +     | +     | 0     | 0     | 0     | 0    |
| Parotid enlargement | +       | 0     | 0     | 0     | 0     | 0     | +     | 0     | 0     | 0    |
| Arthritis     | +     | 0     | 0     | +     | 0     | +     | -     | 0     | 0     | 0    |
| Ovarian function | D     | P. M. | P. M. | P. M. | N     | M     | P. M. | P. M. | N     | N    |
| Conjunctival flora | N     | N     | N     | N     | N     | N     | N     | N     | N     | N    |
| Cornea         | S. K. | S. K. | S. K. | S. K. | S. K. | S. K. | S. K. | S. K. | Op.   | F    |
| Visual impairment | +   | +*    | sl.   | sl.   | 0     | sl.   | 0     | +*    | S. K. |      |
| Effect of treatment: | C     | C     | C     | C     | C     | C     | C     | 0     | 0     | I    |

N = Normal  M = Menopause  P. M. = Post-Menopause
D = Dysmenorrhea  S. K. = Superficial keratitis  F = Filaments
-- = Diminished  Op. = Corneal opacity  - = No record made
C = Cured  I = Improved  sl. = Slight
* = Visual impairment due to fundus lesion.

Her eyes were first examined on October 17, 1938. She complained that for about a year the eyes had smarted and burned, and that she did not see so well as formerly. V.R.E. = 20/100; L.E. = 5/200, improved to 20/50 in right eye and to 20/100 in left eye. She said that the left eye had never been so good as the right.
The conjunctiva was congested, and stringy mucus was found in the lower cul-de-sac. The corneae stained widely and irregularly over their entire surfaces with fluorescein. No filaments were seen. By the Schirmer test, lacrimation was found to be greatly lessened. Sensitivity was diminished. The interiors were normal. The conjunctival flora were negative. On October 30, 1939, the puncta were closed temporarily, and the next day no corneal staining was observed. The patient manifested no symptoms. On November 14, 1939, the canaliculi were closed permanently, and on December 5, 1939, her vision was: R.E. = 20/40; L.E. = 20/70, with correction. On December 18, 1939, when last seen, she reported that her eyes were entirely comfortable.

**Case 6.**—S. K., a housewife, aged fifty-three years, was first seen on February 12, 1940, complaining that for the last two years her eyes had burned and that she had had a feeling as of sand in both eyes. For several years her nose and throat had been dry, and she had also had some pain in her joints.

With the exception of occasional "gallbladder" attacks, which necessitated drainage, her history was negative, as was her general physical examination.

Her vision was: R.E. = 20/15; L.E. = 20/30+ with her correction. The eyes did not appear particularly dry, but by the Schirmer test the secretion was found to be diminished. The cornea stained in a fine punctate fashion over its entire area. Otherwise the eyes were normal. The conjunctival flora was negative.

On February 16, 1940, the canaliculi were permanently occluded. Three days later the patient was free of symptoms and the relief has persisted to date.

**Case 7.**—S. C., a widow, aged seventy-one years, was seen first on November 20, 1939. She complained that for two and one-half years her eyes had felt as though there were sand in them. Recently her symptoms had grown much worse.

Her family history was irrelevant. Her personal history revealed that she had had a low-grade cystitis for three years, and that her appetite had been poor for years. Her appendix had been removed in 1921.

Her physical condition, except for coldness of the extremities, was essentially normal. Her blood-pressure was 180/80.

Neurologic examination gave negative results. X-ray revealed periodontoclasis, and also a small osteoma of the hard palate.

Her blood picture was: Hemoglobin, 84 per cent; red blood cor-
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puscles, 4,090,000; white blood corpuscles, 7,000; small lymphocytes, 22; large lymphocytes, 1; mononuclears, 6; polymorphonuclear neutrophiles, 68; basophiles, 1; band forms, 2.

Urine showed glucose +. Conjunctival flora was normal.

Examination of the eyes showed: R.E. = 20/30, unimproved to 20/25; L.E. = 20/50, unimproved. Foamy secretion was observed at the canthi, and frequent blinking was noted. The conjunctiva was congested, and the cornea showed many superficial staining areas. No filaments were seen. There was nuclear sclerosis of each lens, and stringy vitreous opacities, colloid degeneration around each macula, and moderate retinal arteriosclerosis were present. The Schirmer test revealed almost no wetting of the paper.

On November 27, 1939, the canaliculi were occluded by electrocoagulation, and, when last seen, the patient was free of irritative symptoms.

**Case 8.—** C. F., a widow of fifty-eight, was first seen on June 23, 1936. She complained that for about three years her eyes had burned and felt tired. This sensation was present constantly, but was rendered worse by reading. About the time that her eyes became troublesome, her mouth became dry.

Her family history was irrelevant. Her personal history showed that her menses ceased following hysterectomy for fibroids seven years ago. Twenty-five years ago she had had acute articular rheumatism for three months, and several attacks of auricular fibrillation had occurred in the last four years.

Physical examination revealed the presence of auricular fibrillation and arteriosclerotic heart disease. This was confirmed by the electrocardiogram. Laboratory reports were as follows: Urine, albumen +; Wassermann test, negative; basal metabolic rate, normal. Blood: Hemoglobin, 90 per cent.; red blood corpuscles, 4,530,000; white blood corpuscles, 7,500; polymorphonuclears, 68; lymphocytes, 21; mononuclears, 9; eosinophiles, 2; sedimentation rate, 50 to 86 mm. in an hour; smears, normal.

Serum: Total protein, 6.9 per cent.; albumin, 3.9 per cent.; globulin, 3.0 per cent.

X-ray showed gallbladder region to be normal.

Examination of the eyes showed: V.R.E. = 20/30; L.E. = 20/20—, corrected. The conjunctivae were congested. Foamy secretion was present in the canthi, and strings of sticky mucus were found in the lower retrotarsal folds. The corneae stained in a punctate fashion, chiefly over the centers, and sensitivity was re-
duced. By the Schirmer test the lacrimal secretion was found to be scanty. The interiors were normal.

On July 28, 1936, all puncta were closed temporarily. On August 7, 1936, there was no corneal staining, the eyes were comfortably moist, and the vision in each eye was 20/20+. Closure of the puncta was then made permanent, and, when last seen, on July 3, 1937, patient had no ocular symptoms.

Case 9.—G. M., a schoolboy, aged seventeen years, was first seen on June 21, 1937. He stated that ever since a severe attack of scarlet fever in the previous fall his eyes had been sore and he suffered greatly on exposure to light. His general health was excellent, and a recent physical examination was said to have been negative. Wassermann test was negative. Diet was adequate.

Examination revealed the presence of much photophobia, with vision 20/100+ in each eye. Refraction was not done. The conjunctivae were congested, and the filter paper was not moistened at all after several minutes in the lower culs-de-sac. The corneae stained irregularly and superficially, and sensitivity was decreased. The conjunctival flora were not investigated, as repeated bacteriologic examinations elsewhere were said to have been negative.

The puncta were occluded, and the patient was returned to his physician in the West with the suggestion that the ducts be closed permanently. The patient was comfortable for a while, but later his symptoms were said to have recurred. I did not see him again until three years later. His canaliculi were then apparently closed, but his eyes were still somewhat dry, and his vision had been seriously reduced by interstitial vascularization and superficial central corneal opacity.

Case 10.—L. G., a housewife, aged thirty-five years, was seen on September 25, 1937. She complained that for the last three years her eyes, particularly the left one, had been painful and red. Her general health was good, and physical examination was said to have been negative.

Examination of her eyes revealed: V.R.E. = 20/20; L.E. = 20/20—with correction. The conjunctivae were congested, but the flora was normal. The left cornea showed superficial areas of staining over the entire surface. The right cornea was normal. Lacrimation in the left eye was markedly diminished. On April 2, 1938, local treatment having proved futile, the left canaliculi were occluded. It was necessary to repeat the closure on two subsequent
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occasions, but when the patient was last seen, on July 22, 1939, she was quite comfortable.

Case 11.—P. K., a housewife, aged fifty-two years, was first seen on January 8, 1940, complaining that for the last four years she had had the sensation as of a foreign body in both eyes. She had consulted many oculists, but without obtaining relief.

The personal history disclosed the fact that she had had multiple arthritis and some cholecystitis. Her mouth was dry. Her general physical condition was said to have been normal.

Examination of her eyes showed dried secretion in the inner canthi. The palpebral conjunctivae were injected, and there was mucus in the lower culs-de-sac. Innumerable areas of superficial staining were seen over both corneal surfaces. Otherwise the eyes, including the flora, were normal.

On March 18, 1940, the canaliculi were occluded. Improvement was immediate, and when last seen, the patient was entirely comfortable.

Case 12.—M. R., a housewife, aged sixty-five years, was first seen on February 9, 1937, complaining that her eyes had been dry and “sticky” for about a year. Two years ago, following an intestinal upset, her mouth had become dry and simultaneously her parotid glands had swelled. They had been treated by three exposures to the x-ray, but this had caused the swellings to increase.

She had been suffering from cholecystitis and multiple arthritis for twenty-five years. Her blood sugar, blood urea, and urine were normal; her Wassermann was negative; and her basal metabolic rate, −12. Her mouth was dry and her tongue was fissured.

Examination of the eyes revealed the vision to be 20/20— in each eye, with correction. The conjunctivae were congested, and elastic strings of mucus were found in the lower culs-de-sac. The corneae stained superficially over their entire surfaces.

On February 12, 1937, the puncta were closed temporarily. She was comfortable for three weeks, after which her symptoms recurred. The canaliculi were then occluded permanently, and when last seen, on March 24, 1937, she was entirely comfortable.

Case 13.—W. D., a widow, aged sixty-six years, was first seen on September 27, 1937, complaining that for the last year her eyes had felt irritated. Her mouth, throat, and nose had been dry for an undetermined period. Except for an indefinite history of anemia of unstated type, and of cystitis, the general history was negative.

Ocular examination revealed subacute conjunctivitis in both
eyes, with superficial staining of the right cornea. The left cornea did not stain. Cultures of the conjunctiva revealed many rod-like forms resembling the Morax-Axenfeld bacillus. Lacrimation in both eyes was diminished. On November 23, 1937, the left canaliculi were occluded. Ten days later the patient reported that she felt much better, and when last seen, on October 6, 1939, her eyes were comfortable, but she stated that she had developed multiple arthritis.

CASE 14.—B. E., a gardener, aged sixty-one years, complained that for about a year his eyes had felt irritated, and that light annoyed him excessively. His personal history was irrelevant, and a complete physical examination was said to have given negative results.

His vision was: R.E. = 20/15; L.E. = 20/30+, with correction. The conjunctivae were congested, and mucus was present in the lower culs-de-sac. His corneas stained superficially over their entire surfaces, and an occasional short filament was seen. Lacrimation was markedly diminished. The conjunctival flora was normal. Ocular examination was otherwise negative.

His canaliculi were closed with the actual cautery, and since then he has been relatively free of irritative symptoms.

TABLE 4.—RESULT OF TREATMENT (ALL CASES)

| Status       | Percentage |
|--------------|------------|
| Cured        | 79         |
| Improved     | 14         |
| Unimproved   | 7          |

**Summary**

Deficient lacrimation may produce a troublesome keratoconjunctivitis. When this is associated with pharyngitis sicca, xerostomia, and parotid swelling (the Sjögren syndrome), the condition is easily diagnosed. In other cases, however, the absence of obvious systemic disorders may result in failure to recognize the true nature of the disease.

Four cases of the Sjögren syndrome and 10 cases of keratoconjunctivitis sicca without marked systemic derangement are reported. Diagnosis and an effective method of treatment are discussed.
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DISCUSSION

DR. SANFORD R. GIFFORD, Chicago, Ill.: May I supplement Dr. Bruce's excellent paper with a few notes which Dr. Puntenney and I have been preparing for the last year?

We have been interested for a long time in Sjögren's work. When however, Dr. de Röth of Budapest was in our clinic and showed us the application of the Schirmer test, we became practically interested in it. It is a relatively rough test but, if you use Whatman's No. 41 filter paper, it is fairly constant. We use strips 35 mm. long,
of which the upper 5 mm. is turned over; we consider anything less than 15 mm. of wetting of the filter paper as evidence of deficient lacrimation. Dr. de Röth, in a paper which will soon be published, has shown how this alters with age. We find that in young people the whole filter paper is wet in three minutes. The usual test is run for five minutes. In people past forty, some will show a slight deficiency in lacrimation. In a group of cases we have included some which showed deficiency by the Schirmer test. Two typical cases of keratoconjunctivitis sicca were not included. It is probable that some cases are included which Dr. Bruce would regard as examples of senile atrophy of the lacrimal gland, because not all showed the complete Sjögren syndrome. Five cases had arthritis. One case had not only arthritis, but a vitamin deficiency which improved with the use of haliver oil. Case No. 5 was a physician, aged forty-five years, who had been treated for conjunctivitis for six years, with aggravation of his symptoms on every kind of treatment. The table shows the Schirmer test indicating the amount of filter paper that was wet in both eyes at different periods. All the cases show marked deficiency. There are some in which there was no wetting of the filter paper. There is a little variation in some cases, but in most of them it is fairly constant. Case No. 9 was another patient with arthritis, and also Case No. 11. This latter patient had chronic arthritis deformans of an extreme degree, so that she is crippled, and I can recall several other cases in the past in which I did not make the diagnosis. I remember one case in which I made a diagnosis of trachoma, and the poor woman was treated for years with copper. I have not included here two cases, in one of which salivary deficiency is so great that she cannot eat without constantly moistening her mouth. Unless she uses frequently the solution which Dr. Rucker, of Rochester, Minn., has devised, and which is a substitute for tears, she is miserable. Many of these patients have refused to have their tear points closed. In some the deficiency was not great and the symptoms were not extreme. In many of the cases relief is obtained by using Dr. Rucker's solution, which is Locke's solution with the addition of 0.7 per cent. gelatin; to this we have added 0.5 per cent. chlorethone as a preservative. This solution must be used seven or eight times a day, and one patient carries it about with her and uses it all day in order to keep relatively comfortable.

There is a possibility that some of the cases which I have diagnosed as a mild epithelial dystrophy might be instances of keratoconjunctivitis sicca, because the picture is somewhat similar. We
have seen only two cases which returned for treatment, and were gratified to find that the epithelial dystrophy did not depend on a deficiency in lacrimation.

I was also interested in cases of neuroparalytic keratitis, since Dr. MacMillan has shown that closing the tear points, by giving a full amount of tears, does protect the cornea. We have had only two patients to test, and they have had normal lacrimal function. There may be some who will show a deficient lacrimal secretion.

DR. E. C. ELLETT, Memphis, Tenn.: I should like to mention an occasional cause of this syndrome which was not included in Dr. Bruce's list, and that is intensive x-ray treatment. My remarks are based on the observation of one case, a woman who had bilateral enlargement of the parotid glands, for which she was treated intensively with the x-ray, with the result that she developed not only a very dry mouth, but in addition dry eyes. There were many fine staining areas on both corneae, and a test of the lacrimal secretion showed it to be more than 50 per cent. deficient. We know that the x-ray sometimes causes cataract, but apparently it can also sometimes cause conditions similar to keratoconjunctivitis sicca. This woman did not have moisture enough in her mouth to wet a postage stamp.

DR. HANS BARKAN, San Francisco, Calif.: It may be informative to relate an incident in connection with a case we had four years ago while Lindner was on a visit to San Francisco. I showed Lindner the patient, and he said: "This is simple; give the patient an onion to smell, and if she does not cry when she holds the onion under her nose, this indicates a lack of tears. Give her Ringer's solution to use."

The onion test proved successful; the woman crushed the onion in her hand and held it to her nose without shedding a tear. We concluded that she had atrophy of the lacrimal gland, and accordingly prescribed Ringer's solution.

DR. F. H. VERHOEFF, Boston, Mass.: I have used a very simple method to get rid of the canaliculus in these cases. I place an ordinary pin in the canaliculus and carefully dissect around it. In this way you remove practically nothing but the epithelium of the canaliculus. The wound is closed by sutures. A very good cosmetic result is obtained, and it is impossible for the canaliculus to reform. If you want to ascertain beforehand whether or not the procedure will be effective, I suggest placing a suture temporarily
around the canaliculus. I recall one case in which the operation was so effective that the patient had epiphora afterward. When Dr. Beetham first suggested obliterating the canaliculus, I regarded the suggestion as preposterous; it did not seem to me possible that the procedure would be effective, but it certainly is.

DR. TRYGVE GUNDERSEN, Boston, Mass: There are two points I should like to make: First, I believe a differentiation can be made between keratoconjunctivitis sicca and filamentary keratitis. In keratoconjunctivitis sicca there may be hundreds of fine filaments on the cornea. These are short and are simply shreds of surface epithelium. In filamentary keratitis there are generally only a few large filaments—usually from one to ten. Second, keratoconjunctivitis sicca characteristically occurs when there is a quantitative tear deficiency; filamentary keratitis usually occurs without any tear deficiency. There are certain cases in which the Schirmer test is positive but the cornea appears normal. In these mild cases I have found it of diagnostic and therapeutic value to use a protective goggle before resorting to surgery.

DR. GORDON M. BRUCE, closing: We have not tried Dr. Gifford's suggestion as to the solution, but some of the German writers say the Gifford solution is far the best for this condition.

Concerning the matter of the x-ray: some of our earliest cases were diagnosed as neoplastic and treated with the x-ray for a time. They all grew a great deal worse.

I believe I will adopt Dr. Verhoeff's suggestion and see how it works out.

In regard to the matter of onions, we did try this once. The patient did not cry, but everybody else in the office did.