LEPROSY OF THE EYE*

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GENERAL CONSIDERATIONS

The eyes are subject to a great variety of infectious diseases. Of these, the disturbances caused by the *Mycobacterium leprae* were, until recently, responsible for more ocular and adnexal damage and more blindness than the microorganisms and toxins of any other infectious disease. This led Boshoff to urge, "Always examine the eyes in leprosy."

Despite the work of many investigators, it has been impossible to transmit human leprosy to experimental animals or to grow cultures of the bacillus on artificial media. In 1955, Shang-Ho Lai, by repeated implantations of leproma nodules over a long period of time, was able to induce suggestive, though not definitely diagnostic, signs of human leprosy in Taiwan monkeys.

The spread to the eye is most likely by the hematogenous route. However, an ascending infection from the nose by way of the nasolacrimal duct or a direct extension from macules and nodules of the face has been suggested. *Mycobacterium leprae* also enter the fine cutaneous twigs of the peripheral nerve of the face and forehead. From there they spread upwards into larger branches affecting both the motor and sensory axones. Involvement of the eyes and the extent of ultimate visual impairment are influenced by geographic and racial factors, the type and duration of the infection, the patients' general health, the adequacy of therapy, and other variables.

GEOGRAPHY AND CLIMATE

The disease affects over five million people in the world, of whom only 400,000 are under treatment. It occurs with greatest frequency in tropical and subtropical areas. In Africa, India, Japan, Korea, the Philippines, Southeast Asia, islands of the North and South Pacific, in certain parts of Australia, and in Central and South America it is endemic. In Argentina, it poses a serious public health problem. Under the United States flag, there are estimated to be from 1,500 to 2,000 cases.

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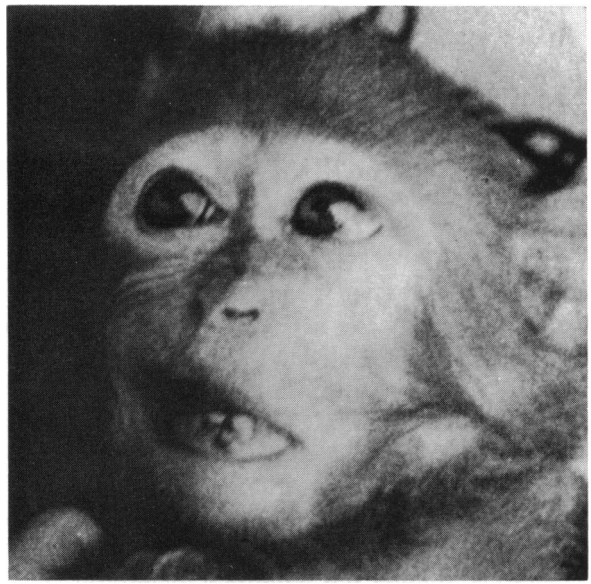


FIGURE 1. LEFT SIDED FACIAL PARALYSIS INDUCED BY REPEATED IMPLANTATION OF LEPROMA NODULES

FIGURE 2. DISTRIBUTION OF LEPROSY

Based on the original color map, Plate 7, of the *Atlas of Diseases* (American Geographical Society).

Wade observed that the "overall picture of leprosy differs so much in different parts of the world qualitatively and quantitatively that a description of it seen in one region may not agree with what is seen in another." Shionuma observed that leprous alopecia of the scalp and brows seldom occurred in tropical zones, but were frequent in colder climates.

In Japan, Korea, Okinawa, Formosa, and Hong Kong I found ocular involvement in approximately 10 percent of the patients. In India I noted an even lower percentage of eye involvement. From Israel, Landau and Gabboy reported involvement of the eyes in over 90 percent of the cases. In Havana, Lopes found "some lesion of the eye or of its appendages in every single case of leprosy."

RACE AND SEX

All human races are susceptible to the disease, males more than females, children more than adults. For the latter reason, Brown postulated that susceptibility may be genetically influenced. In Prendergast's series, at the United States Public Health Hospital in Carville, Louisiana, Mexicans developed fewer eye lesions than patients of other races. According to Cochrane, King, and Clemmey, dark-skinned natives of Asia and Africa also exhibit fewer ocular manifestations than lighter-skinned patients, such as Anglo-Indians.

In a recent survey amongst the multi-racial population of Hawaii, Chung-Hoon and Hedgcock found a smaller incidence of the disease among lighter-skinned, "diluted" part-Hawaiians than among other ethnic groups, such as the darker-skinned pure Hawaiians and Filipinos.

GENERAL HEALTH

Leprosy has been described by Cochrane as "one of the most thrilling and exciting adventures on which any medical man can embark." Its management, with or without eye complications, requires minimum sanitary and housing facilities, supportive medical regime, and adequate sulfone therapy. Tissue predisposition, immunologic responses, and other factors have some bearing on the localization and sequelae of lesions of the eye.

Defective nutritional status, vitamin, iron, and other mineral and protein deficiencies, notably those of lysin and methionine, are capable of rendering susceptible individuals more prone to ocular complications and of retarding the healing of existing eye lesions.

General debility, diabetes, chronic liver or kidney disease, hypertension, amyloidosis, venereal disease, tuberculosis, chronic dysentery, ma-

laria, and parasitic infections may per se be responsible for ocular complications. When these conditions coexist with leprosy they often predispose to the ocular manifestations of this disease. Foci of infection such as carious teeth, infected sinuses, infected or draining ulcers, and areas of infected bone necrosis may aggravate lesions of the cornea and uveal tract or precipitate and prolong endogenous uveitis, episcleritis, and scleritis.

If acute and chronic infections, or metabolic, endocrine, and degenerative diseases are present, they should be managed in accordance with standard therapeutic principles. It is only by following this regime that arrest or recovery from eye lesions may be expected.

Eye injuries among patients with leprosy are potentially more serious than those among a corresponding group of healthy individuals. It is therefore essential that patients' eyes be protected with goggles, case-hardened lenses, or at least with regular glasses or sunglasses when they are exposed to hazardous occupations. It is also highly desirable that patients wear glasses or goggles when they are out of doors, exposed to flying particles of dust and dirt. Trivial injuries in patients with anaesthetic cornea are capable of producing corneal abrasions and ulcers that pass unnoticed but may go on to perforation, uveal prolapse, and possible purulent endophthalmitis.

MENTAL ATTITUDE

The terms leprosy and leper are irretrievably allied with social reproach. At the patients' request, they have been largely eliminated from the vocabulary of the United States Public Health Hospital at Carville, Louisiana, and from that of Hawaii. The term Hansen's Disease has been substituted.

The morale and the will to live of crippled, ulcerous, bed-ridden, and needy patients with poor eyesight can be immeasurably strengthened and maintained by spiritual, social, moral, and physical aid. In Hansen's Disease, cooperation between government officials, physicians, ministers, social workers, and the general public is often necessary to attain this end. These sentiments are properly expressed on placards exhibited throughout Japan in commemoration of the late Empress Teimei's birthday, asking for consolation to patients with leprosy.

Tranquilizing drugs such as Chlorpromazine, Reserpine, Meprobamate (Miltown), and others may occasionally be required as adjuncts to therapy to allay anxiety states, tension, and mental depression and to relieve psychiatric manifestations that aggravate the physical components of the disease.

Occupational therapy and hobbies for those who are visually handicapped should be encouraged. Properly sterilized articles made by patients may be sold to the public. A practical example of a profitable business operated by patients with this disease is a brick kiln on the outskirts of Taipei, Taiwan.

The blind, too, can be helped in a variety of ways. Radios are popular with blind patients the world over. Short-wave receiving and sending sets are successfully operated by two blind men in Hawaii. Talking books are valuable morale builders for the blind and are available at no cost at public libraries in the United States. Specially designed plastic plates with raised Braille letters for lip and tongue reading have been designed and successfully used in Japan for blind patients who have lost their fingers. "Seeing eye" dogs for those blinded by leprosy have not proved to be practical. Fortune-telling and massage are practiced by some blind people in Asia. This includes a few patients whose blindness is due to leprosy.

As in all other fields of medicine and surgery, the confidence and cooperation of patients is essential for successful therapy. Once this has been established, patients often come forward and request prophylactic, therapeutic, and cosmetic surgical assistance, even though they realize that the prognosis may be poor. On the other hand, there are patients whose vision may be restored with glasses, low vision aids, or medical or surgical means, but who fail to submit to treatment because of distrust, fear of the operating room, loss of pension, or other reasons. Occasionally the complacency of the patient's attending physician has to be overcome before definitive treatment to the eyes may be begun. This holds true in instances where patients have been blind for many years and may, because of the added visual disability, exhibit various forms of mental deterioration.

Acute psychoses necessitating the use of restraints and the services of a psychiatrist are met with periodically. Poch and his associates reported psychosis resulting from sulfone therapy. Upon discontinuation of the drug, the mentality returned to normal. Occasionally, patients confronted with loss of the last remaining eye, even though it may be totally blind, will sink into a severe but usually reversible mental depression.

Acute or chronic alcoholism and drug addiction are also of considerable importance in leprosy. They render patients less aware of damage to their eyes from foreign particles and injuries and predispose them to potentially grave and permanent ocular impairment.

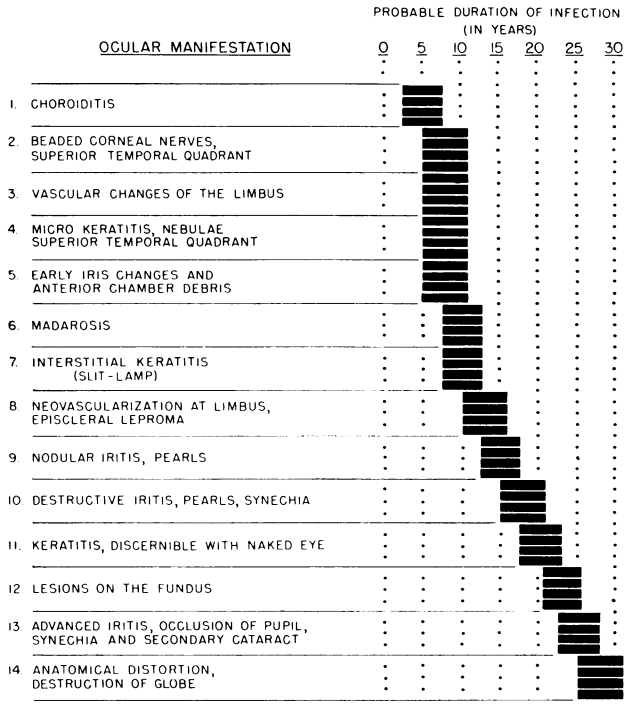


FIGURE 3. OCULAR MANIFESTATION TIME SCALE

Reprinted from "An Interpretation of the Ocular Manifestations of Leprosy," by David C. Elliott, Ann. N. Y. Acad. Sc., 54:96, 1951.

DURATION OF INFECTION

Kirwan called attention to the relative scarcity of eye complications during the first five years of the disease. Chance stated, "The incidence of ocular symptoms bears no relation to the duration of the general disease, but may come on at any time in its course; although it is not usually found till several years have passed." Morrow and Lee, on the other hand, in commenting on the frequency with which the eye is involved, said that such involvement occasionally occurs quite early in the disease. Elliott reported perineural beading along the course of corneal nerves together with early degenerative changes of the iris in a child four years old! He drew up an "ocular manifestation time scale," and postulated that the duration of infection bears a distinct relationship to the appearance of various ocular lesions.

TYPE OF INFECTION

In lepromatous leprosy, ocular lesions are due to destruction and replacement of the normal cellular structure by an overgrowth of granulomatous tissue. This process is accompanied by inflammatory and ultimately degenerative changes within the eye. Bacilli in this type of leprosy are usually present in large numbers with a tendency to aggregate to form "globi" and typical foamy "lepra cells."

The eye lesions are for the most part confined to the anterior segment. However, they do invade the posterior segment as well, though less frequently.

In tuberculoid leprosy, epithelioid cells predominate. The *Mycobacterium leprae* are rarely found in smears. Invasion occurs in the sheath of the nerves, producing a chronic interstitial neuritis with ultimate destruction of nerve fibers and thickening of fibrous tissue. The Mitsuda (lepromin) reaction, consisting of intradermal injection of a suspension of triturated lepromatous tissue, is usually positive in this form of the disease. It produces a small ulcerated nodule within two or three weeks. The ocular lesions and mask-like expression which are often associated with tuberculoid leprosy are secondary to an extension of the inflammation along the course of the fifth and seventh cranial nerves.

In the indeterminate forms of leprosy, skin lesions show few bacilli and do not have a tuberculoid histologic structure. The severity and nature of ocular involvement run a parallel course with the systemic manifestations.

ACUTE LEPROUS REACTION AND ERYTHEMA NODOSUM

Acute leprous reactions occur periodically in both tuberculoid and lepromatous types of disease. They are often precipitated by intercurrent infections or incidental nonrelated diseases which lower the patient's resistance. They last from a few days to a few weeks or even months. These reactions constitute a febrile allergic flareup, with marked bacillaemia. They are characterized by malaise, prostration, severe neuralgia, and an exfoliative type of skin eruption. According to Muir, they comprise one of the most distressing conditions of leprosy, as they may bring on "irreparable damage to the eyes in a few days." From an ophthalmologic standpoint, they may be accompanied by severe pain, lachrymation, photophobia, circumcorneal injection, cells in the anterior chamber, keratic precipitates, pigment deposits on the anterior lens capsule, posterior synechias, and occasionally exudation into

the vitreous body. In addition to severe uveal inflammation, episcleritis and nodular scleritis may also occur during these reactions.

Erythema nodosum leprosum occurs in lepromatous leprosy. It is an acute, subacute, or chronic reaction characterized by the appearance of erythematous painful nodules. The reaction is often associated with fever, malaise, nausea, and some loss of weight. Occasionally the reaction may recur at frequent intervals, or, in the more chronic forms, it remains active for long periods of time. Shuttleworth found that approximately 63 percent of lepromatous cases had erythema nodosum reactions at some time during their illness, and approximately 93 percent of these occurred after institution of sulfone therapy.

Treatment of the eyes during these reactions depends upon the extent and severity of the involvement. If signs of iridocyclitis or other ocular complications supervene, they should be treated in accordance with standard, accepted methods of therapy.

The general therapy of both of these flareups in the past, and to some extent at the present, consisted of the reduction or discontinuation of sulfone therapy; the systemic administration of dihydrostreptomycin (1 gm. every other day), of sodium or potassium antimony tartrate —Fuadin—(2–4 gm. every other day), of Benadryl (50 mg. two or three times a day), of nicotinic acid (50 mg. two to three times a day), or of protamin zinc insulin (25 to 40 units daily); and of many other measures too numerous to mention.

The advent of steroids such as cortisone, adrenocorticotropic hormone (ACTH), prednisone, prednisolone, and others have replaced many of the older forms of therapy. These hormones are especially valuable, as they permit continuation of sulfone therapy without interruption. In Wade's opinion, "cortisone does not cure iritis but changes the process from one of acute, increasing inflammation to a low-grade, easily controlled, subsiding one." It is very likely that as the physiologic and biochemical action of pituitary and cortical hormones becomes better understood, our concepts regarding them will undergo further modifications in the future. For the present, from the clinical standpoint, we are fortunate to have available substances that dramatically suppress the symptoms of inflammation. Long-term, individualized steroid therapy as advocated by Steffensen often produces great improvement or even clinical remission in chronic cases that heretofore have been relatively unresponsive to shorter and less intensive treatment.

If cortisone is used, Jopling and Cochrane recommend five-day courses, beginning with 100 mg. on the first day, 75 mg. the second day,

50 mg. the third day, 25 mg. the fourth day, and 12.5 mg. the fifth day, as long as the reaction is being controlled. They feel that these courses may be repeated as the need for them arises.

Del Pozo and associates reported on six patients with nodular leprosy and three with diffuse form who were receiving cortisone for long periods. In four patients, treatment was continued for a year. A lepra reaction has been present continuously or frequently in each, making the usual treatment with 4-4-diamino-diphenyl sulfone (DDS) impossible. This drug had caused marked exacerbation, forcing interruption of treatment.

Cortisone acetate was given orally in the minimum amount necessary for suppression of the lepra reaction. DDS was well tolerated while the patients received cortisone and was given in doses of 100–300 mg. daily during part of the observation period. Total suppression of the lepra reaction by cortisone was achieved in every case. Favorable results of treatment were indicated by resorption of diffusely infiltrated lesions, fibrotic nodules and keloid scars. No new manifestations of the lepromatous infection were observed while the patients were under treatment. There was no evidence of decrease in the effectiveness of cortisone after months of administration. Secondary and undesirable effects of cortisone did not appear in any patient despite continuous administration in doses averaging 25–100 mg. daily for as long as a year.

This dosage schedule is considerably higher than ours. We feel that the dosage of cortisone, ACTH, prednisone, and other steroids must be adjusted individually to each patient. Attempts should be made to secure maximal suppression of the disease with the least amounts of these hormones.

If ACTH is used, Jopling and Cochrane recommend five-day courses, beginning with 40 mg. of long-acting ACTH gel on the first day, reducing it to 30 mg., 20 mg., 10 mg., and 5 mg. over a five-day period. We have used higher beginning dosages than these—40 mg. long-acting ACTH gel twice a day—for the first two to three days and then gradually reducing the dosage. We also use ACTH gel at the beginning of therapy and follow it with Meticorten, 5 mg. three times a day.

Improvement of chronic cases can be maintained by the administration of prednisone or prednisolone. These drugs have been used continuously for ten months or longer. The dosage schedule for relief of patients varies from an initial dose of 10 to 30 mg. daily for the first three or four days, followed by a maintenance dose of 2.5 to 5.0 mg. daily and later on alternate days.

When long-term steroid therapy is used, the intake of sodium should be limited, and 1 to 3 gm. of potassium chloride by mouth daily should be prescribed. Antacids have been recommended to prevent gastro-

intestinal disturbances. Vitamin C, in dosages of 100 mg. twice daily should be administered to prevent bleeding manifestations in patients so treated.

The long-term systemic administration of any of the steroids calls for thorough and repeated physical examinations and laboratory tests. Patients should be observed for changes of weight and blood pressure. Periodic checks should also be made on their white and red cell counts, their serum sodium, potassium, calcium, urea nitrogen, and blood sugar levels. Tests for glycosuria should be made and 24-hour urinary excretion of calcium should be measured. Patients should be questioned regarding symptoms of gastrointestinal or genitourinary irritation, increase of irritability, headaches, and fatigue. In patients who have been taking steroid for long periods, X rays of the gastrointestinal tract and spine may reveal valuable information.

The various types of untoward reactions reported with long-term steroid therapy are shown in Table 1.

TABLE 1. SIDE EFFECTS DUE TO STEROIDS

Nervous System	*Gastrointestinal System*
Insomnia	Flatulence
Headache	Heartburn
Euphoria	Abdominal cramps
Fatigue	Epigastric distress
Anxiety	Peptic ulcer
Depression	Increase of appetite
Genitourinary System	*Skin*
Urinary frequency	Hirsutism
Nocturia	Striae
	Acneform eruption
	Increased supraclavicular fat
	Ecchymosis

Miscellaneous

Moon-shaped face
Diminished resistance to infection
Glycosuria
Osteoporosis
Eosinopenia
Increased intraocular pressure
Tendency toward hemorrhages

THERAPY

The introduction of sulfone drugs has resulted in greatly improved prognosis for both the systemic and the ocular manifestation of leprosy.

Lowe believed that the serious eye problems in leprosy were preventable by early diagnosis and thorough general treatment. Cochrane felt that blindness might be prevented if treatment were commenced at an early stage. However, he called attention to the danger of complacency of assuming "all is well" because these drugs are being administered. He felt that active lepromatous eye lesions may become aggravated and blindness may be hastened if the drugs are administered by untrained personnel and the eyes are not carefully watched to prevent damage from iridocyclitis complicating acute lepra reactions. Choyce observed that sulfones prevent, mitigate, and delay ocular complication. In his series, as a result of adequate therapy, the ocular signs became arrested in several patients, while in others regression took place. Yet, he noted that no patient had a "complete cure" of his eye lesion.

Amendola concluded that "since the adoption of sulfone therapy, leprotic eye pathology does not occur in treated cases who had not presented that involvement before." He went on to say that "ocular pathology has disappeared from the picture of leprosy in the treated cases." Contrary to the foregoing, Urrets Zavalia found that Promin neither arrested nor delayed the development of the slowly progressing ocular lesions of leprosy. From the public health standpoint, Dr. Mani, Regional Head of the World Health Organization for Southeast Asia, observed that at the present leprosy of the eye cannot be considered preventable, because of inadequate segregation, difficulty in access to patients, and poor follow-up contacts that still exist in areas where the disease is endemic.

The usual dosages of sulfone drugs are as follows: Promin is given intravenously, in daily doses of 1 to 5 gm.; Diasone is used orally in daily doses, 0.3 to 1.2 gm.; Promacetin in daily doses of 0.5 to 4.0 gm.; diaminodiphenyl sulfone (DDS) is administered daily by mouth in dosages of 0.1 gm.; thiosemicarbazone is administered in dosages ranging from 10 to 500 mg. daily. This drug is used only as an alternative in patients who do not tolerate or fail to respond to sulfones. As the sulfone drugs are potentially hemotoxic, their administration should be augmented with iron compounds, vitamin B complex, liver extract, and the like.

According to Doull, the sulfone drugs are neither curative nor bacteriocidal. They seem to assist natural processes of recovery by the liberation of DDS (diaminodiphenyl sulfone). This drug represses the multiplication of bacilli and eventually brings about an arrest of the disease in a considerable proportion of cases. Slowness of action, however, is a recognized handicap of the sulfones.

There is no clear indication that any sulfone compound is more effective than another in the therapy of leprosy. As the *Mycobacterium leprae* cannot be grown in artificial media or in experimental animals, antibiotic sensitivity tests are of no value.

Dihydrostreptomycin is another valuable drug in the treatment of leprosy. It is administered intramuscularly in doses of 1 gm. three times weekly.

With the advent of sulfone drugs, the use of chaulmoogra oil has been gradually abandoned. However, intradermal injections of iodized chaulmoogra ethyl esters are still recommended by Davison primarily for their beneficial cosmetic effect. Injections are given two to three times weekly in dosages of 2 to 3 cc. at a time. Bose, in 1955, also felt that the absorption, diminution, and disappearance of bacilli from leprous lesions of the face are hastened by intradermal or subcutaneous injections of hydrocarpus (chaulmoogra) oil along with daily massage of the affected parts and the administration of sulfones by mouth. In his experience, combining the two drugs gave better bacteriological results in a shorter time than sulfone therapy alone.

Multivitamin therapy is considered a valuable adjunct in the treatment of the disease.

When, usually after a few years of treatment, some patients become bacteriologically negative and are discharged from the hospital, they should be kept under observation and reexamined once a month for a period of at least five years. Following discharge, they should remain on daily maintenance doses of one of the sulfone drugs. Ideally, at the time of the routine monthly physical examinations and laboratory tests, the vision of either eye should also be tested and the eyes be examined with the slit lamp and the ophthalmoscope.

Once a lepromatous eye lesion develops, sulfone therapy alone as a rule will not arrest its progress. Nor will sulfone drugs restore the vision of patients whose eyes have undergone irreversible damage. However, if chemotherapy is administered early in the course of the disease, at regular intervals, over a sufficiently long period of time and in adequate doses, it appears to have a beneficial effect on eye lesions in many, though by no means in all, patients. Unfortunately, even under the most ideal conditions, eye complications continue to occur both among patients admitted previous to and since the discovery of sulfone drugs.

Using Elliott's ocular manifestation time scale as a yardstick and keeping in mind the extreme chronicity of the disease, time alone will decide the extent of the ultimate beneficial effects of sulfone therapy on the occurrence, severity, and arrest of ocular manifestations.

Elective, intraocular surgery should not be undertaken unless the patient's eyes have been in a quiescent stage for at least three to six months. If it is decided upon, preliminary slit-lamp examination of the eyes should be done. If this reveals evidence of active uveitis, the operation should be postponed. The nasolacrimal passages should be tested for their patency and should be free from discharge. The patient should be able to recognize light and be able to tell the direction from which it comes. For four to seven days preceding surgery, as a prophylactic measure, he should be given eye drops containing a sulfa drug (e.g. 30 percent sulfacetamide) or a topical antibiotic (e.g. 1.5 percent Chloromycetin solution) for instillation into both eyes several times a day. His general health should be checked over. Frank foci of infection such as grossly infected teeth, areas of bone necrosis, and draining ulcers should be cleared up. Metabolic or systemic disturbances such as coexisting diabetes or hypertension should be regulated. Prophylactic, systemic antibiotics such as chloramphenicol, tetracycline, penicillin, or penicillin combined with streptomycin should be given for several days preceding and following surgery in cases where a coexisting low-grade infection is present or is suspected. In this regard, it is worthy of note that certain organisms develop a resistance to some antibiotics such as penicillin or others, as during the course of the disease they have been subjected to them at frequent intervals. Ample and effective preoperative sedation, akinesia, and local anaesthesia should be administered. Regarding surgical treatment itself, only those operations should be chosen which combine the greatest safety with the best results; the operative technique applied should be best suited to the type of surgery that is being planned; a great deal of experience should be acquired in the method of one's own personal preference; meticulous, aseptic surgical technique should be observed. The postoperative use of steroids, enzymes, antibiotics, analgesics, and hypnotics should be prescribed as need for them arises. Adequate electrolyte balance should be maintained. With these precautions, some degree of useful vision may often be restored to patients who were previously considered hopelessly blind.

INVOLVEMENT OF THE EYES AND OCULAR ADNEXA

A careful appraisal of each patient's ocular adnexa and eyes should be made and a record of his vision should be taken soon after the diagnosis of the disease has been confirmed and periodically thereafter. A specially prepared chart for this purpose is shown in Table 2.

TABLE 2. EYE EXAMINATION FOR PATIENTS WITH LEPROSY

NAME_____ CASE NO._____

SEX_____ DATE OF BIRTH_____ ETHNIC GROUP_____

1. COMPLAINTS (check the symptoms)
   ( ) Pain
   ( ) Redness
   ( ) Crusts
   ( ) Secretion, or tearing
   ( ) Lump, mass or swelling
   ( ) Disturbances of eyelids
   ( ) Disturbances of eyeball
   ( ) Disturbance of vision
   ( ) Others

2. HISTORY
   Present eye complaints:

   Previous eye complaints (history of injury, operation):

   Glasses or other optical aids:

	Right	*Left*
s glasses		
c glasses		

3. VISION Distant
   Near

4. EYEBROW AND ORBIT
   Loss of hair, nodules, pigmentary anomalies, thickening of supraorbital ridge

5. EYELIDS
   Madarosis, anaesthesia, entropion, ectropion, lagophthalmos, xanthalasma, blinking, fibrillation, blepharochalasis, symblepharon

6. CILIA (trichiasis)

7. MEIBOMIAN GLANDS

8. EXTRAOCULAR MUSCLES

9. CONJUNCTIVA
   Acute inflammation, chronic inflammation, discharge, trachoma, nodules, pigmentary anomalies, pingueculum, pterygium

10. CARUNCLE

11. LACRIMAL APPARATUS
    Lacrimation, discharge, dry eye, abnormalities of the puncta, patency of nasolacrimal duct

12. EYEBALL IN GENERAL (phthisis, staphyloma)

13. SCLERA
    Episcleritis, scleritis, nodules, perforations, staphyloma

14. CORNEA AND LIMBUS
    Anaesthesia, pannus, superficial punctate, interstitial keratitis, ulcers, scars (nebula, macula, leukoma) leproma

TABLE 2. EYE EXAMINATION FOR PATIENTS WITH LEPROSY (*Continued*)

	Right	*Left*
15. ANTERIOR CHAMBER Cells, flare, etc.		
16. IRIS Acute or chronic iritis, adhesions, ectropion uvea, nodules, atrophy, coloboma, response to atropine or Neo-Synephrine, keratic precipitates		
17. PUPIL Polycoria, occlusio pupillae, seclusio pupillae		
18. LENS Opacity, location, type		
19. VITREOUS Opacity		
20. FUNDUS Retina, choroid, optic disc; margins, cupping, pallor, macula, blood vessels: AV ratio, hemorrhages, exudates, pearls, pigmentary deposits, scars, detachment		
21. INTRAOCULAR TENSION Instrument used		
22. VISUAL FIELDS (attach card)	Date done	Date done
23. REFRACTIVE ERROR Manifest, cycloplegic	____sph____cyl____x Add____	____sph____cyl____x Add____
24. SLIT-LAMP EXAMINATION		
25. LABORATORY EXAMINATIONS Conjunctival smears, corneal scrapings		
26. SPECIAL EXAMINATIONS X ray, gonioscopy, Schermer test		
27. PHOTOGRAPHS (place in file)	Date done	Date done
28. DIAGNOSIS (Ocular)		
29. DIAGNOSIS Type of leprosy, systemic disease		
30. TREATMENT AND RECOMMENDATIONS		

Date_____ _____M.D.

PROGRESS NOTES

Reexamination date_____ _____M.D.

Reexamination date_____ _____M.D.

BONY ORBIT

Thickening of the supraciliary ridge is a characteristic and early finding in lepromatous leprosy. Later the forehead may become deeply wrinkled. These changes along with irregularly shaped nodules on the forehead and thickening and deformities of the lips, nose, and ears are responsible for the leonine face described in the past as characteristic of leprosy. Deep-seated orbital pain may be encountered. When it is associated with a blind eye, retrobulbar injection of 1 to 2 percent Novocain followed by 1 to 2 cc. 75 percent ethyl alcohol usually effects relief for several months or permanently. Enucleation is an alternative form of treatment. Supraorbital, infraorbital, and frontal neuritis, like neuritis elsewhere in the body, may also give rise to severe subjective discomfort. It may be treated with analgesics, salicylates, the administration of vitamins B and K, discontinuation of sulfone drugs and diathermy over the affected area. Intraneural injection of equal parts of 1 to 2 cc. of 2 percent Novocain and a suspension of 25 mg. per cc. of hydrocortisone has been recommended to relieve the edema responsible for the pain. If these measures are ineffective, injection of 1 to 2 percent Novocain followed by 75 percent ethyl alcohol or 25 percent magnesium sulphate may effect symptomatic relief. As a last resort, splitting the nerve sheath or avulsion of the nerve must be considered.

LACRIMAL APPARATUS

Fuchs noted that Japanese investigators found lepra bacilli in the tears of 66 percent of patients whose eyeballs were normal.

Leprotic dacryoadenitis has been described by King, Cochrane, and Sloan. Amendola, prior to the discovery of sulfone drugs, recommended surgical excision of the lacrimal gland as the treatment of choice for acute eye complications. In his experience, "this procedure never failed. It completely relieved pain and stopped other acute ocular manifestations."

Leprotic dacryocystitis is often secondary to advanced nasal disease. It may be treated by intubation of the nasolacrimal duct, dacryocystectomy, or if the condition of the nose permits, with dacryocystorhinostomy.

Epiphora occurs occasionally. It may be attributed to lagophthalmos or to eversion of the lacrimal punctum. Both conditions are amenable to surgical repair.

Diminished secretion of tears—dry eye—associated with facial palsy and inability to close the eyes in tuberculoid leprosy, is more frequently

encountered than excessive tearing. For this condition, the local instillation of 1 percent methyl cellulose is an especially valuable artificial tear substitute, as it does not support bacterial growth. For total xerophthalmia, transplantation of the parotid duct to the conjunctival sac has been recommended.

EYEBALL

Shrunken, deformed, phthisical blind eyes are still encountered among patients in the older age groups. Large, bulging, unsightly staphyloma, and corneal leproma are not infrequent accompaniments of the disease. At times the globe is so large that it protrudes between the lids; the upper lid is drawn up and the lower lid sags down in lagophthalmos. However, as long as light perception remains and the eye is free from pain, it is best to leave it alone. If light perception is lost or if the eye becomes red and painful, its removal for both therapeutic and cosmetic reasons is indicated. Contracted sockets may need surgical reconstruction to permit the wearing of an artificial eye. In this regard, it should be kept in mind that patients who have lost several fingers find it difficult or impossible to insert and remove artificial eyes. In these cases, dark glasses or merely an eye patch worn over the affected eye may be sufficient to conceal the cosmetic deformity and is preferable to a major surgical procedure such as reconstruction of the conjunctival cul de sac.

BROWS AND LIDS

The disease affects the eyebrows and lids with great frequency. Simple hypertrophy of the lids and brows is common. Leproma appear on the brows and upper lids, but do not invade the lower lids. These lesions often resolve in time on systemic treatment with sulfone drugs. Blepharochalasis of the upper lid is seen in late cases. It is due to stretching of the skin and relaxation of the tissues, by previous lepromatous nodules. If it impairs vision in the upper isopters of the peripheral visual field, it can be corrected by operative interference.

Anaesthetic areas on the face and upper and lower lids occur in tuberculoid leprosy. The blinking reflex is frequently absent. In this type of the disease abnormalities of the lids and lashes are primarily responsible for the ocular damage and ultimate visual impairment. Paralysis of the orbicularis with facial paralysis is noted in about 10 percent of the cases. Atrophy of the involved muscles usually follows. The lid margins are almost invariably involved. Entropion of the upper and lower lids causes subjective discomfort and objective cosmetic de-

formity. When the lashes are present, they may be misdirected, causing trichiasis, conjunctival or corneal irritation, corneal ulcers and scars. Widening of the palpebral fissures with sagging of the lower lids is frequently observed. In early cases, this causes only slight cosmetic disfigurement. As the condition progresses, paralytic ectropion and lagophthalmos result. Loss of sensation, loss of protection by the lids, and loss or diminution of tearing may result in chronic conjunctivitis, exposure keratitis, corneal ulceration, and perforation of the globe.

Entropion of the upper lid can be corrected by using Lagleyze's technique or other similar operations.

Entropion of the lower lid may be corrected by resection of the tarsus and orbicularis, or by a Hughes type of tarso-conjunctival graft.

Trichiasis may be very annoying and may cause corneal damage. It is treated by periodic epilation or electrolysis of the misdirected lashes. If severe, the condition may be surgically repaired with a tarso-conjunctival graft from the opposite lid sutured into an incision at the mucocutaneous junction.

Ectropion of the lower lid may be paralytic or cicatricial. If it is paralytic, it is usually associated with lagophthalmos. A transparent, plastic cup worn over the affected eye will protect the eyes, especially during sleep. The instillation of 1 percent methyl cellulose with or without 0.5 percent cortisone or mild antiseptic or antibiotic ointments also affords some degree of protection to partially exposed globes. However, the ideal treatment for ectropion and lagophthalmos is surgical repair. Lateral tarsorrhaphy, Minsky's figure "8" suture, the Kuhnt-Szymanowski operation, or repair by a fascia lata sling are all suitable and may be used, depending upon the severity of the defect and the discretion of the surgeon.

In paralytic lagophthalmos involving the upper lid, recession of the levator as recommended by Goldstein is a valuable approach.

In all operations involving flaccid lid tissue, it should be kept in mind that the underlying muscles lack tonus and are usually atrophic. To obtain an adequate functional and cosmetic result, it is advisable to correct these conditions fully or even overcorrect them slightly. Transplantation of the temporalis muscle according to Ferris Smith's technique has also been recommended to improve the appearance of patients and to lend tonus to paralytic lids.

Unilateral or bilateral loss of hair follicles from the eyebrows, with loss of lashes, may appear early in the course of the disease. The loss of brows commonly begins on the temporal side and may involve the entire brow. In countries where eyebrow pencils are available, female

patients are often content to use them as cosmetic beauty aids. Intradermal artificial pigmentation—tattooing—to the area of the brows has been successfully performed at the United States Public Health Hospital in Carville, Louisiana. Transplantation of individual hair follicles to create eyebrows was first suggested by Fujita. At the present it is commonly and successfully practiced in Japan. We prefer hair-bearing grafts from the scalp or from the opposite brow if they are available.

OCULAR MUSCLES

Leprosy seldom causes oculomotor disturbances. Mitsuda reported that he has not seen paralytic squints arising from the disease nor was he able to find the bacillus in the oculomotor nerve. However, Viallefont and Fuentes and King did find paralytic strabismus due to involvement of the third nerve. Divergent strabismus secondary to amblyopia of one eye is not uncommon. Paralysis of the intrinsic muscles of the eye involving paralytic mydriasis or accommodative palsy occur periodically. They occur more frequently in patients with lepromatous leprosy who have undergone erythema nodosum type of reactions. Prescription of eye glasses with suitable presbyopic reading addition is usually sufficient to enable patients with such defects to read, sew, and do close work.

CONJUNCTIVA

Leprosy bacilli as a rule do not invade the conjunctiva. However, the bacillus has been recovered from the conjunctival secretions in large numbers, even in eyes showing no leprous stigmata.

Acute superimposed infectious conjunctivitis usually responds to topical applications of 30 percent sulfacetamide or ophthalmic aureomycin drops. If these drugs fail, a smear, culture, and antibiotic sensitivity test from the conjunctival sac frequently help determine the antibiotic to which the bacilli are most sensitive and which is most likely to control the infection. Coexisting trachoma occurs frequently, especially in the tropics. According to Professor Ida Mann, the sulfones used in the treatment of leprosy "can entirely kill the trachoma virus." Professor Mann confirmed this observation by successfully treating with DDS a group of children who had trachoma, but did not have leprosy.

Chronic conjunctivitis is common. It is believed to be due to exposure and secondary bacterial infection rather than leprous infiltration. However, Shionuma, on histologic examination of the conjunctiva, found tuberculoid type of changes with lymphocytes, epithelioid cells, and

Langhan's cells. Miliary nodules occasionally appear in crops near the limbus in association with similar lesions on the cornea and iris. The treatment of chronic conjunctivitis depends upon the bacterial flora of the conjunctival sac. It usually responds to antiseptic or antibiotic collyria or to the local application of 0.15 to 0.25 percent zinc sulfate drops, 1 percent methyl cellulose, or the like. We have no experience with the topical instillation of sulfone drugs in the treatment of leprous eye lesions. Due to the granulomatous nature and chronicity of the disease as well as the slow action of sulfone drugs, we feel that this method of administration is of doubtful value. However, Tsukahara, Ishihara, and Tajiri advocated topical applications of 1 percent to 5 percent Promin ointment as well as subconjunctival injections of 5 percent Promin. Roy suggested 1 to 5 percent Sulphetrone for local instillation.

Pterygium is common. Unless it is highly vascularized and actively growing, it is best left alone. However, surgical removal followed by beta radiation or radiation with low voltage X rays along with topical instillation of 0.5 percent cortisone usually effects a cure.

Symblepharon occurs frequently. It may be corrected with a mucous membrane transplant from the conjunctiva of the opposite eye, the lips, the labia minora, and the like. Unless a contact lens is worn for several months after surgery, the adhesions may recur. The topical and systemic administration of adrenal cortical steroids is of help in suppressing fibroplastic proliferation that follows the surgical repair of these lesions.

EPISCLERA AND SCLERA

The episclera, according to Fuchs, is the earliest site of ocular involvement. Valle believed that the rich anastomosis between the anterior ciliary arteries and posterior conjunctival vessels is responsible for the preferred episcleral location. Yellowish, gelatinous, leprous nodules containing bacilli usually abound in the episclera near the limbus. These nodules are often symmetrical and are more commonly situated on the temporal halves of the bulb. They tend to spread around the limbus and infiltrate the cornea. They may even invade the angle of the anterior chamber. They temporarily respond to topical or in severe cases to systemic administration of cortisone, hydrocortisone, or some of the other steroids. However, they frequently recur.

The sclera itself usually does not harbor bacilli. A yellowish discoloration of the sclera has been reported by several authors. Peritomy has been recommended to relieve both episcleritis and scleritis.

Anterior, intercalary, or scleral staphyloma follow repeated acute attacks or chronic forms of episcleritis or scleritis. Tissue therapy consisting of intramuscular or subconjunctival injections of placenta extracts has been recommended by Pennec for these unsightly lesions. In a few clinics in India, staphyloma are resected. We feel that if the lesions are sufficiently large to cause cosmetic deformity or pain, the eye should be removed.

CORNEA

The cornea is the most vulnerable of all ocular structures affected by the *Mycobacterium leprae*. Bacilli may be found in corneal scrapings.

Infiltration of the corneal nerves may be demonstrated by slit-lamp examination. This process is essentially similar to the infiltration that takes place in the peripheral nerves elsewhere in the body. Beading of the corneal nerves in the superior lateral quadrants of both eyes was observed by Pillat. Thickening of the nerves in the stroma with minute granulomatous infiltrations has been described by Boshoff.

Partial or total loss of corneal sensitivity is an important sign, as either may be the forerunner of neuroparalytic keratitis with consequent visual impairment. Thomas stated that sensory nerves are believed to exert some controlling effect upon the metabolism of the corneal cells, chiefly the epithelial cells. When this proper, regulatory effect is lacking, there is an accumulation of cellular metabolites causing an edema and tissue destruction. The cellular edema and disturbed nutrition with its accumulated extracellular and intracellular deposits leads to a breakdown and exfoliation of the epithelium so that minor trauma, bacteria, and foreign bodies can readily damage this structure.

Exposure keratitis or keratitis e lagophthalmos is a serious complication of tuberculoid leprosy. It is the aftermath of paralysis of the orbicularis muscle. The involvement is usually in the lower, exposed portions of the cornea. As the cornea derives some of its nutrition from the tears as well as from the limbal vessels and the aqueous, abrasions, ulcers, and scars that accompany this type of keratitis are partly due to evaporation of tears.

The prophylactic treatment of both neuroparalytic and exposure keratitis includes protection of the cornea with goggles. If goggles are equipped with side shields they create a moist chamber and afford added protection and comfort. Especially constructed plastic cups which can serve as moist chambers are commercially available. If such are not obtainable, at least eyeglasses or sunglasses should be provided for added protection. Patients should also be instructed to apply 1 percent

methyl cellulose to their eyes before retiring and to keep their eyes patched at night. Methyl cellulose is preferable to bland ointments and oils such as U.S.P. lanolin or U.S.P. petrolatum, as the latter tend to produce mechanical irritation, delay or inhibit wound healing despite lubrication. If patients do not fully appreciate the potential hazards of neuroparalytic or exposure keratitis, their eyes should be permanently protected by a lateral tarsorrhaphy or a lateral and a medial tarsorrhaphy. Two small adhesions between the upper and lower lids afford considerable protection to the cornea, and still permit patients to see through a central unobstructed narrow slit.

The active treatment of corneal abrasions and ulcers consists of the application of local, subconjunctival, or systemic antibiotics, the use of mydriatics, and patching the eye. Grossly infected corneal ulcers may require curettement and thermal or chemical cautery. The systemic administration of vitamins A, C, and D, riboflavin, or multivitamin preparations has been recommended to assist the healing of corneal ulcers.

Boenjamin and Mendonca de Barros recommended large doses of vitamin A for corneal lesions, as they believed that this may help regeneration of corneal epithelium. However, Romero warned that vitamin A may cause an exacerbation of acute lepra reactions. When corneal lesions are complicated by anterior uveitis, the latter should be actively treated.

When corneal scars reduce vision, refraction and the prescription of proper glasses or low vision aids may be sufficient to obtain visual improvement. Optical iridectomy should be reserved for eyes where the scarring involves the central portions of the cornea and where a clear, transparent peripheral area is available. If no such area is present, superficial keratectomy may be considered. However, because of the possibility of rupture of the globe due to surgical thinning of a diseased cornea, lamellar corneal transplantation is preferable to this procedure. A successful case of transplantation in a patient with dense corneal opacities was reported by Degas, Voisin, and Delzant. If keratoplasty is decided upon, it should be kept in mind that multiple operations may be required, especially if the cornea is heavily vascularized. Leigh described an ingenious series of procedures which he performed with good results on eyes where the cornea was densely scarred and heavily vascularized.

Superficial punctate keratitis is considered pathognomonic of the disease. Shionuma found it in 21.7 percent of cases of lepromatous leprosy. It usually begins at the superior limbus as a light, milky haze in the

substantia propria, dotted by tiny, white, irregular spots resembling dust or grains of chalk. As it spreads downwards, its lower margin is delineated by a wavy line. Lepra cells and lepra bacilli may be seen in the scrapings from such lesions.

Leprotic pannus may be seen in all stages of vascularization and granulomatous infiltration. Clinically it resembles the pannus of phlyctenular keratoconjunctivitis. It differs from that of trachoma by the absence of involvement of the tarsal plates. The lepromatous pannus encroaches and often destroys Bowman's membrane as it advances into the parenchyma. In doing so, it causes a partial or complete hyperplastic keratitis and ultimately brings on severe visual loss. Its progress may be checked by peridectomy and recession of the vascularized tissue 4 to 5 mm. back of the limbus. Large limbal or corneal vessels may be destroyed with the electrocautery. These operations should be followed with local applications of cortisone drops or ointment for a period of weeks or months. Beta radiation has also been recommended as an effective means to control extensive vascularization of the cornea.

Sclerosing keratitis originates as a white, milky band in the episclera or sclera. It gradually advances to the cornea, often giving rise to sclero-corneal leproma. These leproma are generally bilateral and may attain very large proportions. Mitsuda reports that 94 percent of his patients with lepromatous leprosy developed leproma of the cornea. This figure is out of proportion with our statistics (less than 10 percent) and with my personal observations in Korea, Formosa, and India.

Another type of leproma occurs in the center of the cornea surrounded by relatively transparent tissue (Ruato's corneal leproma). Large, isolated corneal leproma, according to DeSouza, may be extirpated surgically or treated with galvanocautery or with carbon dioxide snow. However, when light perception is lost and the eye becomes red or painful, little can be gained by temporizing procedures, and enucleation is the treatment of choice.

Interstitial, nodular, or discoid keratitis is also seen in the lepromatous form of the disease.

IRIS AND CILIARY BODY

Lepromatous iritis and cyclitis may be caused by actual invasion of the uveal tissue by the bacillus itself—granulomatous uveitis—or it may be due to hypersensitivity to anaphylaxis resulting from protein sensitization—nongranulomatous uveitis.

Granulomatous uveitis of leprosy is a chronic, nonpurulent inflammation of the uveal tract which results from actual infection. It runs a

prolonged course and causes tissue necrosis. In this type of inflammation, bacilli are present in enormous numbers. Fuchs demonstrated large nests of lepra bacilli in the iris and in the ciliary body on histologic examination. The essential pathologic change according to Woods is characterized by exudation, mobilization, and proliferation of inflammatory cells. These changes may be observed under the slit lamp. They consist of an aqueous flare with a mutton-fat type of keratic precipitates and fibrinous exudate in the anterior chamber. The clinical course is characterized by slow, often insidious onset and gradually decreasing visual acuity. Pericorneal injection is usually slight. If the disease progresses, multiple—according to Mendonca de Barros, myriads of—miliary, glistening lepromatous nodules considered pathognomonic of the disease can be seen near the pupillary margin or in the iris stroma. There is marked tendency to form heavy posterior synechias. The latter are usually permanent and are difficult to break. Whole sectors of iris may become atrophic, depigmented, and lead to heterochromic iridocyclitis. Seclusio and occlusio pupillae and secondary cataract frequently supervene.

Each exacerbation produces increased damage to the eyes. In severe cases, the eye may progress to phthisis. Occasionally a leproma of the ciliary body infiltrates the angle of the anterior chamber, displaces the iris and advances toward the pupil.

Nongranulomatous iridocyclitis has been described by Woods as a sterile reaction. He states:

> It is the result of acute and later chronic recurrent insult to the tissues. The latter could be due to bacterial hypersensitivity, or to an anaphylaxis caused by protein sensitization. The absorption of the soluble bacterial protein from a focus of infection may readily explain the inflammatory reaction in these eyes. The clinical course in this type of involvement is characterized by sudden onset of considerable pain which reaches its maximum intensity in two or three days. Intense pericorneal congestion, hyperemia, muddy iris, contracted pupil, photophobia, and lacrimation are present. On slit lamp examination, fibrinous exudation into the anterior chamber with many cells and intense aqueous ray are noted. There is only slight tendency to the formation of posterior synechiae. The attacks are short-lived, and run a self-limited course in one or several weeks.
>
> After repeated attacks, however, annular posterior synechiae may be found. The iris and ciliary body become thinned and atrophic. There may be clouding of the lens with secondary cataract. Organized fibrinous exudates on the iris may simulate the picture of severe granulomatous disease.

Ashton called attention to the frequent coexistence of uveitis with infective, usually streptococcal, foci in the tonsils, teeth, and so forth,

and the improvement which sometimes follows the removal of such foci. He felt that these findings offered at least persuasive support for regarding focal sepsis as a factor of importance in the etiology of nongranulomatous uveitis. For this reason, in nongranulomatous types of uveitis of leprosy a thorough medical search should be carried out and infected foci should be eradicated.

There is no uniformly beneficial treatment for acute iridocyclitis. In both granulomatous and nongranulomatous forms of the disease, the local instillation of mydriatics (1 to 2 percent atropine, 0.2 percent scopolamine, 10 percent Neo-Synephrine) is used. Cortisone and other steroids are of great value in the treatment of acute attacks of iridocyclitis, choroiditis, and occasionally optic neuritis. Treatment with these preparations was discussed in conjunction with acute lepra reactions. Topical instillations of 1 to 2 percent dionin are still used by ophthalmologists in India, with good results.

External heat in the form of hot, moist compresses, heating pads, or short-wave diathermy is gratefully received by most patients. The parenteral administration of certain enzymes, such as trypsin, occasionally provides relief in the management of recalcitrant cases of uveitis. The intravenous administration of calcium gluconate or lactate is also occasionally used in arresting refractory cases of iritis. Anterior chamber puncture has been tried with beneficial effects in a case of leprous iritis by Spyratos. However, as a hyphema occurred in conjunction with the paracentesis, the author ascribed the favorable effects of the procedure to autohemotherapy. He felt that paracentesis was too risky for routine use.

Intramuscular injections of milk were recommended by Asano. Other types of foreign protein therapy such as intravenous typhoid vaccine, the intramuscular injection of lactoflavin, autohemotherapy, and transfusions of whole blood also had their advocates.

Ericson recommended the daily intramuscular administration of 0.5 to 1.0 gm. of streptomycin for two to four weeks. He called attention, however, to the potential hazards of vertigo, tinnitus, and deafness that may arise as a result of long continued use of this drug.

Romero recommended the daily intravenous administration of 1 gm. of streptomycin in 1,000 cc. of glucose solution. In his hands, neither the streptomycin nor the glucose solution alone gave satisfactory results.

Prado recommended intravenous injections of hypertonic glucose (30 percent) every second day for an average of ten doses. There is, however, a danger of damage to the veins from using this form of therapy.

INTRAOCULAR PRESSURE

Prendergast, among 350 patients at Carville, found only one patient with chronic simple glaucoma and sixteen with secondary glaucoma. He believed that the reason glaucoma did not occur was due to atrophy and hyalinization of the ciliary body and ciliary processes.

Kirwan and Kimura independently reported a few cases of secondary glaucoma following plastic-granulomatous iritis. Neither one observed primary glaucoma.

Verne found no increase in the intraocular pressure in Tahiti. He observed a drop in the intraocular pressure at the onset of leprous reactions. This eventually returned to normal. He noted that the drop in the intraocular pressure coincided with arterial constriction of the vessels of the fundus. He believed that the fluctuation was on an allergic basis and termed it "unstable intraocular pressure."

Urrets Zavalia examined the angle of the anterior chamber in 29 patients. Of these, 10 had tuberculoid and 4 indeterminate forms of leprosy. None of them showed abnormalities. However, in 15 lepromatous cases of long duration, miliary nodules, goniosynechias, anterior peripheral synechias, and loss of substance of the base of the iris were present. In our experience, primary or secondary glaucoma seldom if ever occurs in conjunction with leprosy.

VISUAL FIELDS

De Silva and Iwakiri, working independently, failed to find abnormalities of the visual fields for either form or color. During acute lepra reactions, Verne noted four different types of peripheral visual field defects. They consisted of a generalized contraction, defects in the upper half of the field, defects in the upper temporal quadrant, and bitemporal hemianopsia. These abnormalities occurred either singly or in multiples. Verne postulated that they were caused by pressure in the region of the optic chiasm associated with venous engorgement of hypophyseal hypertrophy. This theory is based on Selye's concept of hypophyseoadrenal response, which under conditions of stress stimulates the hypophysis to secrete an excess of growth hormone.

NIGHT BLINDNESS

Uchida recorded several cases of night blindness in Japan among patients afflicted with leprosy. He attributed them to anomalous fat metabolism associated with leprous hepatitis. Systemic treatment with vitamin A often brings about subjective improvement, in these patients.

LENS

Uncomplicated cataracts in elderly patients occur with the same frequency as in a corresponding group of healthy population. They should be removed by accepted standard surgical techniques. As a rule, lens opacities are the aftermaths of severe recurrent attacks of anterior uveitis. Shionuma found a decrease in the vitamin C content of the aqueous in patients with postinflammatory cataracts of leprosy.

The successful surgical removal of complicated cataracts requires the careful and gentle separation of synechias from the anterior lens capsule. This may be done through traction on the iris at the time of the iridectomy or with a flat iris spatula before the lens is extracted. Great care must be used in delivering the lens because the vitreous is often degenerative and fluid. After the lens is removed, a pair of scissors is introduced into the lower half of the anterior chamber and the iris is incised at the lower pole. This step prevents the late formation of a drawn-up pupil in a cyclitic membrane.

LESIONS OF THE POSTERIOR SEGMENT

Lesions of posterior segment are rare. Valle advised that all conditions capable of producing changes in the retina and choroid, such as syphilis, tuberculosis, and others, should be ruled out before the diagnosis of chorioretinitis due to leprosy is made. Changes in the retina are believed to be secondary to those in the uveal tract. Neither Kirwan nor Prendergast was able to demonstrate the bacillus *leprae* in the retina or optic nerve. However, Mancione and Inatomi reported acid fast organisms in both the choroid and retina. Prendergast observed involvement of the fundus in 42 out of 241 patients. Trantas and Rupert reported unilateral or bilateral isolated punctate lesions in the periphery of the choroid with some pigmentary proliferation. Stallard noted clumps of lepra bacilli in the suprachoroidal lymph spaces. Verne described four different types of changes in the fundus, during acute leprous reactions, in 43 out of 120, or 35 percent, of his patients. They consisted of: congestion of the disc with blending of the shades of the nasal and temporal halves of the disc; papilloedema, which varied from blurring to complete disappearance of the disc margins; infiltration of the posterior pole seen as an increase of the retinal glimmer; a brilliant perimacular circle with or without vascular changes; persistent venous dilatation accompanied by vascular undulations; and a decrease, sometimes amounting to collapse, of the central artery. In addition to the foregoing, at times, Verne also observed perivascular infiltration of the

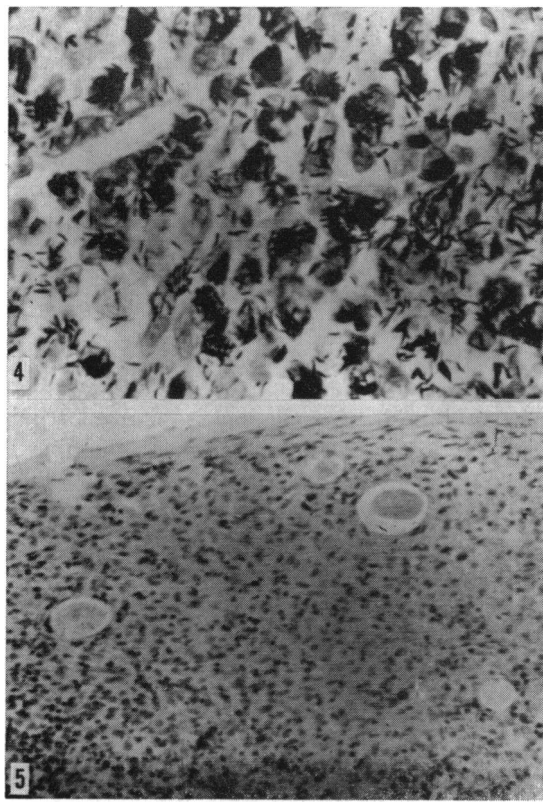


FIGURE 4. MYCOBACTERIUM LEPRAE

FIGURE 5. GLOBUS, FOAMY CELL

FIGURE 6. LEPROMA OF EYEBROW

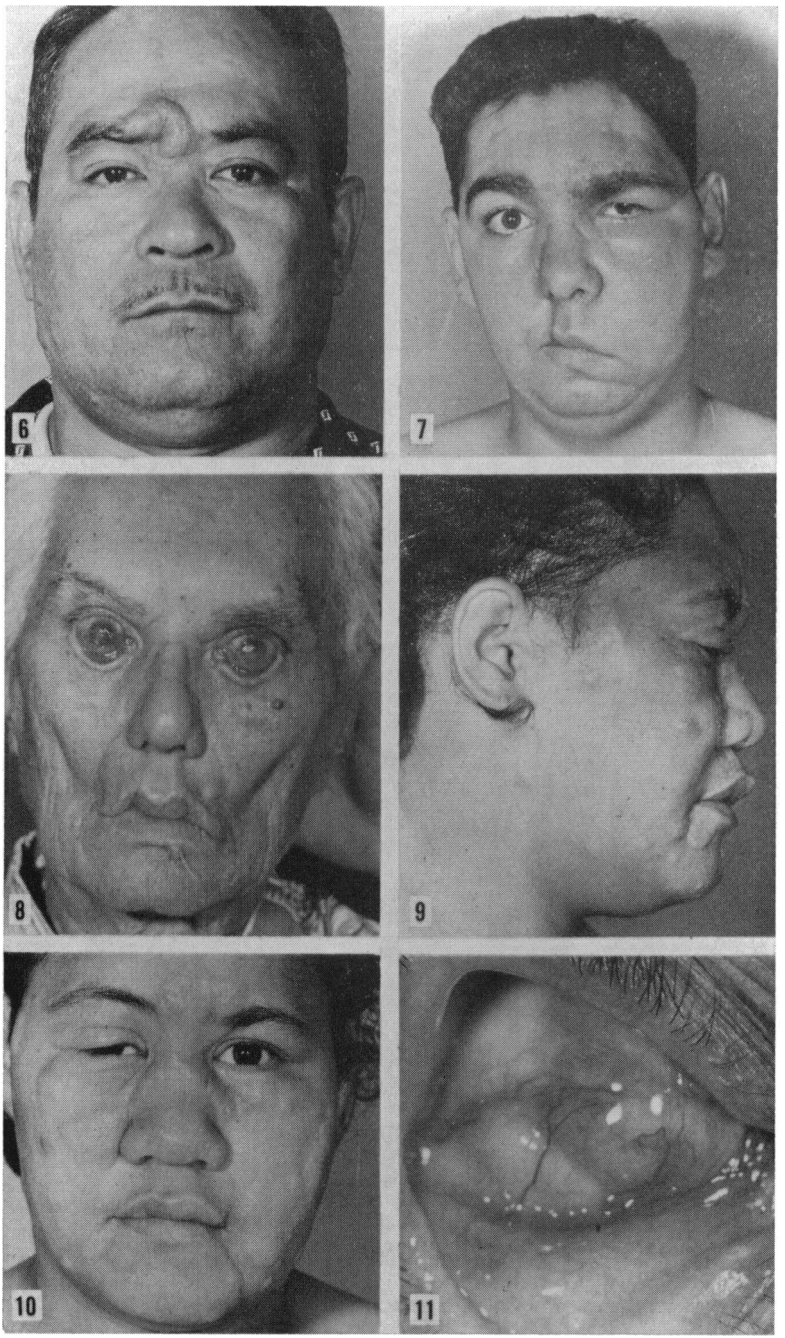
FIGURE 7. TUBERCULOID LEPROSY

FIGURE 8. INTERMEDIATE FORM OF LEPROSY: ECTROPION, LAGOPHTHALMOS, EXPOSURE KERATITIS

FIGURE 9. ERYTHEMA NODOSUM LEPROSUM

FIGURE 10. ERYTHEMA NODOSUM LEPROSUM

FIGURE 11. PHTHISIS BULBI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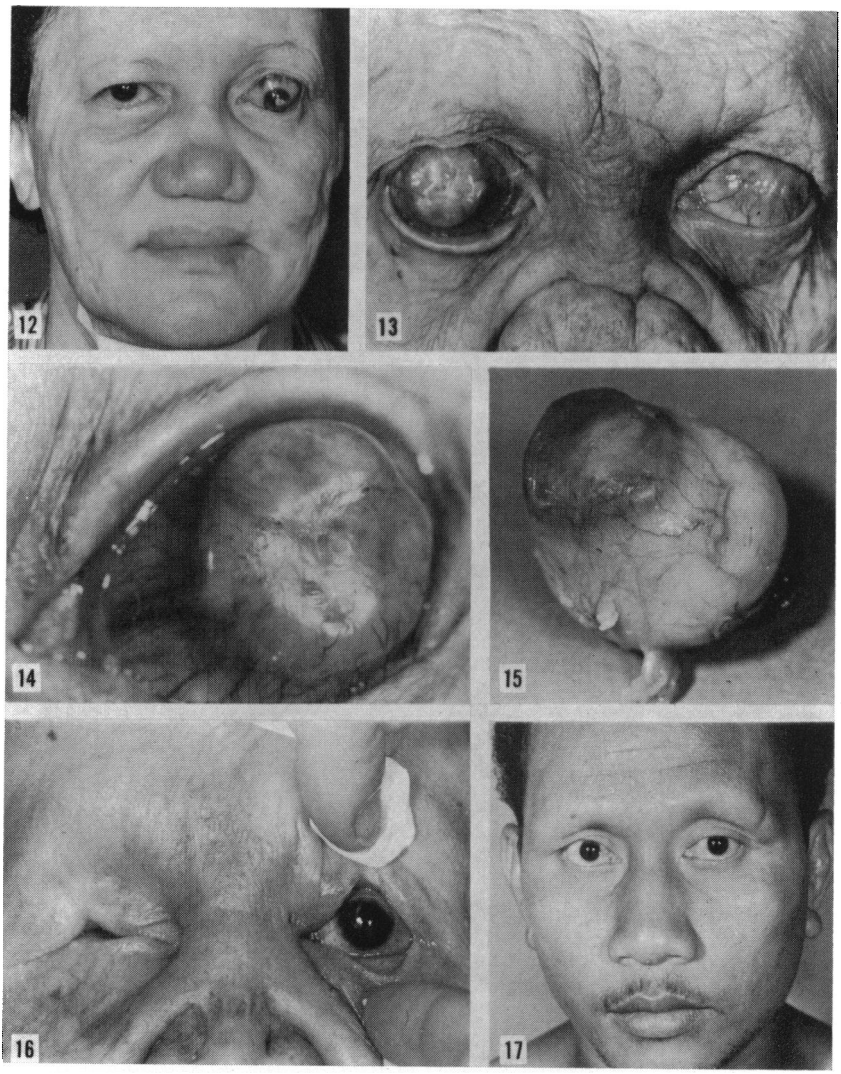


FIGURE 12. ANTERIOR STAPHYLOMA

FIGURE 13. CORNEAL LEPROMA, RIGHT; ANTERIOR STAPHYLOMA, LEFT

FIGURE 14. CORNEAL LEPROMA

FIGURE 15. CORNEAL STAPHYLOMA

FIGURE 16. CONTRACTED SOCKET, RIGHT; COLOBOMA UPPER LID, LEFT

FIGURE 17. ALOPECIA OF BROWS, THICKENING LEFT SUPRAORBITAL RIDGE

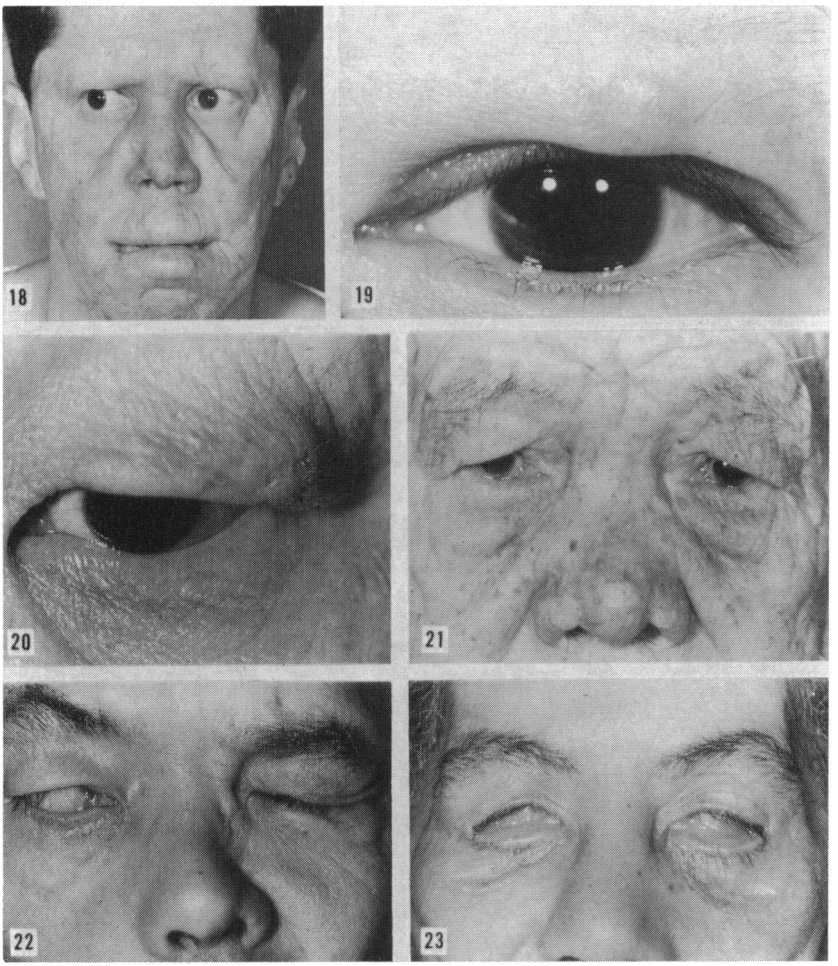


FIGURE 18. LEONINE FACIES

FIGURE 19. LEPROMATOUS NODULE OF UPPER LID

FIGURE 20. BLEPHAROCHALASIS

FIGURE 21. BLEPHAROCHALASIS

FIGURE 22. FACIAL PARALYSIS, TUBERCULOID LEPROSY

FIGURE 23. BILATERAL ECTROPION

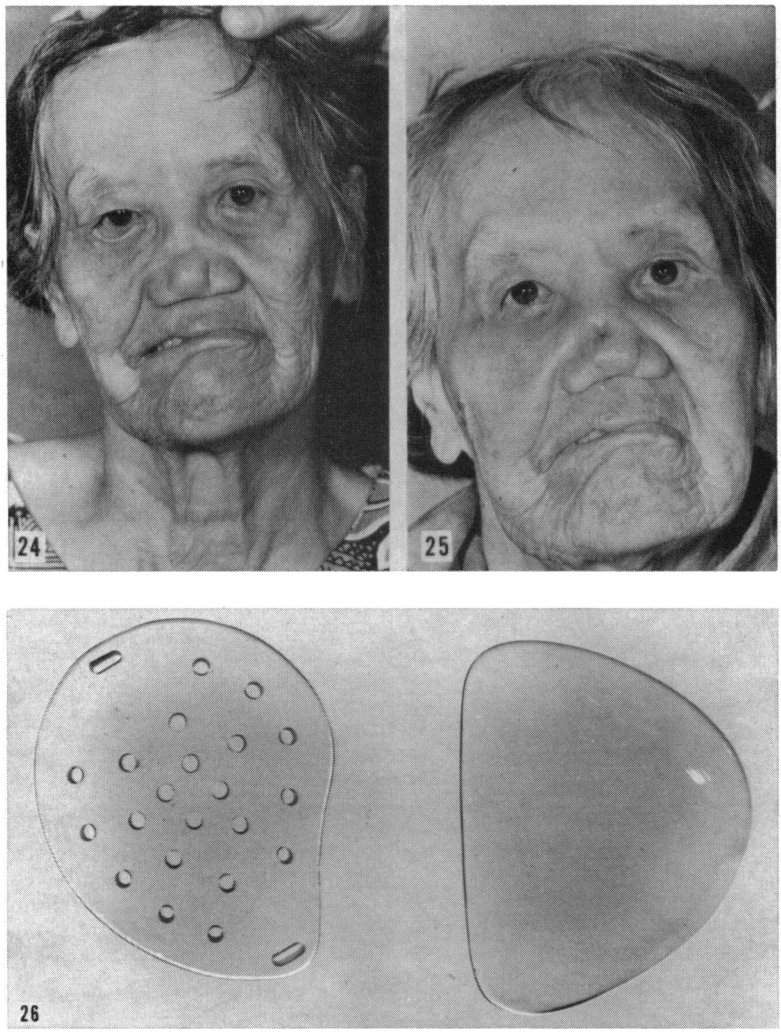


FIGURE 24. LAGOPHTHALMOS WITH PARALYTIC ECTROPION, BEFORE SURGERY

FIGURE 25. LAGOPHTHALMOS WITH PARALYTIC ECTROPION, AFTER SURGERY

FIGURE 26. PLASTIC CUP TO PROTECT EYE DURING SLEEP

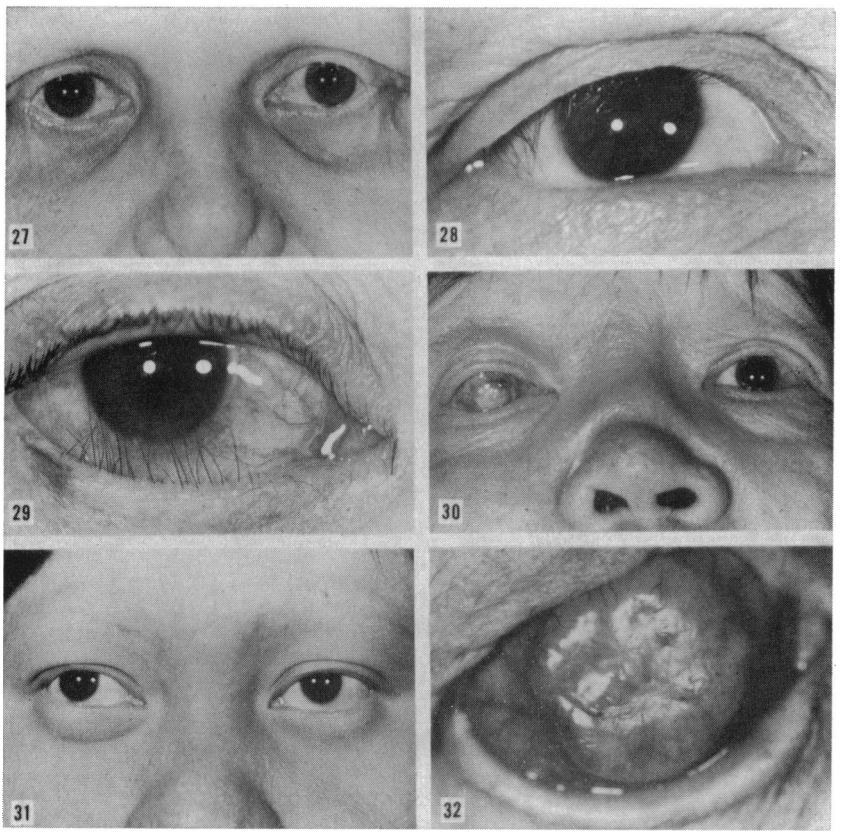


FIGURE 27. BILATERAL LATERAL TARSORRHAPHY

FIGURE 28. ENTROPION, TRICHIASIS, UPPER LID

FIGURE 29. TRICHIASIS, LOWER LID

FIGURE 30. PARTIAL MADAROSIS BOTH BROWS, CORNEAL STAPHYLOMA RIGHT EYE

FIGURE 31. ALOPECIA OF BROWS AND LIDS

FIGURE 32. CORNEAL LEPROMA, LAGOPHTHALMOS LOWER LID

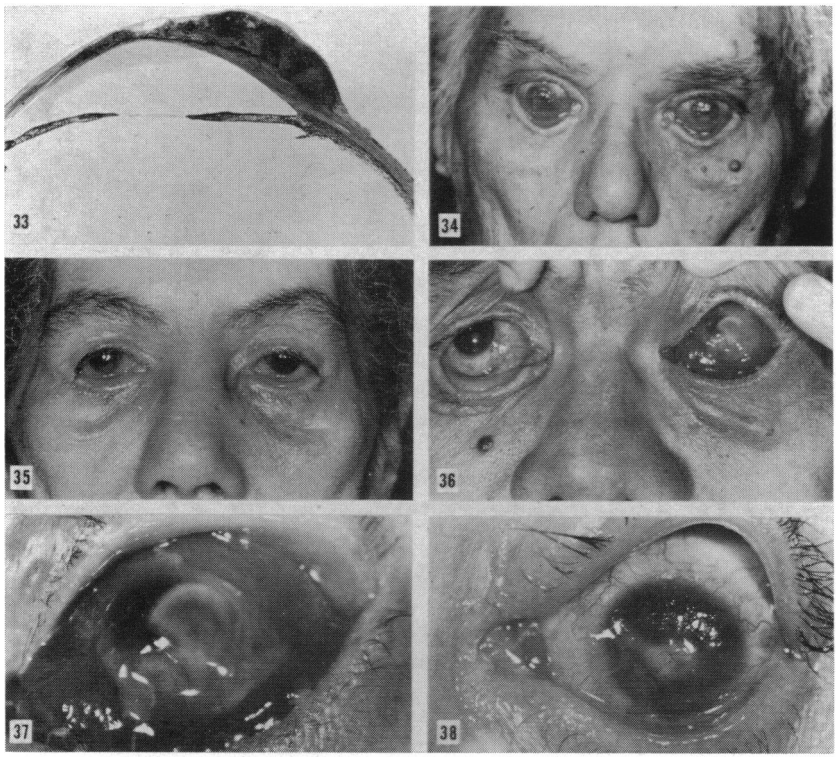


FIGURE 33. CORNEAL LEPROMA

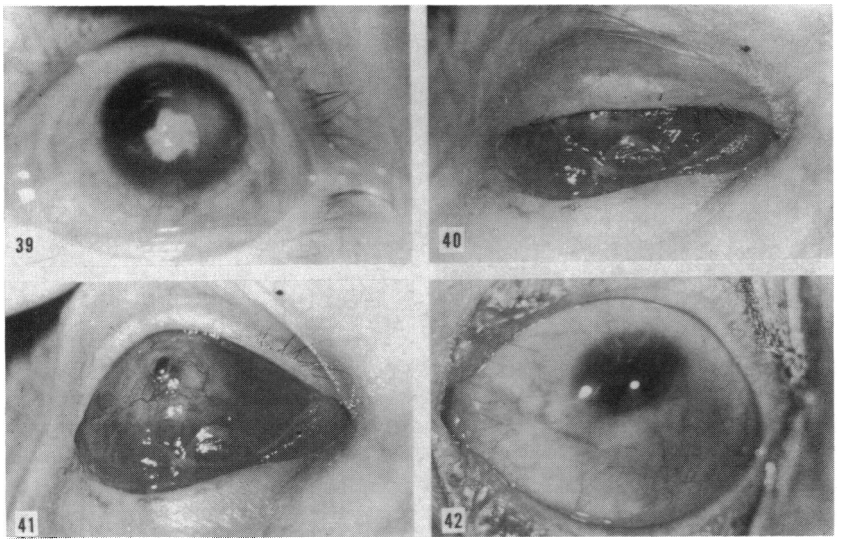
FIGURE 34. EXPOSURE KERATITIS, RIGHT; LEPROMATOUS PANNUS, LEFT

FIGURE 35. BILATERAL ECTROPION, EXPOSURE KERATITIS

FIGURE 36. LEFT CORNEAL ABSCESS, PURULENT ENDOPHTHALMITIS

FIGURE 37. CORNEAL ABSCESS

FIGURE 38. LEPROMATOUS PANNUS



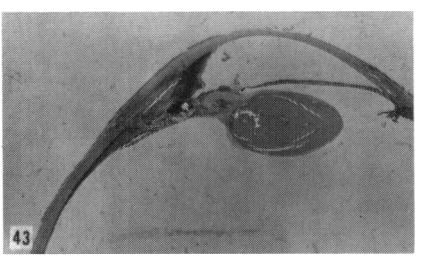


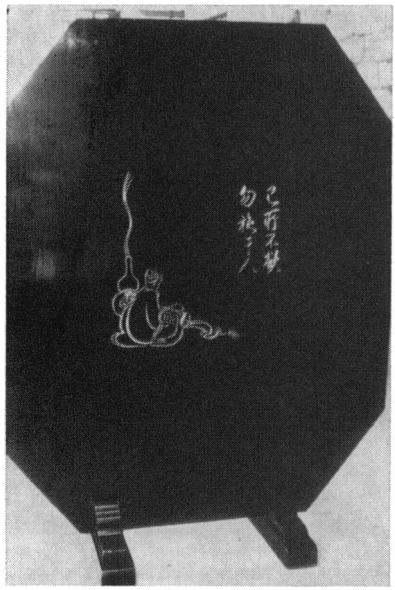
FIGURE 39. PARENCHYMATOUS KERATITIS, SURGICAL COLOBOMA OF IRIS

FIGURE 40. SEVERE CHEMOSIS, ACCOMPANYING PERFORATION OF GLOBE

FIGURE 41. PERFORATION OF EYEBALL, LEPROMATOUS PANNUS

FIGURE 42. LEPROTIC PANNUS, COMPLICATED CATARACT

FIGURE 43. LEPROMATOUS IRIDOCYCLITIS, ANTERIOR AND POSTERIOR SYNECHIA, CATARACTA COMPLICATE



"SERVE OTHERS WITHOUT EXPECTING A REWARD."

"GIVE CONSOLATION TO THE PATIENTS WITH LEPROSY."

afferent and efferent central vessels and a grayish, edematous appearance of the macula.

Kennedy reported 9 cases of leprous choroiditis. Elliott reported 6 cases of retinal pearls visible through the ophthalmoscope. They appeared as small, waxy and creamy white pedunculated nodules projecting into the vitreous. Somerset and Sen described round, yellow homogenous nodules situated superficially on the retina.

Van Poole described 49 cases of optic neuritis among 206 patients. He believed that these were transitory and were caused by bacterial allergy. Takahashi, in lepromatous cases, was able to demonstrate bacilli in the optic nerve. He ascribed the involvement to an extension of the lepromatous infiltration.

In conclusion, I should like to quote my former colleague, Dr. Paul W. Brand, distinguished orthopedic surgeon of the Christian Medical College, Vellore, South India. Dr. Brand, in his Hunterian lecture before the Royal College of Surgeons in 1952, called on "orthopedic and plastic surgeons to come forward and open the door that leads the leprosy patient from isolation back to his family and job." Dr. Brand's timely challenge is equally applicable to the ophthalmic profession. With adequate sulfone therapy and timely and appropriate prophylaxis we can prevent much suffering and eliminate needless blindness. With proper medical and surgical management we can conserve eyesight and restore useful vision to patients who were previously considered beyond help.

I know of no better way to express the spirit of treating patients afflicted with leprosy than to quote the inscription on a simply carved wooden screen at Hay Ling Chau Sanatorium off Hong Kong: "Serve others without expecting a reward."

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DISCUSSION

DR. JAMES H. ALLEN. I wish to compliment Dr. Holmes on a beautiful demonstration of some interesting lesions. I have had the privilege of seeing patients at Carville now for several years. It is our impression that there are approximately 2,500 diagnosed cases of leprosy under treatment in this country and there are probably that many or more undiagnosed. The disease is endemic in parts of Florida, Louisiana, Texas, and Southern California, with sporadic cases occurring in all other states in this country. The majority of cases now at Carville are from the southern part of the United States and some of our possessions.

I should like now to show a few additional slides.

Tuberculoid leprosy usually does not produce as many overt ocular lesions as lepromatous leprosy. A form of tuberculoid leprosy is represented here with a skin lesion of the face causing ectropion. This responded very well to sulfone therapy and the youngster now has minimal scarring from that lesion.

In contrast, here is a case of the lepromatous type which has been under sulfone therapy for some time. You can still see the very large lobes of the ears and loss of the brows and lashes. There is scarring of the brow, face, and nose, and extensive scarred lesions of the cornea.

This is a case of nodular episcleritis, which occurs frequently as an acute episode even during general sulfone therapy. I might emphasize that sulfone therapy is very effective in controlling leprosy, but it is not curative. Acute episodes both in the skin and in the eye occur during therapy.

The typical early corneal lesion is superficial punctate keratitis, usually beginning in the superior temporal quadrant and spreading from there to the other quadrants of the eye.

Here is a diffuse superficial stromal keratitis.

Here is a very severe late lepromatous lesion of the cornea.

This is not a lepromatous lesion. It is a complication of tuberculoid and occasionally lepromatous leprosy; exposure keratitis resulting from paralysis of the seventh nerve.

Perhaps the first manifestation of corneal involvement is swelling and opacification of the corneal nerves. These are transitory and may be missed. Later superficial punctate keratitis occurs, and again there may be transitory swelling and opacification of the corneal nerves.

The early lesions in the cornea, consisting of infiltration in the region of Bowman's membrane, are shown by this section.

In persistent and continued involvement of the cornea, foam cells or lepra cells develop, and it is probable that these are responsible for the small, white chalky lesions that we see with the slit lamp in lepromatous keratitis.

It is our impression that bacterial invasion of the eye occurs very early in the disease, although clinical manifestations in the eye do not appear until the patient has had the disease for approximately five years. Leprosy is a chronic, persistent infection, but in addition there are superimposed acute exacerbations. This eye was removed at autopsy during one of these acute exacerbations. Here is the ciliary body showing the acute reaction in addition to the chronic foam cell or lepra cell infiltration, and here is a section of the

ciliary body from a quiescent eye showing only the chronic phase of lepromatous involvement.

The flat portion of the ciliary body, here, shows the grayish lepra or foam cells. On acid-fast staining these are filled with organisms.

Here is an acid-fast stain of a section of sclera showing the enormous number of organisms in one of the scleral nerves.

This is the ciliary body, showing the great numbers of organisms in the foam cells in the chronic phase of lepromatous leprosy.

I should like to add that the ocular lesions usually are quite insidious and painless in onset. Therefore, one must follow the patients carefully in order to find the lesions early enough to prevent serious sequelae.

DR. ARTHUR J. BEDELL. I have had the opportunity to see many cases of leprosy in various parts of the world, but only one in Albany during the past fifty years.

The sixteen kodachromes about to be shown will emphasize the points made in the beautiful pictures of Dr. Holmes and Dr. Allen.

They include absence of eyelashes and fullness of the eyebrow region, infiltration of the corneal stroma, low grade iritis and the suggestive opacity of the cornea as emphasized by the author, advanced lesions of the cornea, shrunken atrophic eyeballs and ulcerations of the cornea, sclera, skin of the eyelids and forehead, almost complete loss of the nose, and even absence of fingers.

The final photograph is one of epidermoid carcinoma of the cornea, which illustrates the need for careful analysis of the corneal changes in the absence of leprosy signs.

DR. BRITTAIN PAYNE. It was my privilege a few years ago to attend a meeting of Pan-Pacific Surgical Association in Honolulu. During that meeting Dr. Holmes presented a program at the leprosarium which was one of the best demonstrations I have ever attended.

Dr. Bedell said that he had seen one leprous patient in fifty years of practice in Albany. When I began my internship at the New York Eye and Ear Infirmary we had approximately six patients who came to the clinic from time to time. At present we have had only one visit of a leper at the infirmary in the past three years. Although leprosy of the eye is an important disease in some parts of the world, we do not have enough material to teach our residents, and therefore should at least make them aware of this disease by photographs. I happen to know that in Manila, soon after the Japanese occupation, the lepers were dispersed throughout the city. After Manila was reoccupied by the American and Filipino forces an effort was made to reestablish San Lazaro hospital in the heart of Manila. After this was done, a good many of the lepers came back voluntarily for their treatment. We were able in July, 1945, to have a program in the hospital to show the effect of four years of nontreatment on these patients.

The treatment of leprosy today, as I understand it, is more advanced and the disease, while not completely curable, can be arrested.

I want to express my appreciation for the unusual amount of work that Dr. Holmes has done and to thank him for bringing a record of it to us this morning.

DR. JOHN M. MCLEAN. We have just been treated to an outstanding series of demonstrations of a disease which in the experience of most of us is extremely rare.

Some years ago, through the courtesy of Dr. Allen, I had the opportunity to visit Carville and to see some of the work that was going on there. That was at the time when cortisone was a brand-new drug, and at that time Dr. Allen was beginning to use cortisone in the treatment of leprosy. Since that time we have learned much about corticosteroids and a great deal about their contraindications.

I wonder if either Dr. Holmes or Dr. Allen could enlighten us further now on the action of adrenocorticosteroids in leprosy, because it might have considerable bearing on the basic action of these agents.

DR. WILLIAM JOHN HOLMES. I am very grateful to Doctors Allen, Bedell, Payne, and McLean for their kind comments.

As to Dr. Bedell's point that the ulcerated areas which he has demonstrated seldom occur, and if they do occur they soon become arrested, that is true today at Carville and in Hawaii. It is not true in Korea, it is not true in India, and it is not true in Ceylon and in other places I visited in Asia, where leprosy is common but sulfone drugs are relatively unavailable in sufficient and regular dosages.

Regarding Dr. McLean's question, cortisone in the treatment of leprosy has helped us tremendously. There are many patients who sooner or later develop sensitivity to sulfone drugs or who develop acute leprous reactions which are attributed to sulfone therapy. By prescribing cortisone concurrently with the sulfones we enable many of these patients to continue taking the sulfones without developing these lesions.

In addition, cortisone has helped us in the local treatment of episcleritis and scleritis.

The monograph on which I based this paper today was primarily prepared for ophthalmologists in Korea, Okinawa, Indo-China, Indonesia, India, South Africa, and other remote parts of the world where physicians treat tens of thousands of patients without modern technics to guide them. If this presentation results in the acceptance of up-to-date, uniform methods of medical and surgical therapy, my purpose will have been successfully accomplished.