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Studies in the Epidemiology and Control of Seasonal Conjunctivitis and Trachoma in Southern Morocco*

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It has been noted in many parts of the world that bacterial conjunctivitis is a major cause of total or partial loss of vision. In addition, trachoma is aggravated if there are associated bacterial infections and these lead to more frequent corneal complications.

In the trials described the seasonal variation of bacterial infections was studied in addition to trachoma in 3 pilot sectors in southern Morocco. The frequency of complications and late sequelae from these infections in the whole population of these sectors was also studied.

In one of the sectors 3 different methods of limiting the regular seasonal increase in bacterial infections and of curing trachoma were evaluated separately or in combination. These included the effect of fly-suppression on the transmission of infection, a possible method of chemoprophylaxis, and intermittent treatment with chlortetracycline ointment.

The effect of the latter, when applied to a whole population group by auxiliary personnel, was compared with the long-term effect of self-treatment, in this and the two other sectors.

The total observation period covered 12 years.

INTRODUCTION

The south of Morocco has only recently come in contact with western civilization; conditions are still largely the same as centuries ago and change is very slow.

In the last 30–40 years, however, important progress has been made in the fight against some common epidemic diseases. The great epidemics of typhus, smallpox and plague no longer occur and many other epidemic and endemic diseases have decreased sharply.

Only recently have the problems of communicable eye diseases been considered in health policy planning for the south. The expansion of this health policy was made possible by national activities, international co-operation and new developments in chemotherapy and antibiotic therapy.

The south of Morocco, or more correctly the south-eastern region, is mainly desert and is very different in character from the rest of the country. It is separated from the north-west by the Great Atlas

* The design of the Goulmima survey and clinical trials carried out between 1953 and 1956 was a collective project in which Dr F. Maxwell-Lyons, then of the WHO Regional Office for Europe and consultant to the project, was assisted by the late Dr Satya Swaroop, Chief, Health Statistical Methodology, World Health Organization, Geneva, Switzerland. All field examinations were made and data recorded by Dr J. Reinhards, then WHO Project Officer. The data were tabulated, systematized and analysed by Dr A. Weber.

In later surveys (after 1960) the design of the study was made by Dr K. Kupka, then WHO Adviser in Health Statistics and Epidemiology, assisted by Dr B. Nižetič, WHO Project Ophthalmologist, and Dr J. Reinhards. All field examinations after 1960 were made and recorded by Dr B. Nižetič. These data were tabulated and analysed by Dr K. Kupka assisted in computations by Mr Abolfazli, WHO Statistician.

Parts of the text of the introduction and of various chapters, although written by one or other of the authors in charge, are largely the result of mutual consultations, comments and adjustments in which all named authors have taken part.

Some of the more recent data from Goulmima and Skoura are taken from a thesis by K. Kupka, entitled "A study of Trachoma in Villages of South Morocco" presented at the University of Pittsburgh, 1965.

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Mountains (Fig. 1). The climate is harsh, very hot and dry in summer, but cold and more humid in winter.

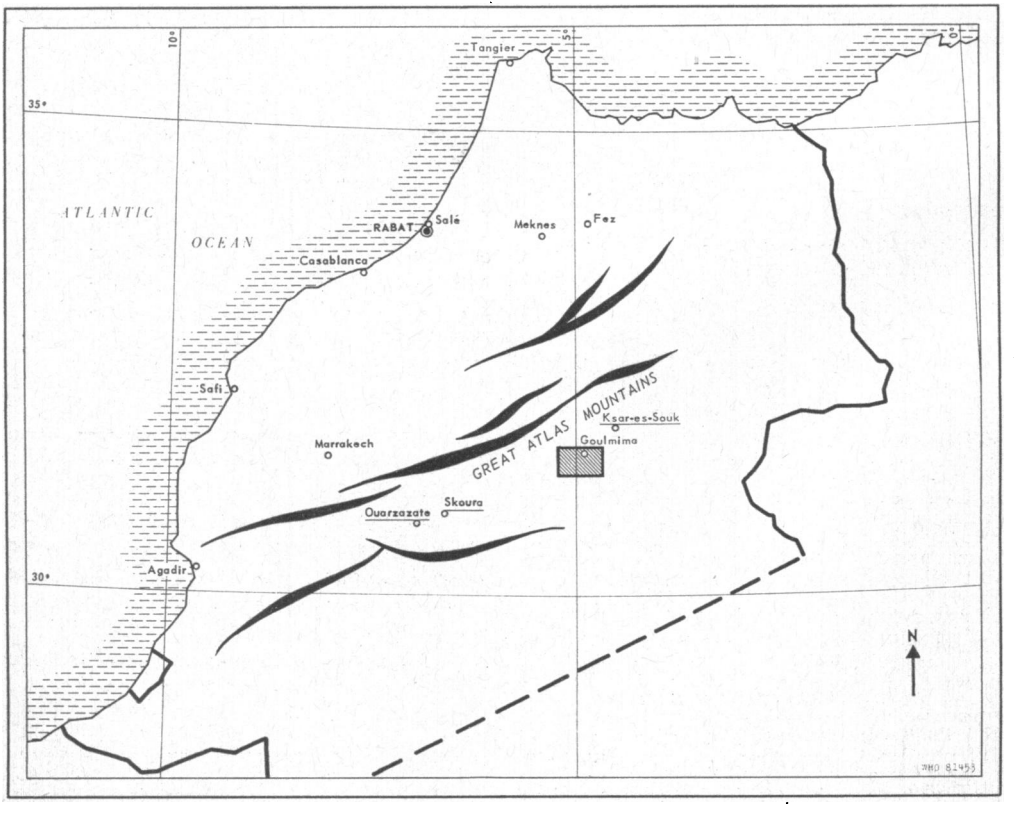
According to a census in 1960 Morocco had 11 626 000 inhabitants, or about 27 persons per km². Some 74% of the population is rural, with 52% under 20 years of age and only 4% over 65 years old (Morocco, 1963). The south is much more sparsely populated than the north with no more than 6 persons per km². The presence of nomads (2%–3%), however, makes it difficult to establish reliable figures. The people inhabit for the most part the mountain valleys where the streams usually ensure an adequate water supply. Except for the nomads most people live in villages or *ksour*; sanitary conditions are bad everywhere.

Very little information was available on trachoma and seasonal conjunctivitis in Morocco before the surveys and mass campaigns, to be described here, were started in 1952. Sakon & Accart (1938) claimed an almost constant prevalence of trachoma of 100%, in 1938, in Tafilalet; Pagès (1949) reported a prevalence between 50% and 100%. Decour (1955) mentions 3% trichiasis in the pre-Sahara. A survey of the blind carried out in 1953 by Jung (1960), with the aid of the civil authorities, showed that 27 879 out of 7 442 110 estimated Moslem inhabitants of the country were blind, that is, 3.75 persons per 1000. Slightly higher rates were found in the south and the figures are thought to be an underestimate of the position.

In 1952 practically all of the people were infected with trachoma in the first months of their life (Reinhards, 1954) and every year almost all were affected by bacterial conjunctivitis. In Morocco, as in other countries in North Africa and the Middle East, the

FIG. 1

GOULMIMA, SKOURA AND OUARZAZATE EXPERIMENTAL AREAS [a] IN MOROCCO



[a] See Fig. 2 for details of shaded area.

seasonal rise and fall in the incidence of bacterial conjunctivitis was closely correlated with seasonal fluctuations in fly breeding (Wilson, 1931–1937, 1945; Pagès, 1951) because of the complete lack of sanitary measures to dispose of human and animal excreta on which the flies breed (Ponghis, 1957).

Epidemic conjunctivitis has been attributed chiefly to *Haemophilus* bacilli. Sporadic cases of gonococcal infection of the eye occur, usually in autumn, and sometimes lead to small localized epidemics. It is suspected that more widespread gonococcal epidemics occurred in the past with the coincidence of certain favourable climatic and other environmental factors. Thus, in some districts, numerous leucomata could be related to a " bad year " when, according to local accounts, " many eyes were lost ".

In general the magnitude of seasonal epidemics depends on the following factors:

(1) the reservoir of bacterial carriers;

(2) the abundance of flies during major breeding seasons;

(3) the direct influence of climatic conditions on fly breeding and possibly indirectly on the virulence of the organisms;

(4) the lack of personal hygiene of the population; and

(5) the presence or absence of rational treatment.

The second and third of these factors usually affect the course of the epidemic from May to December, while the first and the fourth exercise a permanent influence.

Seasonal conjunctivitis was by far the most frequent cause of total blindness for the country as a whole. Many ulcers occurred in the second half of the season, less often with Koch-Weeks conjunctivitis but frequently with gonoblennorrhoea. Perforations were relatively frequent, resulting in total or partial adherent leucomata, secondary glaucoma, staphyloma or phthisis bulbi. Moreover the bacterial infections have further disastrous effects in that they facilitate the transmission of trachoma, prolong its course and aggravate such complications as pannus and excessive cicatrization of the conjunctiva with its sequelae: entropion, trichiasis and xerosis.

The unfortunate, widespread co-existence of these 2 infections resulted in a continuous evolution of trachoma throughout life leading, in a very high percentage of cases, to progressive loss of vision.

Wilson (1945) provided circumstantial evidence that the trachoma agent may be transmitted in the infective discharge of conjunctivitis and it was considered important to check this point in field trials in this country.

Studies carried out in 1952–54 established the fact that in south Morocco the prevalence of both trachoma and seasonal conjunctivitis was high and that both assumed a grave form resulting in high incidence of impaired vision. In the south 18 years ago, no solution could be envisaged to this problem. In countries where trachoma and seasonal conjunctivitis are prevalent it is well known that hospital and dispensary services have generally failed to reduce the incidence of communicable eye diseases, although they may have done much to reduce individual suffering and the incidence of blindness.

Because of the insidious onset of trachoma in early childhood and the relative absence of subjective symptoms in the early stages, the children and their parents are unaware of their illness. Usually only those suffering pain and loss of sight attend hospitals and dispensaries. Persons suffering from conjunctivitis are very often satisfied with the immediate symptomatic relief given by modern treatment, and few of them continue the treatment until cured of the underlying trachoma. It is also well known that treatment of a few individual cases cannot change the natural course of an epidemic of conjunctivitis in a community.

As early as 1950, experimental work was conducted in Morocco to find a suitable mass-treatment method (Bardon, 1953; Bidart & Racoillet, 1953; Ferrand & Parlange, 1951; Ferrand & Soyer, 1953; Gaud, 1949; Gaud & Decour, 1951; Gaud et al., 1950; Pagès, 1938, 1950a, 1950b).

Information on the environmental conditions favouring seasonal conjunctivitis and trachoma infection was available from other countries with similar problems (Wilson, 1945; Maxwell-Lyons, 1953). It has long been recognized that in regions like North Africa and the Middle East, where trachoma and seasonal conjunctivitis co-exist, control measures must be directed against both. In 1952 it was decided that economically feasible mass-treatment methods based on this principle could be applied in Morocco, the importance of environmental sanitation and health education being taken into account.

During 1952 and 1953 a joint programme of work was developed for a mass campaign with the participation of the Government of Morocco, WHO and

UNICEF. Within the project area, 3 experimental sectors were designated: Skoura in 1952, Ouarzazate in 1953, and Goulmima in 1954. The experimental sectors were used for epidemiological investigations and for the continuous development of simpler, more effective and more economical methods and schedules of mass-treatment.

During the years 1954–58, large-scale clinical trials were carried out in schools in the cities of Marrakech and Meknès and in the rural areas of Tiznit to determine the effects of a single antibiotic, chlortetracycline, on trachoma, when administered locally according to different treatment regimens (Reinhards et al., 1959). Having established the superiority of the "intermittent" over the "continuous" schedule of treatment, further trials were conducted, on a smaller scale, to test the relative efficacy of chlortetracycline and tetracycline; the latter proved slightly better. A study of cure rates in young, preschool children was also carried out to establish a base-line for later assessment of induced drug resistance, if any.

After 1953 the mass-treatment campaign was extended (as described later on p. 519) and by 1960 covered nearly the whole of the south and also parts of the country north of the Atlas Mountains with known high prevalence of trachoma. In addition, after 1954, collective treatment was introduced in schools covering an increasing number of children each year; by 1960 treatment was given to all first- and second-grade pupils and in 1966 treatment was also given to third-grade pupils. The numbers of people treated are shown in Table 1.

Although the magnitude of the trachoma problem was obvious from the beginning the shortage of personnel precluded a detailed study of local differences in prevalence, distribution and gravity of the disease and the role of associated infections, except in the experimental sectors mentioned above. The resulting lack of base-line data on the south as a whole has made difficult the evaluation of the results of the mass campaign.

Because of these difficulties large-scale sample surveys have been conducted since 1961. These studies used proper sampling techniques and were designed to assess as accurately as possible the changes that had occurred in the level of communicable eye diseases as a result of the introduction of control measures. These data will also provide a sound basis for evaluation of future surveys. Some factors possibly related to the spread and evolution of trachoma were also studied.

TABLE 1

APPROXIMATE NUMBERS OF PEOPLE (ALL AGES AND SCHOOLCHILDREN) TREATED IN THE MASS-TREATMENT CAMPAIGN

Year	No. treated	
	All ages	Schoolchildren
1953	120 000	—
1954	235 000	30 000
1955	535 000	42 000
1956	835 000	46 000
1957	1 035 000	150 000
1958	1 290 000	200 000
1959	1 490 000	300 000
1960	1 690 000	340 000
1961	1 700 000	449 000
1962	1 700 000	570 000
1963	2 200 000	500 000
1964	2 700 000	700 000
1965	3 000 000	600 000
1966	3 500 000	about 1 000 000

The present paper contains a brief account of the data collected in the early phase, 1952–55[1] and some of the results of the 1961–66 sample surveys. These data may be useful in the planning of similar field studies or control operations.

In the earlier phase the most extensive work was done in the sector of Goulmima in 1954–55, where the epidemiology of seasonal conjunctivitis and trachoma were studied in considerable detail, and these results are reported first. Control measures that had given good or promising results in earlier trials in Egypt (Maxwell-Lyons & Amies, 1949), Morocco (Decour, Ferrand & Reinhards, 1954) and elsewhere were compared in order to determine their relative merits when used singly or in combination and to assess their applicability in a mass-campaign.

Unfortunately it was not possible to continue the trials on this extensive scale for more than one season. Later in this paper an account is given of similar but smaller, and less detailed, experiments conducted in Skoura and Ouarzazate which were continued for a longer period.

[1] Detailed data and a more complete bibliography can be obtained from the WHO Regional Office for Europe, Copenhagen, Denmark.

2. FIELD STUDIES IN GOULMIMA, 1954–55 AND 1964–66

The studies in Goulmima conducted in the period of 1954–55 had the following aims: (1) to collect information on the epidemiology of trachoma and on the seasonal variation in bacterial conjunctivitis; (2) to assess the socio-economic importance of these infections in terms of the frequency and degree of loss of vision; and (3) to develop control measures that would be effective, practicable and economically feasible on a large scale.

METHODS AND PROCEDURES

Three control measures were tested—namely, fly-suppression, chemoprophylaxis, and intermittent antibiotic treatment.

Fly-suppression. Suppression of flies was maintained from June to November by means of repeated spraying of insecticides in the chosen villages. This treatment provided the means to confirm the role of flies in transmitting acute conjunctivitis, and to see whether, by controlling fly-breeding, an appreciable reduction in the incidence of this disease could be obtained. It has long been suspected that in certain regions, for example, in the Middle East and North Africa, the common fly is an important agent in spreading infectious eye diseases. Experiments in Egypt and Morocco have given support to this view without proving it conclusively.

Because the inevitable development of resistance to available insecticides was fully recognized, long-term fly control was not expected from the methods used. This is considered to be possible only by improved general sanitation, composting procedures, etc. The techniques of fly-suppression and methods of study have been reported by Ponghis (1957). In the present paper only the results are considered.

Chemoprophylaxis. The method consisted of collective treatment, with systemic sulfonamides, of the whole population for 4 consecutive days at the beginning of the season of epidemic conjunctivitis. The purpose of this mass treatment was to eliminate, at the beginning of the fly-breeding/epidemic period, the problem of the large number of pathogen carriers that persists during interepidemic periods. The compound sulfonamides, sulfadiazine, sulfathiazole, and sulfamerazine, were used in equal parts in the following daily doses: first day—75 mg per kg body-weight (estimated); second, third and fourth days—50 mg per kg body-weight. The daily doses were given in 2 parts.

Intermittent antibiotic treatment. The third method consisted of collective treatment of the whole population with 1% chlortetracyline ointment applied locally to the eyes, twice daily, on 3 consecutive days, and repeated at regular monthly intervals throughout the season of epidemic conjunctivitis, i.e., June–November. This control measure had been used in Morocco in all previous mass-campaigns.

The effects of the above 3 methods when applied singly or in different combinations were recorded and the results were analysed for possible interactions. A factorial design of experiment was adopted.

The design of the experiment also included control units. The inhabitants in the control units were, of course, not completely without medical help. They were able, as before, to obtain assistance at a rural hospital about 25–28 km away, and at 2 small dispensaries in the experimental sector. They could also obtain certain doubtful remedies from the local witch-doctors or from itinerant unqualified practitioners. For humanitarian reasons, it was decided that during the regular monthly surveys (see below) treatment should be given to any person found to be suffering from severe conjunctivitis with imminent risk of corneal complications. These represented only a small proportion of all cases of conjunctivitis occurring during the month and it is considered that the treatment of a few such cases could have little or no effect on the development of an epidemic.

However, in order to counterbalance any possible effect, the same practice was adopted in the villages where fly-suppression and chemoprophylaxis were applied. The so-called " untreated " units were, therefore, not controls in the absolute sense of the word, but represented very nearly the natural conditions.

Besides the " control " units there were 7 other units in which different schedules resulting from all combinations of the three control measures were applied and which will be referred to hereafter by the following symbols:

Fly-suppression	F
Intermittent chlortetracycline treatment	I
Prophylactic treatment with sulfonamides	S
Fly-suppression + chlortetracycline	FI
Fly-suppression + sulfonamides	FS
Chlortetracycline + sulfonamides	IS
Fly-suppression + chlortetracycline + sulfonamides	FIS
Untreated controls	C

The village formed the natural unit for the allocation of the above regimens. Most villages in southern Morocco have between 300 and 1300 inhabitants and the aim was to use units of about 600 to 800 persons. It was sometimes necessary to group 2 or more small neighbouring villages in order to form 1 unit of this size. In 2 of the units which were too large to be examined on the same day, a sample of 150 families was chosen at random for the trials: the rest of the population in those villages was treated according to the same schedule but was not taken into account in the evaluation.

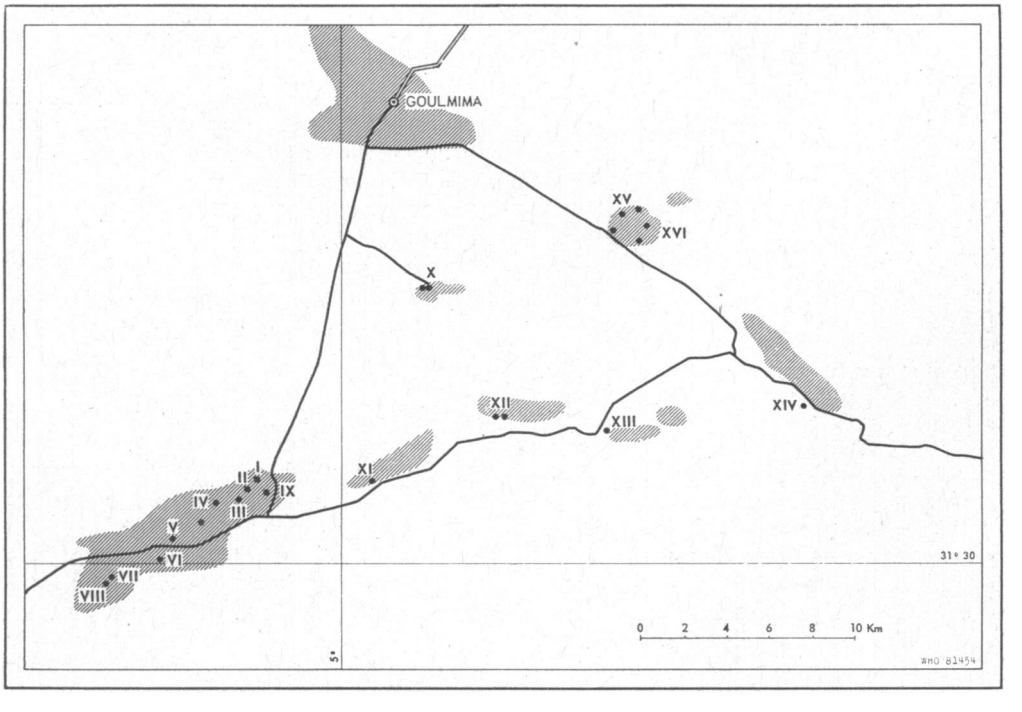
A block of 8 units was necessary in order to apply all the above-mentioned treatments and include a control unit. The repetition of the same treatments in another block of 8 units was considered as the minimum requirement. Sixteen units were therefore used as shown in Fig. 2.

All inhabitants of the chosen villages were examined for the presence of conjunctivitis at the beginning of the survey, and again once every month until November 1954, and the results were entered each month in a special register.

Material for bacteriological study was collected at the time of the clinical examination. In each unit a random sample of 160–180 children of 0–8 years of age was selected. Scrapings were taken with a blunt platinum spatula from one eye of each child, separately from the upper tarsal conjunctiva, from the inner angle of the lids and from the outer canthus, and put side-by-side on one slide. In cases of unequal symptoms, scrapings were taken from the eye with the worse condition. The slides were then stained (Gram) and examined in a central laboratory for at least 10 minutes each. Because of the great distances and difficulties in communication between the study area and the laboratory and of the large number of cases involved, it was impossible to use culture techniques.

FIG. 2

GOULMIMA EXPERIMENTAL AREA, SHOWING THE LOCATION OF THE 16 TREATMENT UNITS



Using a binocular loupe for examination, the clinical signs of trachoma were recorded—on the then standard WHO Individual Record Card for Trachoma—for each child subjected to bacteriological examination, on 3 occasions: (1) at the first examination before treatment in June 1954, (2) at the sixth cycle of treatment in November 1954, and (3) at the beginning of March 1955 about 3 months after the termination of active operations.

The presence of complications and sequelae of conjunctivitis and trachoma, diminishing and endangering vision, was recorded each month for the whole population.

An estimate of the age of each subject had to be made by the clinician. This was relatively easy in the case of children, but was less precise for adults and old people.

In order to avoid variations from one observer to another, it was decided that one ophthalmologist should be responsible for all examinations and clinical records in all 16 units.

The design of the experiment permitted the collection of epidemiological data on the prevalence, distribution, complications, and socio-economic importance of trachoma and associated infections from all communities under study in the experimental sector before control measures were applied, and also from control villages during the entire period of the study. Studies on the seasonal variations in bacterial infections of the conjunctiva were carried out by repeated surveys in untreated communities.

RESULTS

The population of the 16 units was registered in 4 age-group categories as shown in Table 2.

TABLE 2
AGE-GROUP CATEGORIES OF PERSONS REGISTERED

Category	No.	%
Children less than 2 years	775	6.6
Children between 2 and 8 years old	2 725	23.2
Children between 9 and 15 years old	1 708	14.6
Adults (16 years and over)	6 522	55.6
Total	11 730	100.0

This age-grouping was used in all the earlier surveys in Morocco. Only later, following the recommendations in the third report of the WHO Expert Committee on Trachoma (1962), was more rational grouping introduced. The small number of infants seen was probably due to the fact that parents were reluctant to present them at treatment sessions.

Although the sex of children was registered, it was found unnecessary to group them separately, as no sex difference in morbidity was found in children up to 8 years of age.

Seasonal conjunctivitis

Initial examination. The initial examinations, of 9439 persons in the 16 units, for sub-acute or acute bacterial conjunctivitis [1] in June 1954, i.e., before any treatment was administered, showed that the prevalence of conjunctivitis was greater in small children and that, in general, it decreased with increasing age as shown below and also in Table 3:

	Percentage with Co.2 or Co.3
Children below 2 years of age	68.0
Children between 2 and 8 years	32.0
Children between 9 and 15 years	6.1
Adults (15 years old and over)	4.6

The bacteriological findings from the first examination of the sub-sample of the children 0–8 years old showed the following:

	Percentage with positive slides
Haemophilus	81.0
Moraxella	20.1
Pneumococci	19.0
Neisseria	0.4
Corynebacterium xerosis	9.0
Staphylococci	2.7
(No organisms found on the slide)	(10.0)

It is to be noted that the prevalence of sub-acute and acute conjunctivitis and the percentage of slides positive for the different organisms under study

[1] Classification of clinical types of conjunctivitis used in all trials in Morocco was:
Co. 0 = no clinical signs of bacterial conjunctivitis
Co. 1 = mild or doubtful conjunctivitis (hyperaemia and no more than a small bead of exudate in the conjunctival sac)
Co. 2 = sub-acute conjunctivitis (purulent or mucopurulent exudate without marked oedema of the tissues)
Co. 3 = acute conjunctivitis (purulent or mucopurulent exudate with marked oedema of the tissues)
M-A Clin = clinical signs of Morax-Axenfeld type "angular" conjunctivitis.

TABLE 3

PERCENTAGE OF THE POPULATION SUFFERING FROM ACUTE OR SUB-ACUTE CONJUNCTIVITIS (Co.2 OR Co. 3) IN PAIRS OF VILLAGE UNITS UNDER DIFFERENT TREATMENTS

Treatment	Date of examination						
	June 1954	July 1954	Aug. 1954	Sept. 1954	Oct. 1954	Nov. 1954	March 1955
Children under 2 years of age							
C	70.0	62.6	48.1	65.2	77.2	79.4	52.8
F	76.1	64.8	50.5	60.4	62.8	50.2	40.6
I	83.8	37.8	32.6	28.4	35.4	56.5	31.3
S	58.2	33.2	29.4	39.2	45.4	57.5	29.9
FI	65.2	26.6	25.3	31.0	42.2	43.4	20.7
FS	61.5	33.4	24.0	36.1	36.9	40.1	29.0
IS	55.3	28.2	20.5	37.6	32.2	29.1	11.2
FIS	69.4	30.1	15.4	16.8	19.4	28.9	12.0
Children from 2 to 8 years of age							
C	27.4	28.5	23.8	26.7	27.5	36.2	14.1
F	35.7	25.4	13.6	21.3	19.7	24.9	15.6
I	41.7	7.4	5.4	8.1	5.9	18 6	8.2
S	28.0	2.8	3.4	4.6	8.8	14.8	12.2
FI	24.2	8.0	4.8	4.6	8.4	9.5	3.8
FS	37.9	7.8	3.2	2.3	10.8	10.2	6.0
IS	25.1	3.0	4.1	6.0	4.7	6.0	2.8
FIS	37.1	4.9	0.6	2.0	4.8	4.2	1.0
Children from 9 to 15 years of age							
C	7.6	10.9	5.2	14.8	10.6	13.8	2.8
F	10.4	13.4	5.6	13.6	1.3	0.9	2.2
I	6.0	0.8	0.0	2.8	1.1	0.9	0.0
S	5.6	0.0	0.8	0.8	0.4	3.4	0.5
FI	6.1	2.4	0.6	0.0	0.6	1.1	0.0
FS	14.5	0.4	0.4	1.8	0.6	1.6	0.0
IS	3.9	0.0	1.2	1.1	0.6	0.4	0.0
FIS	5.4	0.0	0.6	1.2	0.0	0.0	0.0
Adults							
C	4.8	5.8	4.2	3.8	5.7	7.6	0.4
F	6.2	7.6	4.9	4.4	0.6	1.8	2.0
I	2.8	0.7	0.4	0.8	0.6	0.7	1.0
S	3.3	0.6	0.8	1.8	0.8	1.2	1.8
FI	3.2	2.5	0.8	1.2	0.2	0.4	0.7
FS	6.9	0.9	1.2	0.4	0.8	1.5	1.4
IS	5.0	1.2	1.6	0.6	1.4	0.8	0.0
FIS	6.0	0.3	0.6	0.6	0.8	0.7	0.2
Total population							
C	15.7	17.0	12.8	15.3	16.4	20.4	7.2
F	18.6	16.6	10.2	13.8	9.3	10.8	8.3
I	18.0	4.8	3.8	4.8	4.1	8.6	4.6
S	14.4	3.6	3.4	4.8	5.4	8.3	6.0
FI	13.4	6.0	3.4	3.8	5.2	5.8	2.8
FS	21.7	5.2	3.1	3.4	5.6	6.4	4.4
IS	13.5	3.4	3.6	4.2	4.1	4.0	1.4
FIS	19.0	4.1	1.8	2.4	3.2	3.5	1.4

varied considerably between the 8 pairs of units subjected to the different treatment schedules.

Before any treatment was given, the proportion of organisms associated with acute or sub-acute conjunctivitis was determined, as shown in Table 4.

With the exception of *Neisseria*, which was rarely encountered, a higher proportion of children with *Haemophilus* positive slides, either alone or in association with other organisms, had sub-acute or acute conjunctivitis than was the case with other organisms. A higher proportion of cases with Co.2 or Co.3 was encountered among children positive for the combination *Haemophilus* + pneumococcus than in cases positive for other combinations or for *Haemophilus* alone. The combination *Haemophilus* + *Moraxella* gave the lowest proportion of cases with Co.2 or Co.3. There appeared to be no difference between the proportion of cases with Co.2 or Co.3 among cases having slides positive for other organisms and those with negative bacteriological findings.

In a number of cases with acute or sub-acute conjunctivitis no organisms could be detected on the slides. The reason for this may lie in the limitations of the techniques employed, either because in cases of conjunctivitis of advanced stage we failed to collect the organisms on the slide, or because they were so few and escaped detection.

Negative findings should be regarded with caution unless several samples from the same person are examined. For practical reasons this was not possible in our study. In the absence of any facilities for serological studies it was impossible to estimate the possible importance of viral infection. Failing other evidence, however, the fact that throughout Morocco so very few cases of conjunctivitis failed to respond to treatment with antibiotics would suggest that such infections were uncommon.

Repeat examinations in control villages. The prevalence of clinical sub-acute and acute conjunctivitis in the untreated control communities during the whole period of observation showed clearly that the epidemic was much more marked in younger children and that its magnitude decreased with increasing age. The prevalence of conjunctivitis was high in the months of June and November with a drop in August. In the following March the conjunctivitis rate had fallen considerably for all age-groups, except children under 2 years of age, where the level remained relatively high, as shown in Fig. 3. This confirms previous observations that conjunctivitis is prevalent among very young children in southern

TABLE 4

RELATION BETWEEN CASES OF SUB-ACUTE OR ACUTE CONJUNCTIVITIS AND THE RESULTS OF BACTERIAL EXAMINATION BEFORE TREATMENT STARTED

Organisms	Cases with positive bacteriological findings	Conjunctivitis cases (Co. 2 or Co.3)	
		Number	Percentage
Haemophilus alone	1 142	522	46
Haemophilus + pneumococcus	248	154	62
Haemophilus + *Moraxella*	195	73	37
Haemophilus + pneumococcus + *Moraxella*	91	43	47
Haemophilus + *Corynebacterium xerosis*	71	36	51
Haemophilus + others [a]	67	30	45
All combinations including *Haemophilus*	672	336	50
Pneumococcus alone	27	10	37
Moraxella alone	90	22	24
Combinations not including *Haemophilus*	34	8	23
No organisms found	227	75	33

[a] " Others " include the following combinations:
Haemophilus + pneumoccus + *Corynebacterium xerosis;*
Haemophilus + *Moraxella* + *Corynebacterium xerosis;*
Haemophilus + *Moraxella* + pneumoccus + *Corynebacterium xerosis.*

Morocco at all times of the year, reaching a peak incidence during the summer and autumn months.

The bacteriological findings in the untreated control villages showed that *Haemophilus* was encountered among children in 82%–96% of cases, except in March when it was found in 62% of cases. *Moraxella* and pneumococci were found in progressively increasing numbers through the control period. *Neisseria* appeared in a few cases in November and March only.

It was observed that the frequency of conjunctivitis among cases giving positive slides for *Haemophilus* decreased during June and July and reached a minimum at the end of August; it then increased very rapidly, reaching 84% in November (Table 5). Where *Haemophilus* was found in association with other organisms, the percentage of cases with clinical conjunctivitis did not increase to the same extent during cycles 4–6. Whether alone or in association with other organisms the percentage of cases showing *Haemophilus* and clinical conjunctivitis was low in March 1955.

Pathogenic organisms other than *Haemophilus* occurred in such small numbers that it is impossible to draw any conclusion on the possible seasonal variation in their association with clinical conjunctivitis.

In more than 90% of the cases of sub-acute and acute conjunctivitis *Haemophilus* was found in the scrapings. This percentage was slightly lower in March 1955, as shown in Table 5.

Repeat examinations in treated villages. The percentage of sub-acute and acute conjunctivitis found in all 16 village-units during the whole observation period showed that the epidemic was more severe in small children than in other age-groups and the need to undertake analysis for each age-group clearly emerges (Weber, 1960). The full results are shown in Table 3, and those for age-groups 0–2 years and 2–8 years graphically in Fig. 3.

A separate analysis of variance of the percentage of Co.2 and Co.3 for each of the 6 monthly examinations and for each age-group, i.e., 24 analyses, showed that 4 comparisons gave significant values during the period of study:

(1) main effect of fly-suppression,

(2) main effect of intermittent treatment,

(3) main effect of sulfonamides,

(4) interaction between intermittent treatment and sulfonamides.

FIG. 3

EFFECT OF DIFFERENT TREATMENTS ON THE PREVALENCE OF CLINICAL SUB-ACUTE AND ACUTE CONJUNCTIVITIS IN GOULMIMA, 1954

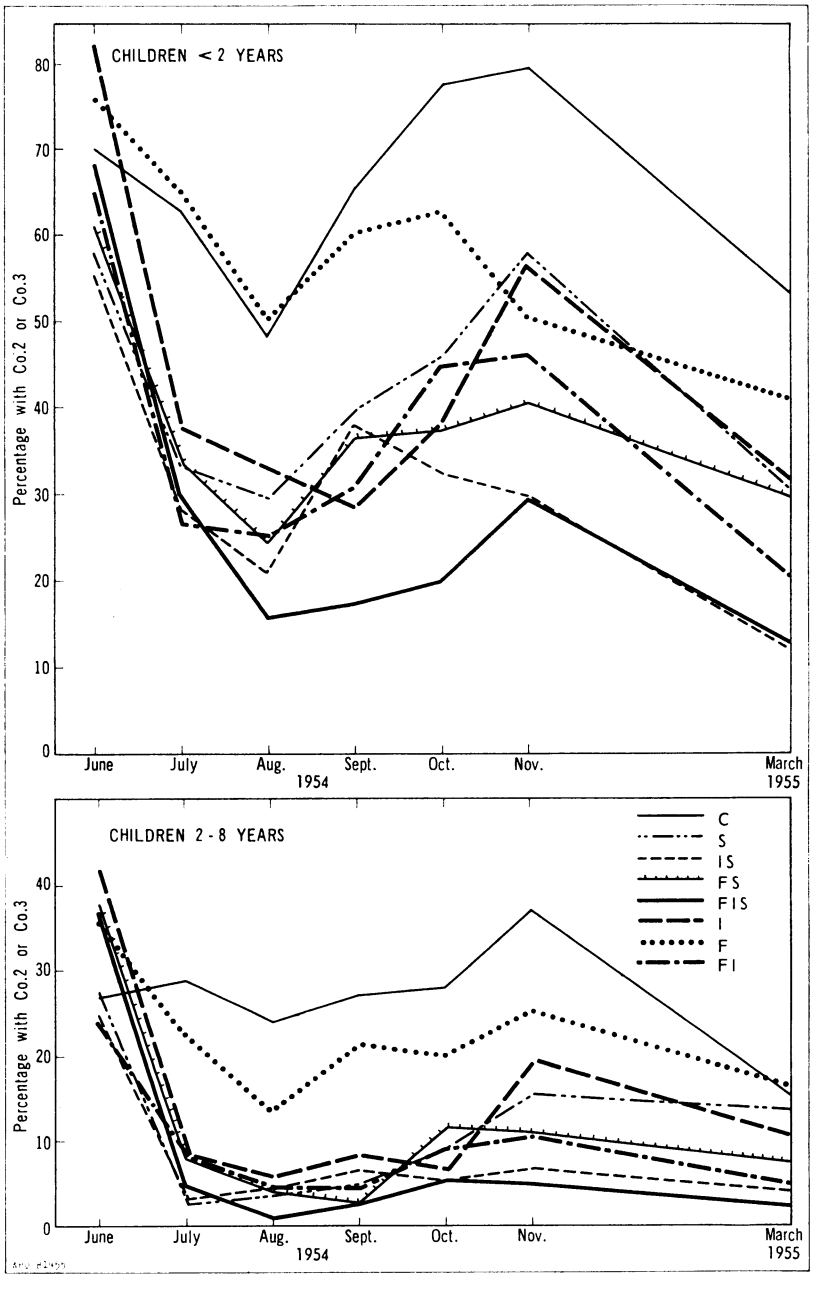


TABLE 5

RELATION BETWEEN CASES OF SUB-ACUTE OR ACUTE CONJUNCTIVITIS AND THE RESULTS OF BACTERIAL EXAMINATIONS IN THE CONTROL VILLAGES

Examination		Percentage of bacterioscopical *Haemophilus* positives associated with clinical acute or sub-acute conjunctivitis		Percentage of clinical acute or sub-acute conjunctivitis associated with bacterioscopical *Haemophilus* positives
Cycle no.	Date	*Haemophilus* alone	*Haemophilus* + others	
1	June 1954	44	48	91
2	July 1954	39	36	98
3	August 1954	30	33	95
4	Sept. 1954	45	35	90
5	Oct. 1954	62	37	99
6	Nov. 1954	84	46	96
Re-examination	March 1955	33	28	84

The results can be summarized as follows:

(1) Fly-suppression had a progressive effect shown by a progressive decrease in the percentage of Co.2 and Co.3 in comparison with units without fly-suppression (F *versus* C, FI *versus* I, FS *versus* S, FIS *versus* IS). This effect became significant at the fourth cycle in the group of children between 2 and 8 years of age and at the sixth cycle in all age-groups excepting children between 9 and 15 years of age.

During the last 3 examinations all comparisons showed that units under fly-suppression had on average less conjunctivitis than the corresponding ones without fly-suppression.

(2) Intermittent treatment. At the second examination intermittent treatment already showed a large reduction in the percentage of Co.2 and Co.3 and the effect persisted during the following cycles.

(3) Sulfonamides. At the second examination the reduction in sub-acute and acute conjunctivitis resulting from chemoprophylaxis was greater than that from fly-suppression or intermittent treatment, except in the younger age-groups. The beneficial effect persisted during the whole period of study but showed a slight decrease in the last 2 examinations.

(4) Interaction between intermittent treatment and sulfonamides. From the second to the fifth examination all interactions were of the same sign and indicated that the reduction in conjunctivitis due to the combined action of intermittent treatment with sulfonamide was not as high as the sum of the effects of the 2 treatments applied separately.

In March 1955 acute conjunctivitis (Co.3) had practically disappeared. The prevalence of sub-acute conjunctivitis (Co.2) was still high. In control units more than half of the children under 2 years had Co.2. The prevalence was lower in the other age-groups.

The differences between the units under the different treatment schedules are shown in Fig. 3 and can be summarized as follows:

(1) a large reduction in conjunctivitis was still observable in units subjected to intermittent treatment. The differences for the 4 age-groups were significant at the 1% level;

(2) a reduction of the percentage of conjunctivitis was still present in units treated with sulfonamides; the difference was significant at the 1% level for all the age-groups except adults; and

(3) no significant residual effect from fly-suppression was noted during this examination.

The interaction between intermittent treatment and sulfonamides may be neglected, as it was small in the 2 lower age-groups, while in the other 2 it was in one case positive and in the other negative.

In children under 2 years of age in units subjected to intermittent treatment, the reduction in conjunctivitis found in the sixth examination was maintained

until March 1955 in the absence of further treatment.

Angular conjunctivitis, of the Morax-Axenfeld type, was observed clinically less frequently in young children than in older persons. The observed cases were often grouped in certain families, where old and young alike were suffering. A great difference was observed in the frequency of this condition from village to village. The number of sufferers was small at the beginning of the observation period and increased later, the majority of cases being seen from September onwards.

It was not possible to detect any influence of fly-suppression or sulfonamides on angular conjunctivitis during the observation period. Intermittent treatment appears to have prevented the seasonal increase and even to have decreased the number of sufferers during October and November. After the discontinuation of intermittent treatment, the rate increased again in March 1955.

Bacteriological considerations in repeat examinations. As regards bacteriological findings *Haemophilus* was most frequently encountered. *Moraxella* and pneumococcus were uncommon at the outset but increased during the period of observation. *Neisseria* was rare: only 44 positive slides were found, or 0.3% of the total number of slides examined.

Corynebacterium xerosis was seldom found during the first examination, i.e., before treatment was commenced, but was frequently encountered in the autumn, specially in units where treatment had decreased the incidence of *Haemophilus*. Staphylococci were not frequent: 466 positive slides were found, or 2.9% of the total.

A separate analysis was made for each of the pathogenic organisms with the exception of *Neisseria* which rarely occurred. The results for all children up to 8 years of age are summarized in the following paragraphs. However, these results, which are for all children up to 8 years of age, are open to serious criticism because of the variation of the epidemic with age and the relatively poor results of sulfonamide administration in young children.

Haemophilus was present in the control units in 87% of the total number of slides taken throughout the whole period of examination.

Fly-suppression and intermittent treatment were followed by a significant reduction in the percentage of *Haemophilus*. The main effect of fly-suppression increased steadily from examination to examination. The main effect of intermittent treatment was the largest of all 3 regimens. For the sulfonamides treatment the analyses do not show any strong effect on the frequency of *Haemophilus* when comparing the first and subsequent examinations. The analysis revealed large interactions between intermittent treatment and sulfonamides: the reduction in the percentage of *Haemophilus* was much larger when the 2 treatments were combined although the reduction was delayed until after the second examination. The nature of the other interactions found, for instance between fly-suppression and intermittent treatment or between fly-suppression and sulfonamides, seems to be more complex and requires further investigation.

The percentage of *Moraxella* found during the first examination was not high, averaging about 20% for all examinations in all units. The prevalence increased in autumn in all the units, reaching a maximum of 65% in the control units during October and November. The only main effect, which is significant at the 5% level, is that of intermittent treatment which can be considered as progressive. As in the case of *Haemophilus*, the effect of intermittent treatment on the prevalence of *Moraxella* was delayed and appeared only after the second examination. A significant interaction between fly-suppression and intermittent treatment was observed. In units subjected to fly-suppression the seasonal increase in frequency of *Moraxella* was less than in the 8 other units; the difference, however, was not significant at the 1% level.

Pneumococci were not frequent at the time of the first examination, averaging about 19% for all units. This number increased in all units in spite of treatment and reached a maximum at the beginning of November with about 58% in the control units.

At the 5% level, no single operation had a significant effect on the natural increase of pneumococcus. The number of pneumococcal infections, however, was smaller in the 8 units subjected to intermittent treatment than in the other 8 units. This difference was still significant at the 10% level.

In March 1955 the prevalence of *Haemophilus* infection had fallen to 62% in the control units as against an average of 87% in the epidemic period. *Moraxella* and pneumococcus infections were still at levels comparable with those at the sixth examination.

In the 8 units with fly-suppression the frequencies of *Haemophilus*, *Moraxella* and pneumococcus infections were lower than in the other 8 units. None of

these differences, however, was large enough to be statistically significant. In the 8 units with intermittent treatment, the frequency of the same 3 organisms was less than in the other 8 units. The reduction was significant at the 5% level only in the case of *Haemophilus*.

In the 8 units with sulfonamides the frequency of *Haemophilus* infections was lower than in the 8 other units. By comparison, the frequency of *Moraxella* and pneumococcus infection was higher. None of these differences was large enough to be significant at the 1% level.

It seems, therefore, that the effect of the control measures, or at least that of intermittent treatment, on *Haemophilus* persisted in some degree until March 1955.

The frequency of associations of other bacterial pathogens and their relationships to clinical manifestations were studied but they appeared to have little epidemiological significance. They are not, therefore, reported here in full.

In general, a lower percentage of conjunctivitis was noticed when *Haemophilus* was associated with *Moraxella* than when it was alone (or *Moraxella* appeared more often in eyes in which *Haemophilus* was not associated with conjunctivitis). A higher frequency of conjunctivitis was noted in the combination *Haemophilus* + pneumococcus than when *Haemophilus* was alone. The additional presence of *Corynebacterium xerosis* did not change the frequency of conjunctivitis.

Neisseria infections are not considered in detail here because they were relatively rare. They were, nevertheless, associated with severe types of conjunctivitis in 33 cases out of the 38 encountered during the epidemic season. In March 1955, of the 6 *Neisseria* infections encountered, 3 were in eyes without acute or sub-acute conjunctivitis.

The important but separate problem of chronic angular-blepharoconjunctivitis caused by *Moraxella* could not be studied in depth.

Certain of the control measures limited the seasonal increase in the number of conjunctivitis cases associated with the different organisms. This was particularly evident in the cases of intermittent treatment and sulfonamides. The analysis of variance of these results shows, however, that the interaction is large, indicating that the reduction in organisms resulting from the combination of the 2 measures is not much higher than that resulting from each treatment applied separately.

By comparison, fly-suppression alone did not result in any appreciable reduction in the number of organisms until later in the season.

Trachoma

Children under the age of 8 years, of the subsample mentioned earlier (see p. 502), were also examined for trachoma on 3 occasions:

in June 1954, before control operations began,
in November 1954, at the end of the period of active operations, and
in March 1955, after a follow-up period of more than 3 months.

Out of a total of about 2250 children, 2127 were present at all 3 examinations. The following report is based on the examination of this latter group.

Initial examination. At the first examination only 6 out of 177 children less than 1 year old showed no signs or doubtful signs of trachoma; 1 of these was 40 days old, 3 were 2 months, 1 was 3 months and 1 was 4 months old.

Since the disease is invariably contracted in early childhood there is a close relationship between age and evolutive stage. Table 6 shows the stage and intensity [1] of trachoma by age. By the age of 3 years most follicles had reached an advanced stage with some central necrosis (Tr II); in some cases early signs of cicatrization were already apparent and increased thereafter each year. After the age of 7 years Tr III was predominant. Although cicatricial changes became more and more marked, there was little tendency to spontaneous cure in this group of children.

Repeat examinations. The top rows of Table 7 show the trachoma status of the children in the control units at the first examination in June 1954 and 8 months later in March 1955.

The period of observation was relatively short. Nevertheless in treated units undoubted clinical cures were seen. In these, all follicles and infiltrations had disappeared from the conjunctiva, which had a smooth surface with visible scars present. The corneal infiltration had in all these cases been resolved.

In a much greater number of cases all infiltrations and follicles disappeared from the cornea and conjunctivae and only slight papillary hypertrophy was still present at the end of the follow-up period. During all experimental work in Morocco, care was

[1] The intensity was measured by the presence and amount of follicles and papillary hyperplasia.

TABLE 6

STAGES AND INTENSITY OF TRACHOMA BEFORE TREATMENT IN CHILDREN 0–8 YEARS OLD IN GOULMIMA IN 1954 [a]

Trachoma		Age-group (years)									
Stage	Intensity	< 1	1	2	3	4	5	6	7	8	Total
Tr 0		3 1.7 %	0	0	0	0	0	0	0	0	3 0.15 %
Doubtful		3 1.7 %									3 0.15 %
Tr I	+	44	19	8	3	0	1	0	0	0	75
	++	3	0	0	1	0	0	0	1	0	5
	+++	1	0	0	0	0	0	0	0	0	1
	Total Tr I	48 27.1 %	19 7.1 %	8 3.5 %	4 1.6 %	0	1 0.6 %	0	1 0.5 %	0	81 3.8 %
Tr II	+	64	70	54	53	39	22	22	6	6	336
	++	55	148	161	173	193	140	149	64	71	1 154
	+++	4	4	2	6	6	3	10	6	5	46
	Total Tr II	123 69.5 %	222 91.7 %	217 95.6 %	232 94.7 %	238 93.7 %	165 78.6 %	181 62.4 %	76 38.8 %	82 28.7 %	1 536 72.2 %
Tr III	+ Fo	0	0	0	0	0	1	3	3	10	17
	+ F+	0	0	1	1	5	10	21	19	28	85
	++	0	1	1	8	11	32	83	93	164	393
	+++	0	0	0	0	0	1	2	4	2	9
	Total Tr III	0 0	1 0.4 %	2 0.9 %	9 3.7 %	16 6.3 %	44 20.9 %	109 37.6 %	119 60.7 %	204 71.3 %	504 23.7 %
Total		177 100.0 %	242 100.0 %	227 100.0 %	245 100.0 %	254 100.0 %	210 100.0 %	290 100.0 %	196 100.0 %	286 100.0 %	2 127 100.0 %

[a] No cases of Tr IV were found.

taken not to declare such cases cured, except when confirmed after a year's further observation. This is why the clinical cures were tentatively grouped together with the " X cases " in evaluating the results (Reinhards et al., 1959).

The fact that each of the 3 main treatments had had an effect on the healing process of trachoma is shown in Table 7.

Fly-suppression alone failed to show any direct effect on trachoma during the short observation period. In the units receiving intermittent treatment, however, additional fly-suppression increased the curative effect of chlortetracycline.

The effect of sulfonamides treatment in the small quantities given was rather weak. Fly-suppression added to sulfonamides treatment did not advance the age of resolution but appeared to benefit cases in which resolution had already commenced.

Intermittent treatment favoured the onset of resolution more than any other single operation. Additional treatment with sulfonamides or with both sulfonamides and fly-suppression gave the best results.

In March 1955, infants born during the observation period, i.e., since the first examination in June 1954, were examined. Great difficulty was en-

TABLE 7

DIFFERENCE IN INTENSITY OF TRACHOMA BEFORE TREATMENT AND AT THE END OF THE FOLLOW-UP PERIOD AFTER TREATMENT (JUNE 1954 AND MARCH 1955)

Treatment	Cured or free of trachoma		Doubtful activity (X) (Tr III+, F = O,P = +)		Active trachoma						Total
					Slight +		Moderate ++		Very intense +++		
	No.	%	No.	%	No.	%	No.	%	No.	%	
C											
Before	0		1	0.4	53	19	222	80	0	0.0	276
After	0		2	0.7	31	11	225	82	18	6.5	276
F											
Before	2 [a]	0.8	0	0.0	56	24	175	74	4	1.7	237
After	0		9	3.8	24	10	185	78	19	8.0	237
I											
Before	0		3	1.0	59	20	212	74	14	4.9	288
After	5	1.7	52	18.0	51	18	176	61	4	1.4	288
S											
Before	1 [a]	0.4	5	2.0	71	28	166	66	7	2.8	250
After	0		24	9.6	35	14	183	73	8	3.2	250
FI											
Before	0		3	1.2	77	31	163	65	6	2.4	249
After	15	6.0	66	27	61	24	106	43	1	0.4	249
FS											
Before	0		2	0.8	75	29	181	70	2	0.8	260
After	3	1.2	40	15	66	25	144	55	7	2.7	260
IS											
Before	3 [a]	1.1	1	0.4	40	14	223	79	15	5.3	282
After	12	4.3	97	34	71	25	102	36	0	0.0	282
FIS											
Before	0		2	0.7	65	23	210	74	8	2.8	285
After	33	12	125	44	76	27	51	18	0	0.0	285
Total before	6 [a]	0.3	17	0.8	496	23.3	1 552	73	56	2.6	2 127

[a] Free of trachoma.

countered in persuading the parents to show those infants who were not on the list of inhabitants used during the treatment period. No proof could be obtained that all had been seen, nor could we be sure whether the infants had already been treated in the units where intermittent treatment was given.

Table 8 shows the occurrence of trachoma in these infants. Six infants were less than 30 days old; 3 of them already had Tr I follicles. These 6 are not taken into consideration in the comparison.

Table 8 shows that out of 143 infants over 1 month and under 10 months old in the units under intermittent treatment, 46 (32%) did not show signs of trachoma in March 1955. No trachoma-free infants were seen in the control units or in units under sulfonamide therapy. Fly-suppression appeared to have decreased the risk of infection. This was best seen in units where fly-suppression was added to other operations. Intermittent treatment alone and in combination was efficient in reducing the infection.

Complications of trachoma and conjunctivitis

To ascertain the number of people who lost their vision by trachoma *per se*, only cases with total pannus causing serious impairment of vision were recorded.

TABLE 8
INCIDENCE OF TRACHOMA IN CHILDREN BORN DURING THE CAMPAIGN AND EXAMINED IN MARCH 1955

Treatment	No visible signs of trachoma		Number examined
	No.	%	
C	0	0	31
F	4	15	26
I	5	18	28
S	0	0	16
FI	12	46	26
FS	9	28	32
IS	11	24	45
FIS	18	41	44
Total	59	24	248

The frequency of trichiasis and entropion was found to increase with age, and was nearly twice as common in women as in men. Trichiasis was very often accompanied by heavy pannus.

Xerosis of the eye due to excessive cicatrization of trachoma was seen in a very severe form in 4 monocular cases.

Under field conditions it was impossible to record all the slight changes of the anterior segment, in particular of the cornea. No precise examination could be made without a slit-lamp and accurate individual testing of vision was impracticable. For this reason only those gross sequelae causing important impairment of vision were taken into consideration.

The estimation of the loss of vision was largely based on objective findings. Where necessary, the finger-counting test was used, a simple method understood by all, and precise enough in cases of severely impaired vision.

Table 9 shows the number of persons with complete loss and severe impairment of vision due to trachoma or bacterial infections. These cases are placed in 4 groups according to the degree of loss of vision:

(1) totally blind, no light perception or, at best, faulty projection of light;

(2) all others economically blind, V=less than 10/200 (together with the first group these form a group unable to carry out any work for which vision is essential);

(3) those blind in one eye, usually capable of some work, but handicapped by the risk of losing the second eye; and

(4) those with serious impairment of vision in one or both eyes, i.e., limited in their working capacity.

Of the whole population, 4.1% were found economically blind. Of these, one quarter were totally blind. A further 10.1% had serious impairment of vision constituting a grave handicap to their working capacity. In this group 3.6% of the total were blind in one eye.

Of all adults (over 16 years of age) 6.9% were economically blind and 14.9% more had serious impairment of vision (including 5.7% who were blind in one eye).

DISCUSSION OF THE RESULTS IN GOULMIMA

The essentially chronic course of trachoma is conditioned and modified by associated bacterial infections and the seasonal variation in bacterial conjunctivitis is reflected in sharp seasonal exacerbations in the number of trachoma cases. Thus the microbiological and clinical picture not only of conjunctivitis but also of trachoma will vary according to the time of the year. The seasonal rise in clinical sub-acute and acute conjunctivitis to epidemic proportions has been ascribed not only to an increase in the number of infections but to a seasonal increase in the virulence of the *Haemophilus* organism as a result of repeated fly-borne passages from eye to eye (Maxwell-Lyons & Amies, 1949).

In a number of cases with sub-acute and acute conjunctivitis no organisms could be detected on the slides. The reason for this may lie in the limitations of the technique employed. If the organisms are few in number there is always the risk that even scraping the conjunctiva may fail to collect them. This might be the case, particularly where conjunctivitis of bacterial origin has reached an advanced stage. Further, when only a few bacteria exist on a slide they may escape detection. Negative findings should thus be viewed with great reserve unless several samples taken from the same person are examined. For practical reasons, however, this was not possible.

It might be thought that trachoma in its earliest clinical stage could be confused with conjunctivitis. In North Africa, however, the onset of trachoma is usually insidious and nearly always preceded by or associated with bacterial infections.

It is generally believed, on clinical evidence, that neonatal inclusion conjunctivitis is rare in Morocco,

TABLE 9

LOSS OF VISION DUE TO CONJUNCTIVITIS AND/OR TRACHOMA IN THE POPULATION OF GOULMIMA

Age-group (years)	Economically blind				Serious impairment of vision				Total for loss of vision		Total population
	Completely blind		Vision less than 10/200		Blind in one eye		Other impairment of vision				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Male population											
< 2	0	0.0	1	0.2	1	0.2	3	0.7	5	1.2	406
2–4	0	0.0	0	0.0	3	0.5	2	0.4	5	0.9	559
5–7	0	0.0	3	0.5	3	0.5	13	2.1	19	3.1	616
8–11	2	0.3	3	0.5	20	3.3	31	5.1	56	9.2	611
12–15	3	0.7	2	0.4	24	5.3	31	6.8	60	13.1	457
16–19	0	0.0	2	0.9	9	4.1	15	6.8	26	11.9	219
20–24	1	0.6	1	0.6	2	1.1	9	5.0	13	7.3	179
25–29	4	2.4	3	1.8	5	2.9	8	4.7	20	11.8	170
30–39	4	1.0	7	1.8	15	3.9	28	7.2	54	13.9	389
40–49	10	1.8	21	3.7	35	6.2	48	8.5	114	20.3	562
50–59	6	1.1	23	4.4	26	4.9	39	7.4	94	17.8	528
60 and above	13	3.7	33	9.5	30	8.6	23	6.6	99	28.4	349
Total	43	0.9	99	2.0	173	3.4	250	5.0	565	11.2	5 045
Female population											
< 2	0	0.0	1	0.3	0	0.0	0	0.0	1	0.3	366
2–4	1	0.2		0.0	1	0.2	3	0.5	5	0.8	599
5–7	2	0.4	2	0.4	5	0.9	17	3.1	26	4.7	557
8–11	1	0.2	10	1.8	13	2.3	30	5.3	54	9.6	565
12–15	2	0.5	19	5.0	16	4.2	30	7.9	67	17.7	378
16–19	4	1.6	3	1.2	13	5.0	17	6.6	37	14.3	258
20–24	4	0.9	10	2.2	23	5.2	37	8.3	74	16.6	446
25–29	3	0.6	17	3.6	25	5.2	55	11.5	100	21.0	477
30–39	8	0.9	41	4.7	51	5.8	80	9.2	180	20.6	872
40–49	6	1.0	65	10.4	43	6.9	85	13.6	199	31.8	625
50–59	7	2.1	43	13.0	21	6.3	40	12.0	111	33.4	332
60 and above	4	1.6	48	18.8	24	9.4	37	14.5	113	44.1	256
Total	42	0.7	259	4.5	235	4.1	431	7.5	967	16.9	5 731

and this may be true. However, as previously stated, infants are not produced for examination until 40 days after birth; thus the acute phase of inclusion conjunctivitis—starting after an incubation period of some 7–12 days and lasting 15–20 days—could be missed, and the subsequent chronic phase, lasting 3 months or more before spontaneous cure, might well be misinterpreted, or superseded by trachoma. More evidence, with laboratory controls, is needed to clarify this important and controversial point.

In the absence of any facilities for serological studies it was impossible to estimate the importance of true viral infections such as those of the adenovirus group; failing other evidence, however, the fact that throughout Morocco so very few cases of conjunctivitis fail to respond to treatment with antibiot-

ics would suggest that such infections are at least uncommon.

In the units under intermittent treatment, the figures expressing the drop in the conjunctivitis rate and in bacteriological positives do not show the full effect of the treatment as they deal with data collected not immediately after each monthly treatment but on the day the next treatment started, i.e., after an interval of approximately 4 weeks. In this period relapses and reinfections could have occurred.

At the time of the October treatment, the following values were found in 148 children seen both before and 1 day after the 3 days' treatment in a unit subjected to intermittent treatment:

	Before treatment		*One day after treatment*	
	No.	*%*	*No.*	*%*
Sub-acute and acute conjunctivitis	13	8.8	2	1.4
Haemophilus present	94	64.0	11	7.4
Moraxella present	51	34.0	5	3.4
Pneumococcus present	41	28.0	5	3.4

One month later these rates were again high and comparable to those found before treatment.

A similar drop in the conjunctivitis rate occurred after the 4 days' treatment with sulfonamides in the first cycle.

The poor response to oral sulfonamide treatment of infants was probably due to the practical dicffiulties in administering the drug to large numbers of young children in the field. It requires skill in handling, patience, time and some luck to ensure that the proper dose is swallowed completely and retained. Moreover, at the time of the trial of this treatment a satisfactory emulsion of sulfonamides was not available in Morocco.

The effect of adding chlortetracycline to sulfonamides was considerable at the end of the survey. This was perhaps due to the fact that the residual effect of the treatment with sulfonamides diminished at the end of the season.

The reported association of pathogenic microorganisms and clinical conjunctivitis may be an underestimate. Since clinical and bacteriological examinations were carried out only once each month, it cannot be excluded that a few of the cases which failed to show an association may have been in the earliest stages of sub-acute or acute conjunctivitis and thus missed, or the clinical signs may have resolved while the organisms still remain in the conjunctival sac.

As regards trachoma, in the intervening period of 9 months between the 2 examinations, from June 1954 to March 1955, 2 factors delaying the resolution of the disease were operating in the untreated units, (1) the seasonal epidemic of conjunctivitis which aggravates the trachomatous process and facilitates transmission of the infection; and (2) the exposure of children to infection, reinfection and superinfection. Some very young children, who were initially free from trachoma, contracted the disease; and in others, a little older and already trachomatous, the disease advanced.

Because of the uniform age at onset and relatively uniform rate of evolution of the disease, a relation between stage of trachoma and age may be accepted in the probability sense. The important factors in determining the effect of treatment on a community basis, therefore, are the relationship between age and commencement of resolution, and the relationship between age and completion of cure.

The 2 relationships are monotonic, the number of cases, at the stage of onset of scarring and the number reaching cure both increasing with age. Further, it is assumed that the more efficacious the treatment, the sooner will resolution commence and cure be achieved. In practically all cases in Morocco at that time, except those effectively treated in the earliest stage, resolution and healing were associated with some degree of cicatrization.

If percentages of Tr III+Tr IV before and after treatment (Tables 10 and 11) are plotted against

TABLE 10

NUMBER AND PERCENTAGE OF TRACHOMA CASES IN WHICH SIGNS OF CICATRIZATION WERE APPARENT BEFORE TREATMENT IN JUNE 1954

Age-group (years)	Trachoma with cicatrization Tr III+Tr IV		Total trachoma cases
	No.	%	
<1	0	0.0	177
1	1	0.4	242
2	2	0.9	227
3	9	3.7	245
4	16	6.3	254
5	44	21.0	210
6	109	37.6	290
7	119	60.7	196
8	204	71.3	286
Total	504		2127

TABLE 11

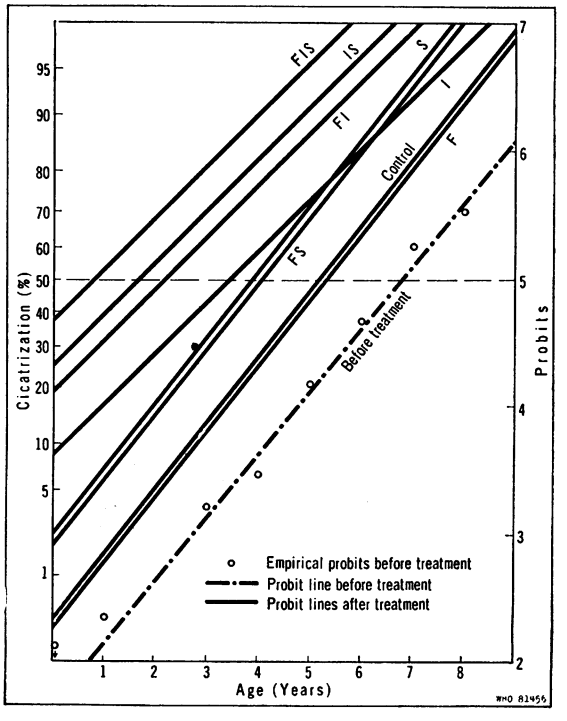
NUMBER AND PERCENTAGE OF CASES OF TRACHOMA IN WHICH SIGNS OF CICATRIZATION WERE APPARENT (Tr III + Tr IV) IN MARCH 1955 IN RELATION TO THE TOTAL NUMBER OF TRACHOMA CASES SEEN

Age-group (years)	Treatment																					
	C			F			I			S			FI			IS			FIS		
	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total
1	1	4	22	1	4	28	2	9	23	0	0	17	7	32	22	2	10	20	7	26	27	9	50	18
1	3	9	33	0	0	32	4	15	26	5	18	28	20	61	33	4	14	28	11	52	21	31	76	41
2	3	12	26	0	0	25	15	42	36	8	31	26	11	53	19	3	10	31	22	71	31	23	70	33
3	8	27	30	4	16	25	14	56	25	14	58	24	23	65	37	21	58	36	30	83	36	28	88	32
4	10	36	28	10	37	27	32	76	42	22	65	34	31	91	34	18	69	26	33	89	37	23	88	26
5	19	58	33	17	68	25	23	85	27	14	74	19	14	82	17	20	91	22	38	95	40	27	100	27
6	36	78	46	24	86	28	41	89	46	29	91	32	28	93	30	28	85	33	36	100	36	39	100	39
7	19	95	20	19	90	21	21	95	22	26	100	26	29	100	29	25	100	25	26	100	26	27	100	27
8	36	95	38	26	100	26	41	100	41	44	100	44	28	100	28	39	100	39	28	100	28	42	100	42
Total	135		276	101		237	193		288	162		250	191		249	160		260	231		282	249		285

ages in each of the 16 units, the points fall close to a normal sigmoid curve. These curves have been transformed into straight lines by a probit transformation (Weber, 1960), and are shown in Fig. 4. Only empirical points have been plotted on the graphs for the results before treatment, to avoid overloading the graph.

FIG. 4

PROBIT LINES FOR TRACHOMA CASES SHOWING SIGNS OF CICATRIZATION



The 8 probit lines adjusted to the results after treatment cannot all be considered parallel ($\chi^2 = 17.26$ with 7 degrees of freedom, which is significant at the 2% level).

If, however, the data are split into 2 groups, those that include intermittent treatment (I, FI, IS, and FIS) and those that do not (C, F, S, and FS), the slopes within each group can be considered parallel.

Although 0.75 year (9 months) has been added to all ages after treatment, there is a large difference between the probit line of the examinations made before treatment and the values found for the control units in March 1955. It seems hardly likely that

the treatment given to the few acute conjunctivitis cases in the control units was sufficient to produce such a large difference. It is possible that in a few cases, unknown to the team, people treated their eyes on their own initiative when they saw what good the ointment did for their neighbours. Further, changes in the appearance of trachoma due to seasonal variation in associated infections might be expected to add to this difference. Nevertheless, the greater part of the difference must be ascribed to the natural evolution of the disease.

By analogy with bioassays, the ages at which 50% of the population began to show signs of resolution (abbreviated as AB_{50}) have been computed for each operation with the 95% lower and upper confidence levels (Table 12).

TABLE 12
AGE IN YEARS AT WHICH 50% OF TRACHOMA CASES SHOWED SIGNS OF CICATRIZATION

	AB_{50} (and lower and upper 95% confidence limits)
Before treatment	6.70 (6.54–6.86)
After treatment	
C	5.11 (4.75–5.47)
F	5.21 (4.80–5.62)
S	3.83 (3.44–4.22)
FS	3.98 (3.59–4.37)
I	3.43 (2.97–3.89)
FI	2.14 (1.62–2.66)
IS	1.63 (1.07–2.19)
FIS	0.77 (0.17–1.37)

Fly-suppression did not accelerate the process of resolution of trachoma in the absence of intermittent treatment. On the other hand, where intermittent treatment was given, the additional effect of fly-suppression speeded the process of resolution by an average of 1.1 years.

The effect of intermittent treatment on resolution is more difficult to estimate owing to the possible difference of slope. This is perhaps due to the direct effect of chlortetracycline on the trachoma agent, the slight forms of trachoma, which are more frequent in the younger children, being more readily cured than are other cases.

Any estimation of the effects of intermittent treatment must be made in relation to the percentage of cases with signs of resolution in the sample chosen for the comparison. Looking at Fig. 4, for instance, it can be seen that, whereas in control units resolution started in 20% of the cases at 3.5 years, in units under intermittent treatment alone it occurred in 20% of the cases after only 1.3 years, i.e., 2.2 years earlier. However, in control units, the commencement of resolution was observed in 80% of the cases at 6.75 years and in units under intermittent treatment at 5.5 years, or only 1.25 years earlier.

Consequently, we can compare, somewhat arbitrarily, the ages at which 50% of the cases show signs of resolution (Tr III + Tr IV):

	Reduction (in years)
I against C	1.68
IS against S	2.20
FI against F	3.07
FIS against FS	3.21

Again on average, in units under intermittent treatment but without fly-suppression, 50% of the cases commenced resolution some 1.9 years earlier, whereas with intermittent treatment and fly-suppression resolution began 3.1 years earlier.

The effect of treatments in inducing completion of cure was evaluated separately. No estimation of the tendency to spontaneous cure before treatment was possible, however, because such healing usually only occurred in higher age-groups than that (0–8 years) studied.

Percentages of completion of cure found after treatment are given in Table 13; the probit lines are reproduced in Fig. 5. To avoid overloading the graph the empirical points have not been plotted. The 8 probit lines can be regarded as parallel.

The age at which 50% of the children were healed, abbreviated to AC_{50}, is given in Table 14 with its upper and lower 95% confidence limits. Values for control, fly-suppression, and sulfonamides lie far outside the limits of experimentation and should be treated with great reserve. The greatest reduction was induced by intermittent treatment, complete cure being advanced in this case by 6.00 years. Sulfonamides treatment was next with an advance of 3.22 years and finally fly-suppression with an advance of 2.20 years.

Fig. 4 and 5 thus demonstrate that each of the 3 main treatments had a direct or indirect effect on the healing process of trachoma. Fly-suppression alone failed to show any direct effect on trachoma

TABLE 13

NUMBER AND PERCENTAGE OF CASES OF TRACHOMA CURED IN MARCH 1955 (SURE CLINICAL CURES AND PROBABLE CURES) IN RELATION TO TOTAL NUMBER OF TRACHOMA CASES SEEN

Age-group (years)	Treatment																					
	C			F			I			S			FI			FS			IS			FIS		
	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%	Total
< 1	0	0	22	1	4	28	1	4	23	0	0	17	3	14	22	1	5	20	1	4	27	5	28	18
1	0	0	33	0	0	32	1	4	26	0	0	28	7	21	33	0	0	28	3	14	21	18	44	41
2	0	0	26	0	0	25	2	6	36	0	0	26	1	5	19	0	0	31	7	22	31	12	36	33
3	0	0	30	1	4	25	2	8	25	0	0	24	3	8	37	2	6	36	11	31	36	13	41	32
4	0	0	28	0	0	27	5	12	42	3	9	34	13	38	34	5	19	26	9	24	37	14	54	26
5	0	0	33	0	0	25	4	15	27	0	0	19	7	41	17	7	32	22	18	45	40	17	63	27
6	0	0	46	3	11	28	10	22	46	3	9	32	14	47	30	6	18	33	17	47	36	23	59	39
7	1	5	20	1	5	21	10	45	22	3	11	26	15	52	29	6	24	25	20	77	26	24	89	27
8	1	3	38	3	12	26	22	54	41	15	34	44	19	64	28	16	41	39	23	83	28	32	76	42
Total	2		276	9		237	57		288	24		250	81		249	43		260	109		282	158		285

FIG. 5

PROBIT LINES FOR TRACHOMA CASES SHOWING COMPLETION OF CICATRIZATION

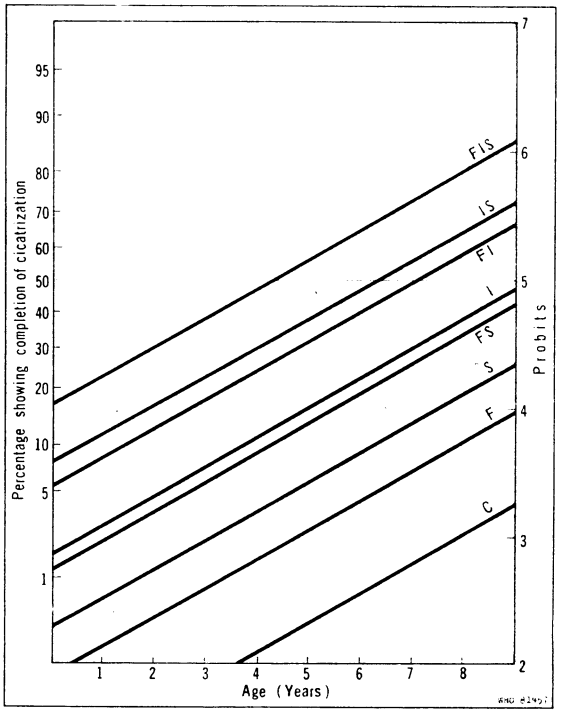


TABLE 14

AGE IN YEARS AT WHICH 50% OF TRACHOMA CASES IN CHILDREN HAD COMPLETED CURE

Treatment	AC_{50} (and lower and upper 95% confidence limits)
C	16.81 (10.35–23.27)
F	13.55 (11.87–15.23)
I	9.35 (8.45–10.25)
S	11.90 (10.59–13.21)
FI	7.10 (6.30– 7.90)
FS	9.89 (8.86–10.92)
IS	6.33 (5.61– 7.05)
FIS	4.27 (3.57– 4.97)

during the short observation period. However, in the units submitted to intermittent chlortetracycline treatment additional fly-suppression increased the curative effect of the antibiotic. This could have worked either by a further reduction in secondary infections, or by excluding repeated superinfection with the trachoma agent through the elimination of the fly vector. The treatment with small doses of sulfonamide had only a small effect on trachoma. This may have resulted from a decrease in secondary infections. Fly-suppression in addition to sulfonamides treatment did not advance the onset of resolution but appeared to benefit cases in which resolution had already commenced. Intermittent treatment favoured the onset of resolution more than any other single operation.

It seems that chlortetracycline acted more noticeably on the less intense cases of trachoma in younger children despite the fact that in this age-group the elimination of secondary infection was less complete.

Additional fly-suppression considerably increased the effect of intermittent antibiotic treatment, but additional treatment with sulfonamides or with both sulfonamides and fly-suppression gave the best results.

Delays obtained in onset of trachoma. In the units which had intermittent treatment 32% of the infants born between July 1954 and March 1955 did not show signs of trachoma in March 1955. This is more than one would expect to be trachoma-free in the south of Morocco. A variety of factors, such as the lateness of the season, the difficulty of determining exact age, the absence of a slit-lamp (required for adequate examination of the eyes) make it unsafe to draw conclusions, however, on the basis of the small number of children examined. The question of chance variation cannot be overlooked here, but the observations in 2 villages in a factorial design would decrease this possibility. However, it was a fact that in certain units, protection against infection was much greater than in the control villages (Table 18). The position may be summarized as follows: (1) no trachoma-free infant was seen in March 1955 in the control units or units under sulfonamide therapy; (2) fly-suppression appears to have decreased the risk of infection with the trachoma agent, particularly in units where fly-suppression was added to other operations, thus supporting the view that the fly is a vector which transmits trachoma; (3) intermittent treatment, alone or combined, was efficient in reducing the infection, probably by diminishing the stock of transmissible agent.

Loss of vision. The full importance of the dual problem of seasonal conjunctivitis and trachoma can only be appreciated when, in addition to incidence and prevalence rates, the frequency and distribution of disabling complications and sequelae are taken into account.

Of the whole population, 4.1% were found economically blind—i.e., unable to perform any work for which eyesight is essential. Of these, one quarter were totally blind. Women were more frequently affected than men in all age-groups over 8 years.

The socio-economic importance of the sequelae is clear from the fact that, of all adults (over 16 years of age), 6.9% were economically blind and 14.9% more had serious impairment of vision (including 5.7% who were blind in one eye).

The proportion of loss of vision was found to increase with age, as each year, new ulcers and progressive pannus probably occurred in all age-groups. In people aged 40–49 years, who should still have been fully capable of work, 8.5% were found to be economically blind, and a further 17.8% had serious impairment of vision, including 6.6% who were totally blind in one eye.

Older persons seemed to be exposed to an extremely high risk of blindness. In the age-group 50–59 years, 9.2% were found to be economically blind. In those over 60 years of age the figure was as high as 16.2%. Furthermore, 14.7% of age-group 50–59 had a serious impairment of vision while in those aged 60 years and over the figure was 18.8%.

To the loss of vision should be added the misery caused by permanent or temporary pain. Physical suffering is considerable in the acute form of the disease, particularly if corneal complications are present, and may be permanent in the case of trichiasis, entropion and the other late complications of trachoma. All those affected are thus physically and economically handicapped.

Independent surveys have shown that very similar conditions prevail in a great part of southern Morocco with the exception of a rather broad zone on the Atlantic coast, from Agadir to Tiznit, where climatic conditions are less severe.

From the data on which Table 9 was based it is estimated that in previous years about 18 out of 10 000 inhabitants lost one or both corneae each year from untreated bacterial ulcers. In trachoma without acute corneal ulceration of bacterial origin the deterioration of vision is usually slow, so that the point at which severe impairment of vision changes to economic blindness would be difficult to

define. Theoretically, however, about 13–15 persons of this category should be added annually to the total of the economically blind in this community of 10 000 people.

In many of the persons who finally became blind, improvement or conservation of vision would have been possible by means of surgical intervention. [1]

As intra-ocular tension could not be measured systematically, it was not possible to diagnose glaucoma in all cases. All eyes with adherent leucomata should be considered as potential cases of secondary glaucoma.

ASSESSMENT OF THE TRACHOMA SITUATION AFTER 10 YEARS OF SELF-TREATMENT [2]

From the summer of 1955 onwards a self-treatment campaign was maintained in the whole of the south of Morocco, including Goulmima and Tinejdad. During the first year (1955) antibiotic ointment was distributed to each family at monthly intervals from July to November. After 1956 only one distribution took place at the beginning of each summer. Ointment was made available in the village tobacco shops at a low price.

In 1964 an *ad hoc* census was made in the area (Kupka, 1965). The total population had increased since 1954 by 23% and the child population had increased by 33.7%.

A total of 3697 children under 8 years of age, chosen at random from 150 families in each of the 16 units, were examined, under similar conditions to those in 1954, by one of us (B. N). All these children had been born since the beginning of the campaign in 1954. A comparison of the clinical findings in 1954 and 1964 (Table 15) shows that in 1964, 18.6% of the children were trachoma-free and 77% of all infants below one year of age were not infected. About 60% of the children were free of infection until they were 1 year old, about 40% until they were 2 years old, about 20% until they were 3 years old.

At 8 years of age 2.6% of the children still had no signs of trachoma. No such delays in onset were observed in 1954. The median age of infection (50% infected) had shifted from under 3 months in 1954 to about 2 years in 1964.

In 1964 active trachoma was present in 76.1% of the total sample, the peak of 91.9% being reached at the age of 4 years, decreasing thereafter due to the appearance and gradual increase of healed trachoma. In 1954 all children up to the age of 8 years had active trachoma; in 1964, by contrast, stage IV first appeared at the age of 3 years, increasing with age and reaching 25.3% at the age of 8 years.

An evaluation of the relative gravity of trachoma in children was made in 1964 following strictly the recommendations given in the third report of the WHO Expert Committee on Trachoma (1962). The results for 1964 together with an evaluation of old detailed records dating from 1954 are shown in Table 16. No difficulty was found in tabulating the cases according to the above requirements. However, some caution is necessary in comparing the frequency of potentially disabling forms of trachoma registered as Tr III F_3C_1 and Tr III F_2C_2 where 2 different examiners have seen 2 groups of people at an interval of 10 years. As all trachomatologists know, there is a bias towards qualifying the " most severe cases of follicles present " as F_3 whereas these may, in fact, differ in non-treated and treated groups, just as they would differ in a European and a North African survey. This leads to upgrading the limits between F_3, F_2 and F_1 in an area where the trachoma is severe.

Similar caution must be applied in the evaluation of pannus under field conditions when a slit-lamp is not used. Using only a loupe it is easy to detect an active and infiltrative pannus of 4 mm or more; but the same pannus in a treated patient may become difficult to see once the infiltrate has been absorbed, and the transparency and surface brilliance of the involved area have become largely restored. The vascularization towards the centre of the cornea may then be practically invisible. These factors may all result in a marked underestimation of the importance of corneal involvement and it may make comparison between treated and non-treated communities difficult.

The above may account to some extent for the discrepancy noted in the results. The 1964 survey did not appear to indicate any reduction in cases classed as " severe " on account of follicles but it did show an enormous reduction in trichiasis, pannus and other corneal opacities and in the total number of cases with one or several categories of lesions (Table 16).

[1] In regions where mass treatment was carried out, a mobile surgical team remained for a period of time each year in small rural centres. About 8000 cases were dealt with by this team during the 1953 and 1954 seasons and less regularly afterwards. The more severe cases were evacuated to the regional hospitals, with a permanent eye service, in Ouarzazate, Erfoud and Ksar-es-Souk.

[2] Most of the data collected in 1964 and used for comparison in this chapter are taken from Kupka (1965).

TABLE 15

PREVALENCE OF TRACHOMA, BY CLINICAL STAGE AND AGE, AMONG CHILDREN IN GOULMIMA AND TINEJDAD, 1954 AND 1964

Stage	Age-group (years)									
	< 1	1	2	3	4	5	6	7	8	Total
1954 findings										
Tr 0	6 3.4 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	6 0.3 %
Tr I	48 27.1 %	19 7.1 %	8 3.5 %	4 1.6 %	0 0.0 %	1 0.6 %	0 0.0 %	1 0.5 %	0 0.0 %	81 3.8 %
Tr II	123 69.5 %	222 91.7 %	217 95.6 %	232 94.7 %	238 93.7 %	165 78.6 %	181 62.4 %	76 38.8 %	82 28.7 %	1 536 72.2 %
Tr III	0 0.0 %	1 0.4 %	2 0.9 %	9 3.7 %	16 6.3 %	44 20.9 %	109 37.6 %	119 60.7 %	204 71.3 %	504 23.7 %
Subtotal actives	171 96.6 %	242 100.0 %	227 100.0 %	245 100.0 %	254 100.0 %	210 100.0 %	290 100.0 %	196 100.0 %	286 100.0 %	2 121 99.7 %
Tr IV (healed)	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %	0 0.0 %
Total trachoma	171 96.6 %	242 100.0 %	227 100.0 %	245 100.0 %	254 100.0 %	210 100.0 %	290 100.0 %	196 100.0 %	286 100.0 %	2 131 99.7 %
Total no. examined	177	242	227	245	254	210	290	196	286	2 127
1964 findings										
Tr 0	196 77.3 %	260 51.2 %	147 28.3 %	44 10.5 %	38 6.4 %	19 5.6 %	32 6.4 %	11 4.5 %	11 2.6 %	688 18.6 %
Tr I	35 21.5 %	200 33.4 %	242 46.5 %	204 48.8 %	219 36.7 %	113 33.5 %	122 24.5 %	50 20.7 %	52 12.5 %	1 237 33.5
Tr II	2 1.2 %	44 8.7 %	123 23.6 %	142 34.0 %	246 41.3 %	117 34.7 %	134 26.9 %	51 21.1 %	62 14.9 %	921 24.9
Tr III	0 0.0 %	4 0.7 %	8 1.5 %	26 6.2 %	83 13.9 %	73 21.7 %	171 31.3 %	106 43.8 %	185 44.6 %	656 17.7 %
Subtotal actives	37 22.7 %	248 48.8 %	373 71.6 %	472 89.0 %	548 91.9 %	303 89.9 %	427 85.7 %	307 85.6 %	299 72.0 %	2 814 76.1 %
Tr IV (healed)	0 0.0 %	0 0.0 %	0 0.0 %	2 0.5 %	10 1.7 %	15 4.5 %	33 7.8 %	24 9.9 %	105 25.3 %	195 % 5.3 %
Total trachoma	37 22.7 %	248 48.8 %	373 71.6 %	474 89.5 %	558 93.6 %	318 94.4 %	466 93.5 %	331 95.5 %	404 97.3 %	3 009 81.4 %
Total no. examined	163	508	520	418	596	337	498	242	415	3 697

TABLE 16

FREQUENCY OF DISABLING AND POTENTIALLY DISABLING LESIONS IN CASES OF DIAGNOSED TRACHOMA IN 1954 AND 1964 IN GOULMIMA BY AGE AND SEX [a]

Condition		Age-group (years)																																	
		< 1			1			2			3			4			5			6			7			8			Total		
		M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Total
1954 findings																																			
Total trachoma cases I-IV	No.	109	97	206	139	118	257	103	130	233	130	103	233	137	109	246	111	91	202	124	139	263	105	91	196	155	139	294	1 113	1 017	2 130
	%																																		
F_3C_1 or F_2C_2 or C_3	No.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	2	2	4	2	8	10	13	7	20	17	19	36
	%	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.2	1.0	1.6	1.4	1.5	1.9	8.8	5.2	8.4	5.0	6.8			
Trichiasis	No.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	3	1	4	2	3	5	5	3	8	11	7	18
	%	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.9	—	0.5	2.4	0.7	1.5	1.9	3.3	2.6	3.2	2.2	2.7			
Pannus ≥ 4 mm	No.	—	—	—	—	—	—	—	—	—	2	—	2	7	2	9	2	2	4	10	11	21	11	13	24	21	19	40	53	47	100
	%	—	—	—	—	—	—	—	—	—	1.5	—	0.9	5.1	1.8	3.7	1.8	2.2	2.0	8.1	7.9	8.0	10.5	14.3	12.3	13.5	13.7	13.6			
Other central corneal opacities	No.	1	—	1	2	1	3	4	—	4	2	3	5	6	6	12	3	2	5	12	7	19	12	14	26	16	16	32	58	49	107
	%	0.9	—	0.5	1.4	0.8	1.2	3.9	—	1.7	1.5	2.9	2.1	4.4	5.5	5.0	2.7	2.2	2.4	9.7	5.0	7.2	11.4	15.4	13.3	10.3	11.5	10.9			
Total severe cases	No.	1	—	1	2	1	3	4	—	4	4	3	7	11	8	19	6	6	12	22	19	41	21	30	51	43	38	81	114	105	219
	%	0.9	—	0.5	1.4	0.8	1.2	3.9	—	1.4	3.1	2.9	3.0	3.0	7.3	7.7	5.4	6.6	5.9	17.7	13.7	15.6	20.0	33.0	26.0	27.7	27.3	27.6			
1964 findings																																			
Total trachoma cases I-IV	No.	12	25	37	139	109	248	199	174	373	182	192	374	281	277	558	157	161	318	234	232	466	120	111	231	191	213	404	1 515	1 494	3 009
	%																																		
F_3C_1 or F_2C_2 or C_3	No.	—	—	—	—	—	—	1	0	1	2	2	4	6	5	11	3	11	14	10	17	27	6	9	15	17	14	31	45	58	103
	%	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Trichiasis	No.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	—	1
	%	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pannus ≥ 4 mm	No.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	%	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other central corneal opacities	No.	—	—	—	—	—	—	1	1	2	1	1	2	1	0	1	—	—	—	—	—	—	1	0	1	1	0	1	5	2	7
	%	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total severe cases	No.	—	—	—	—	—	—	2	1	3	3	3	6	7	5	12	3	11	14	10	17	27	6	9	15	16	14	30	47	60	107
	%	—	—	—	—	—	—	1.0	0.6	0.8	1.6	1.6	1.6	2.5	1.8	2.1	2.0	6.4	4.4	4.3	7.5	5.8	5.1	8.0	6.5	8.1	6.0	7.0	3.1	4.0	3.5

[a] Relative frequency of severe lesions is determined as a percentage of total trachoma cases (I-IV).

The conclusion reached, therefore, is that in children 0–8 years of age the mass self-treatment campaign had the following effects : it delayed the onset of trachoma, reduced the clinical intensity and gravity of trachoma, resulted in earlier appearance of cured cases, and possibly reduced the source of infection by the combination of these factors.

STUDY ON POSSIBLE CHANGES IN THE PREVALENCE OF TRICHIASIS [1]

In evaluating the gravity of trachoma in the children of Goulmima, 10 years after the beginning of the mass campaign, the drop in the trichiasis rate has been remarkable. However, an increase was recorded in persons older than 15.

In order to verify the trichiasis situation in the sector and to compare with the data available from 1954 (complete data on the complications were collected for the whole population in 1954 although complete information on trachoma was not available) a special survey was made by one of us (B. N.) in 1966 with the object of registering all trichiasis, entropion and gross pannus (5 mm and over) in the whole population of the sector.

The survey was made in the same sector as the one surveyed in 1954 and described in detail on p. 502. Again a preliminary census of the whole population recording sex and estimated age was made on the spot.

The age and sex distribution of the sample shows some anomalies, observed in 1954, in 1966 and in other similar studies, which may be accounted for by the difficulty of estimating ages and the migration of adult males out of rural areas. The general increase in the observed sample between 1954 and 1966 is consistent with the population increase of nearly 4% a year.

All members of the households were examined early in 1966 by house-to-house visits. In the absence of civil registration, an *ad hoc* estimation of age had to be made from general appearance, as in 1954.

The results on trichiasis of the 1954 survey as well as those of the 1966 survey are presented in Table 17.

The prevalence of trichiasis, with or without entropion, was found to be consistently higher in females than in males, this relative difference increasing with age up to twice the level. The first cases were observed at somewhat older ages in 1966 than in 1954, earlier in females than in males.

[1] Data from Kupka (1965).

In comparison with the 1954 results, an increase in the over-all rate of trichiasis was recorded in 1966. The increase from 5.5% in 1954 to 9.3% in 1966 is significant at the 1% level. A similar rate of increase was observed for males, from 3.4% to 5.6%, as for females, from 7.5% to 12.6%. It can, however, be seen from Table 17 that while there was a marked increase in trichiasis cases in persons over 16 years of age between 1954 and 1966, for both sexes combined, from 9.3% to 18.3% (from 6.0% to 12.2% in males and 11.6% to 23.0% in females) there had been a decrease of 75% in the rates for the age-groups 0–15 from 1.8% to 0.4% (from 1.3% to 0.3% in males and from 2.0% to 0.5% in females) during the same period. Both of these changes are found to be statistically significant at 1% level by the χ^2 test.

Using the probit technique of Finney, as applied by Weber (1960) to evaluate the resolution of trachoma, it can be seen, by plotting age against the percentage of the sample affected, that the probit lines cross at about the age of 17 years for both sexes combined, giving AB_{15} estimates (the age at which 15% of the persons are affected) of about 55 years of age in 1954 and about 33 years in 1966. The same prevalence of 15% is, therefore, reached 22 years earlier.

This phenomenon may perhaps be explained by assuming that treatment of the more advanced cases, already having much scarring, and still having many mature follicles, had accelerated the process of scarring (such cases were generally more numerous in older children and adults than in young children). If this were so, the formation of even a little additional scar tissue increased the number of cases which started trichiasis each year because of shrinkage of scar tissue. An earlier age of onset of trichiasis would increase its incidence at the age of 15 and above, but this would be an isolated phenomenon, not to be perpetuated in subsequent cohorts.

By comparison, antibiotic treatment of cases having only infiltrates and follicles and little or no scar tissue would exercise a genuinely protective effect by causing only unimportant scars to form.

We should be cautious in drawing conclusions before more observations are made, however, because of the following points :

(1) No information is available on the degree of conjunctival involvement (follicles and scars) for the whole population.

(2) No precise individual information was available as to the amount of treatment the people received.

TABLE 17

PREVALENCE OF TRICHIASIS[a] (WITH OR WITHOUT ENTROPION) BY AGE AND SEX IN GOULMIMA AND TINEJDAD IN 1954 AND 1966

Age-group (years)[b]	Sex	1954			1966		
		No. examined	Trichiasis		No. examined	Trichiasis	
			No.	%		No.	%
< 2	M	406	1	0.2	444	—	0.0
	F	366	—	0.0	414	—	0.0
	Total	772	1	0.1	858	—	0.0
2–4	M	559	—	0.0	808	—	0.0
	F	599	1	0.2	816	1	0.1
	Total	1 158	1	0.1	1 624	1	0.1
5–7	M	616	5	0.8	910	1	0.1
	F	557	7	1.3	965	3	0.3
	Total	1 173	12	1.0	1 875	4	0.2
8–11	M	811	19	2.3	1 258	4	0.3
	F	565	20	3.5	1 145	6	0.5
	Total	1 376	39	2.8	2 403	10	0.4
12–15	M	457	13	2.8	768	7	0.9
	F	378	21	5.6	535	11	2.3
	Total	835	34	4.1	1 303	18	1.4
16–19	M	219	6	2.7	311	6	1.9
	F	258	9	3.5	333	20	6.0
	Total	477	15	3.1	644	26	4.0
20–24	M	179	3	1.7	347	20	5.8
	F	446	19	4.3	721	90	12.5
	Total	625	22	3.5	1 068	110	10.3
25–29	M	170	2	1.2	320	24	7.5
	F	477	52	10.9	690	117	17.0
	Total	647	54	8.3	1 010	141	14.0
30–39	M	389	18	4.6	788	62	7.9
	F	872	70	8.0	1 130	279	25.0
	Total	1 261	88	7.0	1 918	341	17.8
40–49	M	562	35	6.2	520	81	15.6
	F	625	98	15.7	706	168	23.8
	Total	1 187	133	11.2	1 226	249	20.3
50–59	M	528	31	5.9	470	70	14.9
	F	332	65	19.6	427	165	38.6
	Total	860	96	11.2	897	235	26.2
≥ 60	M	349	37	10.6	642	152	23.7
	F	256	65	25.4	475	191	40.0
	Total	605	102	16.9	1 117	343	30.7
Total	M	5 045	170	3.4	7 586	427	5.6
	F	5 731	427	7.5	8 357	1 051	12.6
	Total	10 776	597	5.5	15 943	1 478	9.3

[a] Both non-operated as well as operated cases were registered.

[b] The same unconventional age-groups were used in 1966 in order to match with 1954 procedures.

(3) The male population was relatively underrepresented in the age-groups 20–39 years.

(4) In considering the age of onset of cicatrization one must also take into account the duration of the disease. With the onset delayed, this could not be reliably evaluated.

(5) It will be noted that there was a difference in the over-all trichiasis rate in Goulmima in 1966 and in the rate found in a sample survey of the whole area made between 1962 and 1965 (9.3% and 7.7%). (This fact may indicate that in the Goulmima area the gravity of the disease was particularly high.)

(6) There is no accepted quantitative classification of trichiasis despite the fact that the degree of involvement may vary from 1 or 2 to a whole row of eyelashes. One cannot exclude the possibility of observer variation playing a part in the present assessment, particularly as there were no untreated controls.[1]

It is recognized that many trachomatologists may not agree with the simple explanation outlined above because of their belief that specific treatment of trachoma with antibiotics leads to healing with less residual cicatrization than would occur in the absence of treatment.

Although antibiotic treatment has the advantage of being able to bring cure with minimum cicatrization (Reinhards et al., 1959), we consider that there is as yet little known about the importance of the resulting cicatrization in treated or untreated cases of the various types of trachoma. Thygeson & Maxwell-Lyons [2] consider certain types of cases, presenting important follicles in addition to scars, as poor risks if not treated for later complications and have for this reason proposed to include such cases in the category of "potentially disabling lesions". It would be interesting to collect more evidence to clarify whether such cases should still be kept in the same poor risk category if treated with antibiotics.

Little is known yet about the various factors important in the cicatrization process, especially in terms of the shrinkage ultimately resulting in trichiasis or entropion.

Only by more complete cohort studies such as those proposed for the Goulmima sector could more evidence be obtained.

We believe, however, that a progressive cohort decline of trichiasis can be expected in Goulmima. As the younger children advance in age they should stand a better chance of a cure without first acquiringg the rave lesions which lead to trichiasis.

It is clear from the results of this study that a mass campaign against trachoma does not immediately lead to a reduction in complications due to excessive cicatrization. Increased facilities for surgery should still be available, to cope with the increased demand, until such time as the benefits of the campaign to the new generation, in reducing the incidence of trachoma, begin to materialize. In practice the demand for better medical care always increases as a result of mass campaigns either because people become more conscious of their needs, or because their needs really increase.

3. FIELD TRIALS IN THE EXPERIMENTAL SECTOR OF SKOURA, 1952–55

Skoura lies on the southern side of the Great Atlas Mountains, 40 km to the east of Ouarzazate. It is a compact oasis situated on a plateau 1100 m–1200 metres above sea-level. The population of about 10 000 is made up of mostly Berbers and Arabs, with a small minority of Jews; most are farmers and shepherds. They live in small hamlets or villages, or in separate houses near their irrigated fields and gardens.

Before 1951, when the first government ophthalmic service was established in Ouarzazate, practically no eye treatment was available to the people of Skoura. They were relatively co-operative and open to new ideas. In general, they accepted instructions, medical care and advice better than the inhabitants in other parts of the territory.

The trials in the experimental sector of Skoura, here briefly described, were the first to demonstrate

[1] An interim evaluation during the fifth year of a large-scale trachoma control programme in Taiwan reported an increase of 50% in trichiasis in treated communities, despite the marked diminution in the degree of associated cicatrization (for which a standard classification exists); at the same time an increase was reported of 56% in trichiasis in untreated control communities, with a reduction in the degree of associated cicatrization, less marked than that in the treated groups (Assaad et al., personal communication, 1967.)

[2] Thygeson, P. & Maxwell-Lyons F. (1961) *Le trachome, évaluation de son intensité et de sa gravité.* In: *Report on WHO trachoma conference, Istanbul* (Unpublished document EURO-158.3, from the WHO Regional Office for Europe).

in the field the efficacy of collective short-term antibiotic treatment on the epidemics of seasonal conjunctivitis and on the underlying trachoma.[1] They were in fact the basis on which the Government of Morocco planned its large-scale campaigns with the assistance of WHO and UNICEF. Our object was to show the effect of intermittent antibiotic treatment and prophylaxis on the picture of eye diseases in a typical southern Moroccan community where control was repeated over more than one season of epidemic conjunctivitis. The trials in Skoura and Ouarzazate (reported later in this paper) were very much a pioneer activity, started by one of us (J. R.) in 1952 under difficult conditions, with few facilities and without expert statistical advice. Nevertheless, they have provided data which supplement the findings of the more comprehensive carefully-planned trials in Goulmima.

Regular systematic examination of the whole population for 3 consecutive years allowed the effects to be evaluated. Re-examination of the population of the same villages more than 12 years later allows an evaluation of the long-term effects of self-treatment organized under relatively primitive conditions.

METHODS

A total of 1650 inhabitants in 4 groups of villages, chosen at random, were listed, and an individual record card established for each person. The record card was less comprehensive than the WHO model introduced in Morocco in 1954.

The population was divided into the following age-groups :

Infants	0– 1 year old
Children	2– 8 years old
Children	9–15 years old
Adults	16–50 years old
Adults	⩾ 51 years old

Examination and recording

Conjunctivitis. In the pilot villages examinations for clinical signs of conjunctivitis were carried out at gatherings of the people before each of the 5 cycles of treatment and, in addition, on the evening of the third day of each treatment cycle. The classification Co. 3, Co. 2, Co. 1, Co. 0 (described on p. 503) was used to record the degree of conjunctivitis present in each case.

Trachoma. The clinical signs of trachoma were recorded 3 times each year, i.e., before commencement of treatment in July, after the last cycle of treatment in November and after a follow-up period of about 3 months in winter. All examinations were made by the same ophthalmologist, using a binocular loupe. The trachoma were classified according to the 4 stages of MacCallan, the intensity being indicated by the symbols : +, + +, or + + + according to the relative severity of the 2 principal conjunctival lesions, follicles and papillary hypertrophy, whichever was predominant. Later in the trials a more precise classification of trachoma, recommended by the WHO Expert Committee on Trachoma (1952), was adopted.

Treatment

Treatment was commenced in the whole of the oasis, including the pilot villages, immediately after the first clinical examination. Administered by a mobile team, at gatherings of the people, it consisted of the application to the eyes of 1 % chlortetracycline ointment, twice daily, on 3 consecutive days. This 3-day cycle was repeated 6 times at 3-weekly intervals. Thus, during the first season, 36 applications of ointment were given to each individual.

During each of the subsequent seasons, 1953 and 1954, only five 3-day cycles of treatment (30 applications each year) were given in the pilot sector.[2]

Control villages

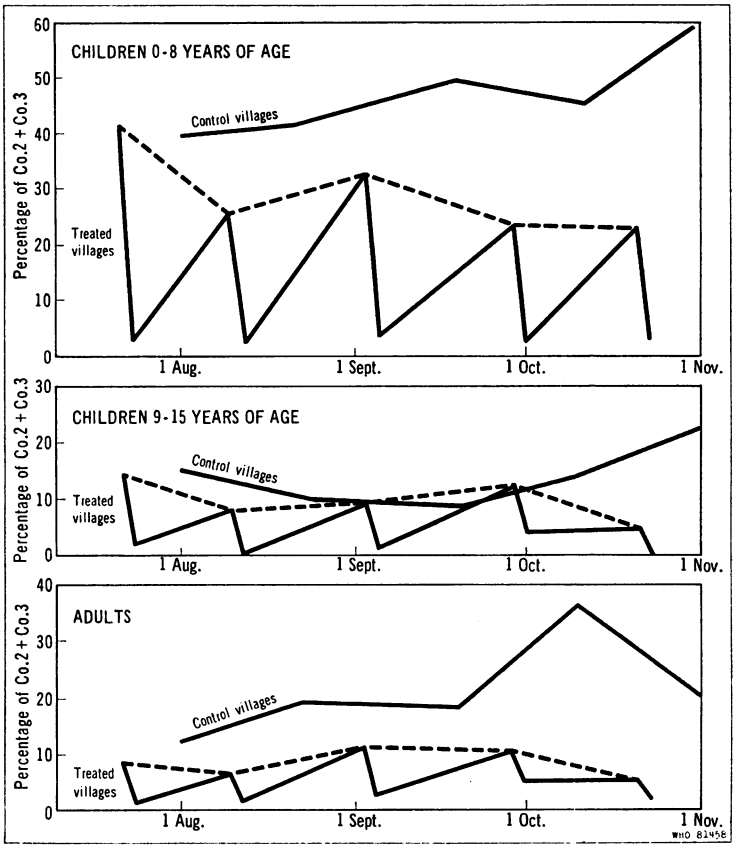
It was difficult to establish satisfactory untreated control units for these trials, but a small neighbouring village of 430 inhabitants with similar climatic and environmental conditions was used initially for the purpose. Examinations of these people, corresponding in time with examinations of the treated groups, were carried out throughout the first year. However, the collaboration of the people very soon ceased as they became aware of the benefits derived by their neighbours from treatment, and they refused to be examined without treatment. For this reason the results in an untreated community are given only for the first year (Fig. 6). Single random surveys

[1] Previous hospital laboratory and field trials in Morocco (Bardon, 1953; Bidart & Racoillet, 1953; Ferrand & Parlange, 1951; Ferrand & Soyer, 1953; Gaud & Decour, 1951; Gaud & Faure, 1951; Pagès, 1950a, 1950b) have shown that most cases of Koch-Weeks conjunctivitis can be cured in about 3 days by applying 1% chlortetracycline ointment. It was also shown that by repeating similar treatment at monthly intervals in whole communities, it was possible to reduce greatly the seasonal epidemics of conjunctivitis.

[2] In 1953, and 1954 throughout the remainder of the oasis of Skoura, chlortetracycline ointment was distributed to each family and instructions given on self-treatment.

FIG. 6

THE CLINICAL COURSE OF THE SEASONAL EPIDEMIC OF CONJUNCTIVITIS IN SKOURA, 1952, IN TREATED AND UNTREATED VILLAGES



were carried out from time to time in other neighbouring untreated villages. The results of these surveys show a high prevalence of acute and sub-acute conjunctivitis and are indicated, for what they are worth, on Fig. 7. Reference is also made to the findings in the untreated control villages in the Goulmima sector (pp. 503–504, Fig. 3, and Table 3).

RESULTS

Effects of intermittent treatment on conjunctivitis

Fig. 6–8 show the clinical course of the seasonal epidemic of conjunctivitis in the treated group of villages during 3 years, 1952–54, and in the single untreated control village during the first year.

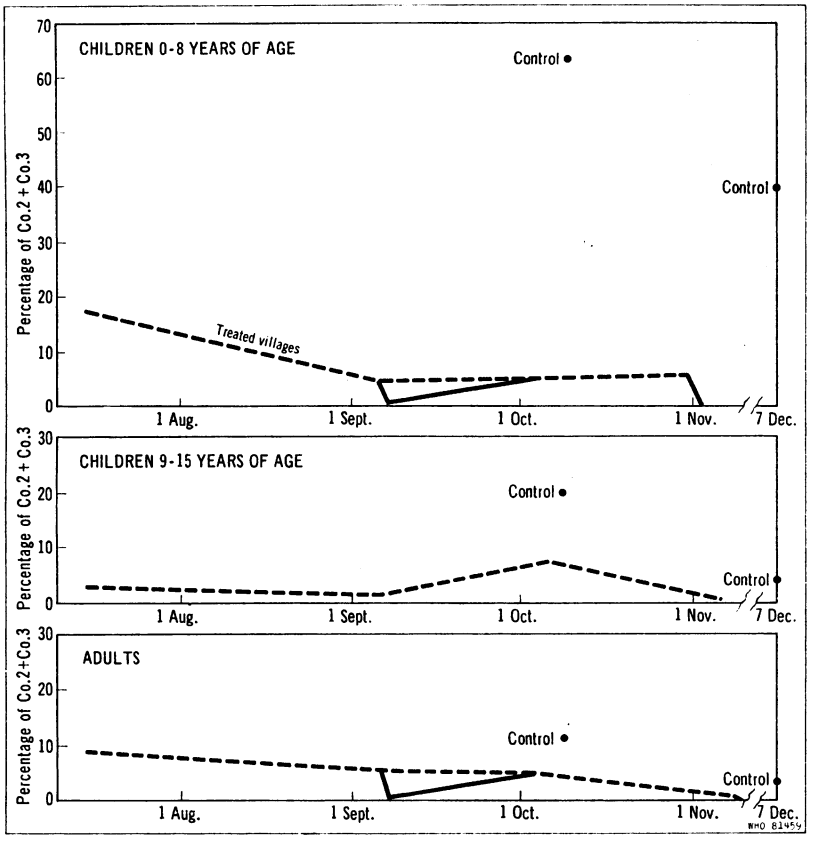
The results in the untreated village show that, throughout the epidemic season, the prevalence of acute and sub-acute conjunctivitis (Co. 3 and Co. 2) varied according to age. The peak incidence for all ages was reached in November.

In the case of the treated communities, the continuous line shows the sharp reduction in the clinical manifestations of conjunctivitis (Co. 3 and Co. 2) resulting from each 3-day cycle of treatment [1] and the subsequent increase. The latter is here indicated by a straight line but, in fact, the shape of this " recovery curve " would depend upon whether the post-treatment rise was due mainly to clinical relapses of

[1] Observations were made on the third day of each cycle of treatment, before the final instillation of ointment was given. A lower level of conjunctivitis would no doubt have been reached on the following day but it was impracticable to reassemble the whole population again for further examinations.

FIG. 7

THE CLINICAL COURSE OF THE SEASONAL EPIDEMIC OF CONJUNCTIVITIS IN THE TREATED GROUP OF VILLAGES IN SKOURA, 1953 [a]



[a] Single points show the results of random surveys at neighbouring control villages.

inadequately treated cases or to reinfections. This was not studied.

The interrupted line joining the peaks of the curve is given here only for comparison with the graphs relating to the Goulmima sector where no record was made of the immediate fall in the conjunctivitis rate after each cycle of treatment.

It can be seen that in October 1952 we had some difficulty in keeping the conjunctivitis rates low in older children. Progressively better results were achieved with younger children, and this while the control curve was increasing. It seems that the younger children were brought for treatment more regularly.

During the second year (1953) the benefits of the treatment were more apparent (Fig. 7). In July, at the commencement of the second season of treatment, the conjunctivitis rate was considerably less than at the corresponding period of the previous year. This may have been because, during the inter-epidemic period, the numbers of residual cases of conjunctivitis and of "carriers" were less than before.[1]

[1] During the winter months of 1952 and 1953, many people from the Skoura sector attended the Ouarzazate hospital. Several hundreds of trichiasis operations were performed and a relatively small amount of antibiotic ointment was distributed for home use. It is unlikely, however, that such treatment alone, given to a few hundred people (mostly to adults and for late complications), would have had any substantial effect on the commencement and course of the next epidemic in a population numbering 10 000.

In the graphs relating to 1953 the maximum points of the epidemic (broken line) observed immediately before each cycle of treatment remain low in each age-group. Owing to lack of clinically trained team-leaders at this stage it was impossible to obtain more data than are shown in these graphs. It was only in September and November that records of the conjunctivitis on the last day of the 3-day cycle of treatment were collected. These show that, in all age-groups, there was practically no obvious conjunctivitis on the evening of the third day.

The curve goes up in October only in children, 9–15 years of age, perhaps for the same reason as the preceding year. In small children, it goes down progressively throughout the season.

The epidemic in 1954 started at a level still lower than that at the beginning of the second year. The curve went down after treatment practically to zero in older children and adults. In mid-September, there were no more Co. 2 or Co. 3 cases in these age-groups. Small children were reinfected less and less and very few cases were observed after October.

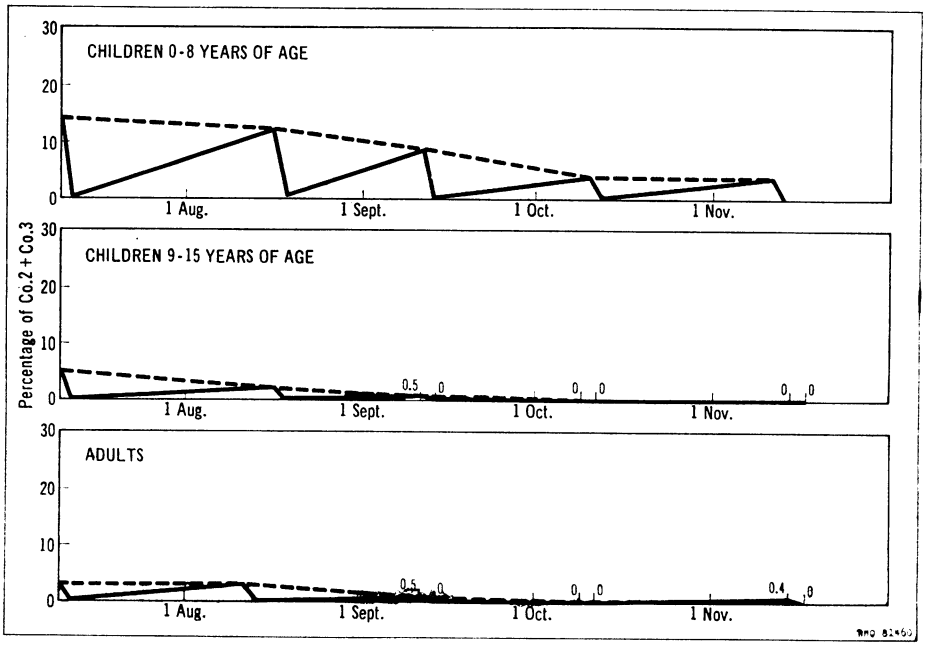
The intermittent treatment schedule as a prophylactic measure could be criticized, because of the risk of creating resistance in the bacteria, especially as it was known that some people were not sufficiently treated because they were not present at all treatment sessions. The fact that during the third season practically all Co. 3 and Co. 2 cases were cured by the third day of each cycle (except the second cycle in small children, see Fig. 8) indicates that in Skoura no clinical evidence of resistance to antibiotics was collected during the first 3 years of this treatment.

During the third year the distribution of ointment was also continued in the rest of the oasis, according to the general plan of self-treatment for the whole territory of Ouarzazate. Practically all villages with which the inhabitants of Skoura could have had contact were now also included in the treatment. In a large area surrounding Skoura, mass-treatment had been available for 1, 2 or 3 years.

It is hoped that the number of carriers in the community has been greatly reduced so that in future the people, having had experience of the benefits, can keep the epidemic low by continuing to use the antibiotic, available to them at a subsidized price, and by following the health education propaganda given to them.

FIG. 8

THE CLINICAL COURSE OF THE SEASONAL EPIDEMIC OF CONJUNCTIVITIS IN THE TREATED GROUP OF VILLAGES IN SKOURA, 1954



Effects of intermittent treatment on trachoma

In the 1572 persons examined before treatment not one eye was trachoma-free.[1] Some 13.2% of the cases were in stage IV and, since practically no treatment was available in this area before the commencement of these trials, it may be assumed that the majority of these cures were spontaneous (Table 18).

Three months after the end of the first year's treatment it was evident that the treatment and the absence of seasonal conjunctivitis had helped the evolution of trachoma towards healing, or at least ameliorated it to an important degree. In all age-groups, there was a marked diminution of follicles and infiltration. In children, stages I and II were disappearing and were replaced by stages III and IV (Decour, Ferrand & Reinhards, 1954). Consequently it was decided to follow a similar treatment schedule in this sector for at least 2 more years. The interval between the cycles of treatment was extended to 4 weeks, but otherwise the treatment and examination were the same as before.

From this experience we hoped to learn what would happen to trachoma with prophylactic treatment initially directed against seasonal conjunctivitis and given in the best way possible under local conditions (applications made by teams during treatment sessions throughout 3 seasons).

Table 19 shows that big changes occurred in the prevalence of trachoma as a result of the 3-year campaign. Whether treated or not, 49.2% of the population showed complete clinical cure as against 13.2% before the treatment was started, and an important improvement was seen in a large number of the remaining 50.8%. The early and florid forms had disappeared and had been replaced in most cases by a mild form of Tr III. In these cases follicles, and infiltration of the conjunctiva and cornea had disappeared and only a slight papillary hypertrophy was still present.

The whole picture can also be shown as follows:[2]

	Before treatment	*After 3 seasons' treatment*
Tr 0	0	2.2
Cured	13.2	49.2
Probably cured—category X (see Table 20)	0	29.1
Slight trachoma	30.0	5.5
Intense trachoma	52.3	13.8
Very intense trachoma	4.6	0.3

Another very significant finding was that in the winter of 1955 out of the 35 infants examined, who had been born during the previous year, 17 were still free from trachoma, as were 3 of the 22 infants born in the year before that. Of these 20, three were older than 1 year, 4 were 1 year old, 2 were 8 months old, 1 was 7 months old, 4 were 6 months old, 4 were 4 months old, 2 were 3 months old and 3 were 1 month old or less, possibly too young to show signs of trachoma.

This means that the first 20 infants escaped the last season's dangers by the protection afforded. It was the first time that so many trachoma-free infants had been seen among the inhabitants of Skoura. Some of these may have become infected during later years, but some may have escaped even longer owing to a decrease in the source of infection.

Because of growing absenteeism only some of the village people could be examined and treated regularly. A group of 888 people were seen and treated regularly, however, at all cycles throughout the 3-year period.

The effectiveness of this treatment can be studied in more detail on this group of 888 people. Table 20 shows the trachoma situation in this co-operative group before and after 3 seasons of treatment.

Table 21 shows that results differ according to age-groups; it contains only those cases of trachoma which were found active on the day of first examination.

The best results were obtained among older children and adults, while the results were less satisfactory with young children and old people.

It is possible that trachoma becomes cured spontaneously if it is freed from secondary infections. But this hardly explains the better results obtained in infants, in whom the tendency to spontaneous cure must be minimal and in whom the elimination of the conjunctivitis was the most incomplete. The trachoma in infants, however, was mostly in stage I and early stages of Tr II. This seemed to us in 1954 to indicate that the local, intermittent chlortetracycline treatment had a specific action on the trachoma agent.

[1] Children under 40 days of age were never, and those under 2–3 months only rarely, shown to the examiner.

[2] By the time of these trials the classification as slight, intense and very intense did not coincide with the criteria adopted by the WHO Expert Committee on Trachoma (1962) but were then based on the amount of follicles and papillary hypertrophy; this nearly corresponds to the classification of intensity.:

Slight trachoma : Tr I, II+, III+
Intense trachoma : Tr II++, III++
Very intense trachoma: Tr II+++, III+++

TABLE 18

PREVALENCE OF TRACHOMA IN 4 VILLAGES IN THE SKOURA DISTRICT IN JULY 1952, BEFORE TREATMENT

Trachoma		Age-group (years)					
Stage	Intensity	≥ 51	16–50	9–15	2–8	0–1	Total
Tr 0		0	0	0	0	0	0
Tr I	+	0	2 0.3 %	1 0.5 %	43 10.2 %	60 53.1 %	106 6.7 %
	++	0	0	0	0	0	0
	+++	0	0	0	0	0	0
Total Tr I		0	2 0.3 %	1 0.5 %	43 10.2 %	60 53.1 %	106 6.7 %
Tr II	+	0	2 0.3 %	4 1.9 %	81 19.1 %	42 37.2 %	129 8.2 %
	++	0	9 1.3 %	37 17.5 %	211 49.9 %	11 9.7 %	268 17.0 %
	+++	0	1 0.1 %	1 0.5 %	1 0.2 %	0	3 0.2 %
Total Tr II		0	12 1.7 %	42 19.8 %	293 69.3 %	53 46.9 %	400 25.4 %
Tr III	+	11 9.5 %	143 20.2 %	47 22.2 %	37 8.7 %	0	238 15.1 %
	++	54 46.6 %	342 48.3 %	106 50.0 %	50 11.8 %	0	552 35.1 %
	+++	28 24.1 %	38 5.4 %	3 1.4 %	0	0	69 4.4 %
Total Tr III		93 80.2 %	523 73.9 %	156 73.6 %	87 20.6 %	0	859 54.6 %
Tr IV	0	0	0	0	0	0	0
	+	7 6.0 %	88 12.4 %	11 5.2 %	0	0	106 6.7 %
	++	16 13.8 %	81 11.4 %	2 0.9 %	0	0	99 6.3 %
	+++	0	2 0.3 %	0	0	0	2 0.1 %
Total Tr IV		23 19.8 %	171 24.2 %	13 6.1 %	0	0	207 13.2 %
Total		116 100.0 %	708 100.1 %	212 100.0 %	423 100.1 %	113 100.0 %	1 572 99.9 %

TABLE 19

PREVALENCE OF TRACHOMA IN THE SKOURA DISTRICT IN FEBRUARY 1955, 3 MONTHS AFTER THE END OF THE THIRD YEAR'S TREATMENT [a]

Trachoma		Age-group (years)					
Stage	Intensity	≥ 51	16–50	9–15	2–8	0–1	Total
Tr 0	0	0	0	0	3 1.0 %	20 57.1 %	23 2.2 %
Tr I	+	0	0	0	7 2.3 %	3 8.6 %	10 1.0 %
	++	0	0	0	0	0	0
	+++	0	0	0	0	0	0
Total Tr I		0	0	0	7 2.3 %	3 8.6 %	10 1.0 %
Rr II	+	0	0	0	3 1.0 %	1 2.9 %	4 0.4 %
	++	0	0	0	1 0.3 %	8 22.9 %	9 0.9 %
	+++	0	0	0	0	0	0
Total Tr II		0	0	0	4 1.3 %	9 25.7 %	13 1.2 %
Tr III	+ F_0	40 26.7 %	88 23.3 %	72 39.8 %	104 34.4 %	0	304 29.1 %
	+ F_+	2 1.3 %	13 3.4 %	2 1.1 %	26 8.6 %	0	43 4.1 %
	++	21 14.0 %	35 9.3 %	24 13.3 %	55 18.2 %	0	135 12.9 %
	+++	0	0	1 0.6 %	2 0.7 %	0	3 0.3 %
Total Tr III		63 42.0 %	136 36.1 %	99 54.7 %	187 61.9 %	0	485 46.4 %
Tr IV	0	0	0	0	5 1.7 %	3 8.6 %	8 0.8 %
	+	1 0.7 %	21 5.6 %	8 4.4 %	66 21.9 %	0	96 9.2 %
	++	52 34.5 %	166 44.0 %	63 34.8 %	27 8.9 %	0	308 29.5 %
	+++	34 22.7 %	54 14.3 %	11 6.1 %	3 1.0 %	0	102 9.8 %
Total Tr IV		87 58.0 %	241 63.9 %	82 45.3 %	101 33.4 %	3 8.6 %	514 49.2 %
Total		150 100.0 %	377 100.0 %	181 100.0 %	302 99.9 %	35 100.0 %	1 045 100.0 %

[a] 888 of these cases were under regular control for 3 years, the rest were not controlled so regularly.

TABLE 20

PREVALENCE OF TRACHOMA IN THE SKOURA DISTRICT IN THE GROUP OF PEOPLE TREATED REGULARLY FOR 3 YEARS

Severity	Before treatment (%)	After 3 seasons of treatment (%)
Cured	11.4 [a]	52.2
Probably cured [b]	—	30.3
Slight trachoma	31.4	3.8
Intensive trachoma	52.7	13.4
Very intensive trachoma	4.5	0.2

[a] In this regularly treated group the initial Tr IV rate is lower than that shown in Table 18, which refers to the total population, because many people with Tr IV, aware of not being ill, did not regularly come for treatment and examination.

[b] Category X (probable cure): Fine papillary hypertrophy or follicles non-pathognomonic of trachoma present at the end of the follow-up period, but with no active corneal lesions. Need for further observation or investigation (Reinhards, Weber & Maxwell-Lyons, 1959).

Besides the cures and the evident failures, there was a third large group of probable cures. In all these cases, in addition to scars only some papillary hypertrophy, which had remained unchanged for a long time, was present at the end of the follow-up period. For this reason, it seemed to us that the diagnosis of a complete clinical cure could not be confirmed. We know now, however, that in the absence of any other active symptoms, such as follicles or corneal infiltration, this slight papillary hypertrophy if seen after antibiotic treatment is not necessarily a sign of still active trachoma (Reinhards, Weber & Maxwell-Lyons, 1959).

Thus our figures on the number of cures were rather too low, as many of the " probable cures " should be added to the total.

Another reason why the number of cures was likely to be higher than shown in the tables is that once they were cured some people no longer came to the treatment sessions and were thus lost for statistical purposes. On the contrary those who were still suffering usually came regularly for examination.

Table 22 gives some more details about what happened to the cases of trachoma which were initially in different stages and of different intensities, after three seasons of treatment. Stages III and I show the better results, stage II was less frequently cured. Those with more severe lesions usually showed less amelioration. Certain cases became aggravated during the treatment.

TABLE 21

RESPONSE TO TREATMENT OF 888 PEOPLE IN THE SKOURA DISTRICT WHO WERE UNDER CONTROL DURING 3 SEASONS AND WHO HAD ACTIVE TRACHOMA BEFORE TREATMENT

	Age-group (years)					
	≥ 51	16–50	9–15	2–8	0–1	Total
Cures (A)	25 46.3 %	171 58.2 %	56 59.6 %	97 34.9 %	29 43.3 %	378 48.0 %
Probable cures (X)	19 35.2 %	86 29.3 %	28 29.8 %	112 40.3 %	13 19.4 %	258 32.8 %
Total success	81.5 %	87.5 %	89.4 %	75.2 %	62.7 %	80.8 %
Relapse (B_2)	6 11.1 %	26 8.8 %	7 7.4 %	37 13.3 %	14 20.9 %	90 11.4 %
Resistant (B_3)	4 7.4 %	11 3.7 %	3 3.2 %	32 11.5 %	11 16.4 %	61 7.8 %
Total failures (B)	18.5 %	12.5 %	10.6 %	24.8 %	37.3 %	19.2 %
Total	54	294	94	278	67	787

TABLE 22

CHANGES IN TRACHOMA AFTER 3 SEASONS OF TREATMENT IN RELATION TO THE STAGE AND INTENSITY BEFORE TREATMENT [a]

Before treatment			After treatment—stage and intensity [b]										
			Tr III					Tr IV					
Stage	Intensity	No.	+		++	+++	Total	0	+	++	+++	Total	Total
			F_0	F_+									
Tr I	+	53 6.0 %	10 18.9 %	7 13.2 %	8 15.1 %	0	25 47.2 %	0	24 45.3 %	4 7.5 %	0	28 52.8 %	53 100 %
	++	2 0.2 %	0	0	0	0	0	0	1 50.0 %	1 50.0 %	0	2 100 %	2 100 %
	+++	0	0	0	0	0	0	0	0	0	0	0	0
Total Tr I		55 6.2 %	10 18.2 %	7 12.7 %	8 14.5 %	0	25 45.5 %	0	25 45.5 %	5 9.1 %	0	30 54.5 %	55 100 %
Tr II	+	94 10.6 %	30 31.9 %	12 12.8 %	26 27.7 %	1 1.1 %	69 73.4 %	1 1.1 %	15 16.0 %	9 9.6 %	0	25 26.6 %	94 100 %
	++	166 18.7 %	78 47.0 %	7 4.2 %	28 16.9 %	1 0.6 %	114 68.7 %	0	18 10.8 %	31 18.7 %	3 1.8 %	52 31.3 %	166 100 %
	+++	2 0.2 %	1 50.0 %	0	1 50.0 %	0	2 100 %	0	0	0	0	0	2 100 %
Total Tr II		262 29.5 %	109 41.6 %	19 7.3 %	55 21.0 %	2 0.8 %	185 70.6 %	1 0.4 %	33 12.6 %	40 15.3 %	3 1.1 %	77 29.4 %	262 100 %
Tr III	+	130 14.6 %	33 25.4 %	0	6 4.6 %	0	39 30.0 %	0	12 9.2 %	73 56.2 %	6 4.6 %	91 70.0 %	130 100 %
	++	302 34.0 %	95 31.5 %	7 2.3 %	34 11.3 %	0	136 45.0 %	0	4 1.3 %	97 32.1 %	65 21.5 %	166 55.0 %	302 100 %
	+++	38 4.3 %	11 28.9 %	1 2.6 %	12 31.6 %	0	24 63.2 %	0	0	2 5.3 %	12 31.6 %	14 36.8 %	38 100 %
Total Tr III		470 52.9 %	139 29.6 %	8 1.7 %	52 11.1 %	0	199 42.3 %	0	16 3.4 %	172 36.6 %	83 17.7 %	271 57.7 %	470 100 %
Tr IV	0	0	0	0	0	0	0	0	0	0	0	0	0
	+	47 5.3 %	4 8.5 %	0	1 2.1 %	0	5 10.6 %	0	12 25.5 %	30 63.8 %	0	42 89.4 %	47 100 %
	++	53 6.0 %	7 13.2 %	0	3 5.7 %	0	10 18.9 %	0	3 5.7 %	38 71.7 %	2 3.8 %	43 81.1 %	53 100 %
	+++	1 0.1 %	0	0	0	0	0	0	0	1 100 %	0	1 100 %	1 100 %
Total Tr IV		101 11.4 %	11 10.9 %	0	4 4.0 %	0	15 14.9 %	0	15 14.9 %	69 68.3 %	2 2.0 %	86 85.1 %	101 100 %
Total		888 100 %	269 30.3 %	34 3.8 %	119 13.4 %	2 0.2 %	424 47.7 %	1 0.1 %	89 10.0 %	286 32.2 %	88 9.9 %	464 52.3 %	888 100 %

[a] Data from a group of 888 people who were regularly treated during 3 seasons.

[b] No patients were in stage I or stage II after treatment.

Cicatrization

The degree of cicatrization is important in the evaluation of a method of treating trachoma. It may be classified conveniently as C0, C+, C++, C+++. Prognosis, as far as risk of late complications, entropion, trichiasis, etc., is good if residual scarring is C0 or C+, doubtful if C++ and bad if C+++. Table 23 shows the degree of cicatrization resulting from the healing of trachoma cases which were initially of different intensity.

TABLE 23

DEGREE OF CICATRIZATION RESULTING FROM THE HEALING OF TRACHOMA CASES OF DIFFERENT INTENSITIES

Stage and intensity	No. of cases	Degree of cicatrization	Percentage of total cases
Tr I	0	C0	0
	25	C+	83.3
	5	C++	16.6
	0	C+++	0
Tr II ‡	1	C0	4.0
	15	C+	60.0
	9	C++	36.0
	0	C+++	0
Tr II++	0	C0	0
	18	C+	34.6
	31	C++	59.6
	3	C+++	5.8
Tr III+	12	C+	13.2
	73	C++	80.2
	6	C+++	6.6
Tr III++	4	C+	2.4
	97	C++	58.4
	65	C+++	39.2
Tr III+++	0	C+	0
	2	C++	14.3
	12	C+++	85.7

In 1955, in Skoura, it seemed possible that treatment with the new drugs would eventually reduce the amount of scarring. Most of the older and more intense cases of trachoma would be cured and young children who would not necessarily escape infection would be cured early. This possibility was partly confirmed in a survey made 10 years later in Goulmima (see p. 522).

Relapses and resistant cases

In the follow-up of individual case-histories there were numerous examples of exacerbation after marked improvement and of reactivation after clinical cure (Table 21). About 20% of all cases suffered one or more relapses, but were finally cured. Another 11.7% of the cases had relapses which ended in a quiet stationary stage, with only a slight papillary hypertrophy present.

A further 11.4% of the cases relapsed after a marked improvement and, at the end of the follow-up period, were still in a more or less florid stage. These cases must be considered as real failures (B_2 in Table 21). It is seldom possible, in these cases, to differentiate between a relapse and a reinfection.

Out of 101 persons who were considered as spontaneously cured (Tr IV) before the beginning of our campaign in 1952, 15 were found to have symptoms of relapse or reinfection during or at the end of the follow-up period. Of these, 11 showed very slight pathological signs (slight papillary hypertrophy only). In these cases a reactivation of the trachoma cannot be excluded, but it seems more likely that a non-trachomatous papillary hypertrophy appeared, which had not been seen before. In later years, when self-treatment replaced professional treatment in Skoura, many more relapses or reinfections probably occurred.

Table 21 (B_3) shows that 7.8% of the cases proved resistant to the treatment, or showed only minor improvement.

Relation of the curability of trachoma to associated bacterial infections

Trachoma associated with chronic *Moraxella* angular conjunctivitis appeared to be relatively resistant to treatment. Clinical signs of *Moraxella* infections were more prevalent and more severe in winter than in summer and whole families, particularly the poorer ones, were often afflicted.

Some individuals were much more prone to repeated bacterial infections than others, and in these, trachoma tended to be more severe and more resistant to treatment.

Table 24 shows the number of cases in which acute or sub-acute conjunctivitis was seen only once or not at all during the 3 seasons, compared with the number of cases in which the acute or sub-acute conjunctivitis reappeared several times (4 times or

TABLE 24

EFFECT OF RECURRENT OR PERSISTENT ASSOCIATED INFECTIONS ON THE CURABILITY OF TRACHOMA IN THE SKOURA DISTRICT

Age-group (years)	Status of trachoma at end of follow-up period	In cases without persistent or repeatedly appearing associated infections	In cases with persistent or repeatedly occurring associated infections				
			Total	Repeated attacks of mucopurulent conjunctivitis (Co.3 or Co.2)	Persistent angular blepharo-conjunctivitis (M-A type)	Persistent blepharo-conjunctivitis with repeated mucopurulent conjunctivitis	Total
Adults ≥ 16	Not cured	21 7.5 %	17 40.5 %	4 33.3 %	5 35.7 %	8 50.0 %	38
	X (probably cured)	88 31.3 %	14 33.3 %	2 16.7 %	5 35.7 %	7 43.8 %	102
	Cured	172 61.2 %	11 26.2 %	6 50.0 %	4 28.6 %	1 6.3 %	183
	Total	281 100.0 %	42 100.0 %	12 100.0 %	14 100.0 %	16 100.0 %	323
Children 1–8	Not cured	28 19.4 %	17 37.8 %	14 35.9 %	0	3 50.0 %	45
	X (probably cured)	53 36.8 %	15 33.3 %	12 30.8 %	0	3 50.0 %	68
	Cured	63 43.8 %	13 28.9 %	13 33.3 %	0	0	76
	Total	144 100.0 %	45 100.0 %	39 100.0 %	0	6 100.0 %	189

more) during the 3 seasons. By comparing the cure rate in each of these groups, we may conclude that the cure rate was significantly higher in the group in which the acute or sub-acute conjunctivitis was not observed at all or, if present, did not recur and in which angular conjunctivitis of the Morax-Axenfeld was never observed.

This clinical observation demonstrates the great role played by seasonal conjunctivitis and by infections with *Moraxella* on the epidemiology of trachoma in North Africa.

Re-examination of the population 12 years later

After the 3 seasons of treatment applied by mobile teams only self-treatment was available to the population (see p. 519). In 1964 the whole population of the same villages was re-examined. A total of 1990 persons was seen and Table 25 shows the trachoma situation presented in the same way as in 1952. Of the infants 0–1 years of age 56.4% were now found trachoma-free; 11.1% of children aged 2–8 years and 3.6% of children aged 9–15 years had no trachoma symptoms.

This may mean that the transmission rate and the source of infection had both decreased. The high level of cured trachoma in old people and adults shows the direct effect of mass treatment. In older children the cure rate was less satisfactory. The situation in children younger than 8 years old may suggest that the benefits of the treatment applied by mobile teams were not maintained by self-treatment in this age-group.

Fig. 9 allows a comparison of the situation before and after the mass campaign. In 1952 no child was seen who was not already infected at the age of 2 months. The first spontaneous cures were found after the age of 8 years, about 25% of them in adults.

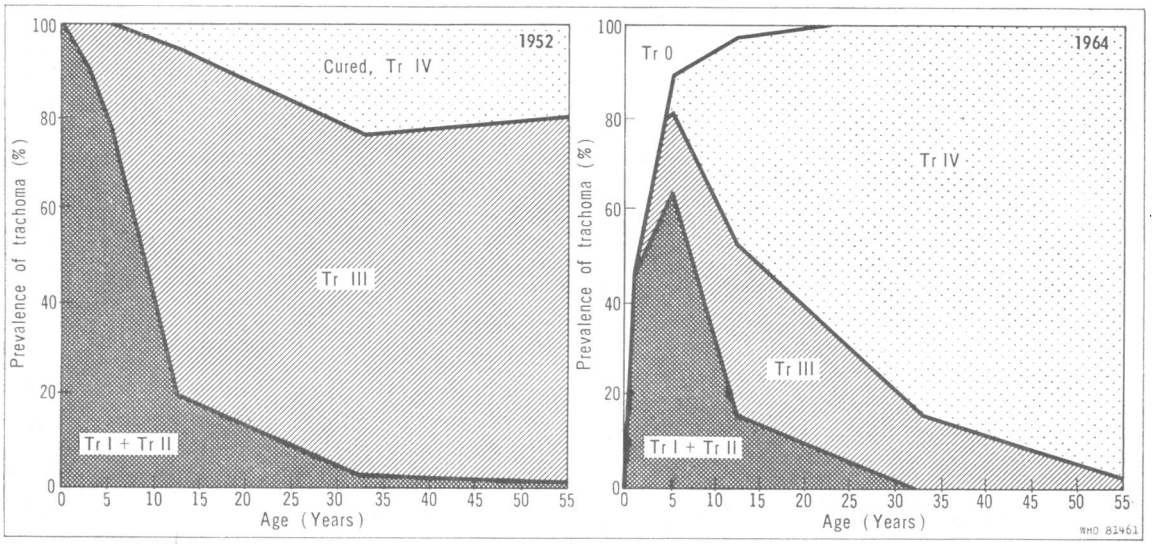
TABLE 25

PREVALENCE OF TRACHOMA IN THE SKOURA DISTRICT IN 1964, TWELVE YEARS AFTER THE BEGINNING OF THE MASS CAMPAIGN

Trachoma		Age-group (years)					
Stage	Intensity	≥ 51	16–50	9–15	2–8	0–1	Total
Tr 0		0	2	10	68	57	137
Tr I	+	0	0	17 62 %	166 27.1 %	27 26.7 %	210 10.6 %
	++	0	0	0	11 1.8 %	1 1.0 %	12 0.6 %
	+++	0	0	0	0	0	0
Total Tr I		0	0	17 6.2 %	177 28.9 %	28 27.7 %	222 11.2 %
Tr II	+	0	4 0.6 %	2 0.7 %	7 1.1 %	3 3.0 %	16 0.8 %
	++	0	0	22 7.9 %	163 26.6 %	12 11.9 %	197 9.9 %
	+++	0	0	4 1.4 %	49 8.0 %	1 1.0 %	54 2.7 %
Total Tr II		0	4 0.6 %	28 10.1 %	219 35.8 %	16 15.8 %	267 13.4 %
Tr III	+	1 0.3 %	101 15.0 %	101 36.6 %	102 16.7 %	0	305 15.3 %
	++	1 0.3 %	12 1.8 %	3 1.1 %	6 1.0 %	0	22 1.1 %
	+++	1 0.3 %	0	1 0.4 %	0	0	2 0.1 %
Total Tr III		3 0.9 %	113 16.8 %	105 38.0 %	108 17.6 %	0	329 16.5 %
T IV	0	0	1 0.1 %	0	0	0	1 0.1 %
	+	35 10.7 %	146 21.7 %	91 33.0 %	37 6.0 %	0	309 15.5 %
	++	162 49.5 %	302 44.8 %	21 7.6 %	3 0.5 %	0	488 24.5 %
	+++	127 38.8 %	106 15.7 %	4 1.4 %	0	0	237 11.9 %
Total Tr IV		324 99.1 %	555 82.3 %	116 42.0 %	40 6.5 %	0	1035 52.0 %
Total		327 100.0 %	674 100.0 %	276 99.9 %	612 99.9 %	101 99.9 %	1990 100.0 %

FIG. 9

PREVALENCE OF TRACHOMA IN SKOURA IN 1952 AND 1964 [a]



[a] After 3 years of intermittent treatment and 9 years of self-treatment.

4. ADAPTATION OF THE INTERMITTENT METHOD OF TREATMENT TO A LARGE-SCALE FIELD CAMPAIGN IN OUARZAZATE, 1953–54

Until such a time as the general standard of living and hygiene in Morocco can be further improved, collective treatment with antibiotics appears to be the most effective way of reducing the toll of trachoma and epidemic conjunctivitis. Experience has shown, however, that treatment must be repeated each year for many years. In hyperendemic areas gatherings of village communities and treatment by teams have proved a satisfactory way of reaching the inhabitants but tended to become unpopular after a time. Despite the most advantageous deployment of resources this system is too costly in personnel and transport, however, to be continued on a more or less permanent basis in a population numbering millions.

In view of the good collaboration of the people, and their obvious appreciation of the relief afforded by treatment, the Government took the view that a programme of self-treatment of the population could be gradually and successfully introduced. Further, as a necessary long-term saving and in order to give the people a sense of responsibility in their own problems, it was decided that they should ultimately be induced to purchase their requirements of antibiotic ointment. The relatively low cost of the drug needed per person together with the practical and psychological advantages of the short-term intermittent schedule of treatment offered hopes of success in this direction.

A programme was planned along the following lines:

1st year— Practical demonstration of the value of antibiotics in the control of trachoma and epidemic conjunctivitis, during a season of collective treatment by professional teams. Simple health education, and explanations were repeated regularly.

2nd year— Systematic instruction and practice in the application of antibiotic ointment; continued health education and campaign propaganda. Six cycles of intermittent antibiotic treatment applied by the people themselves; the ointment distributed free by teams in the course of monthly supervisory visits.

3rd and subsequent years— Annual visit to each community by a professional team for a single free distribution of ointment and repetition of instruction. From then on, supply of antibiotic ointment, through tobacco shops in every village market place, for sale at a low price subsidized by the Government.[1]

This 3-stage programme was commenced in July 1953 in the territory of Ouarzazate and covered practically the whole accessible population of 120 000.

Because a full evaluation of such a programme is extremely difficult and cannot in any case be completed for a number of years, an attempt at evaluation was made in a chosen sector with total population of over 5000.

The sector chosen for this purpose was similar in most respects to that of Skoura (see above).

Unfortunately many practical difficulties were encountered. Migration of the population interfered with the survey and attendance at the gatherings was generally poor. At times, floods made it impossible to visit some of the villages. Untreated control villages were extremely difficult to maintain and were soon abandoned as useless. Finally, it was impossible to carry out systematic surveys during the third year (the first year in which ointment was bought by the villagers themselves) because, at this stage, the people refused to come to the gatherings only to be examined.

For these reasons, only the following somewhat incomplete appraisal of the first 2 phases of the programme was possible. The results, however, were distinctly encouraging and provided some indications as to how the programme should be developed. A long-term evaluation, giving some information on the validity of self-treatment, was attempted in the sectors of Goulmima and Skoura as discussed above.

RESULTS

Seasonal epidemic conjunctivitis

In the course of the first season of collective treatment by professional teams (1953), the initial high rate of conjunctivitis was greatly reduced and kept at a low level throughout the epidemic seasons (Fig. 10).

At the commencement of the second season (July 1954), when self-treatment was introduced, the conjunctivitis rate was considerably lower than at the corresponding period of the year before. Throughout this second season, moreover, the conjunctivitis rate for all age-groups was maintained at a lower level than during the previous year. A similar progressive effect of the treatment repeated during 2 consecutive years was seen earlier in the sector of Skoura (Fig. 7 and 8).

Trachoma

Although no untreated control villages were available in the sector of Ouarzazate, attention is drawn to the comparative findings in treated and untreated communities during the same year (1954) in the Goulmima sector (see Fig. 3 and pp. 503–504).

Out of a total of 5000 inhabitants in the pilot sector of Ouarzazate, 1908 attended all treatment and distribution sessions and were present at all clinical examinations. Only this group is considered here.

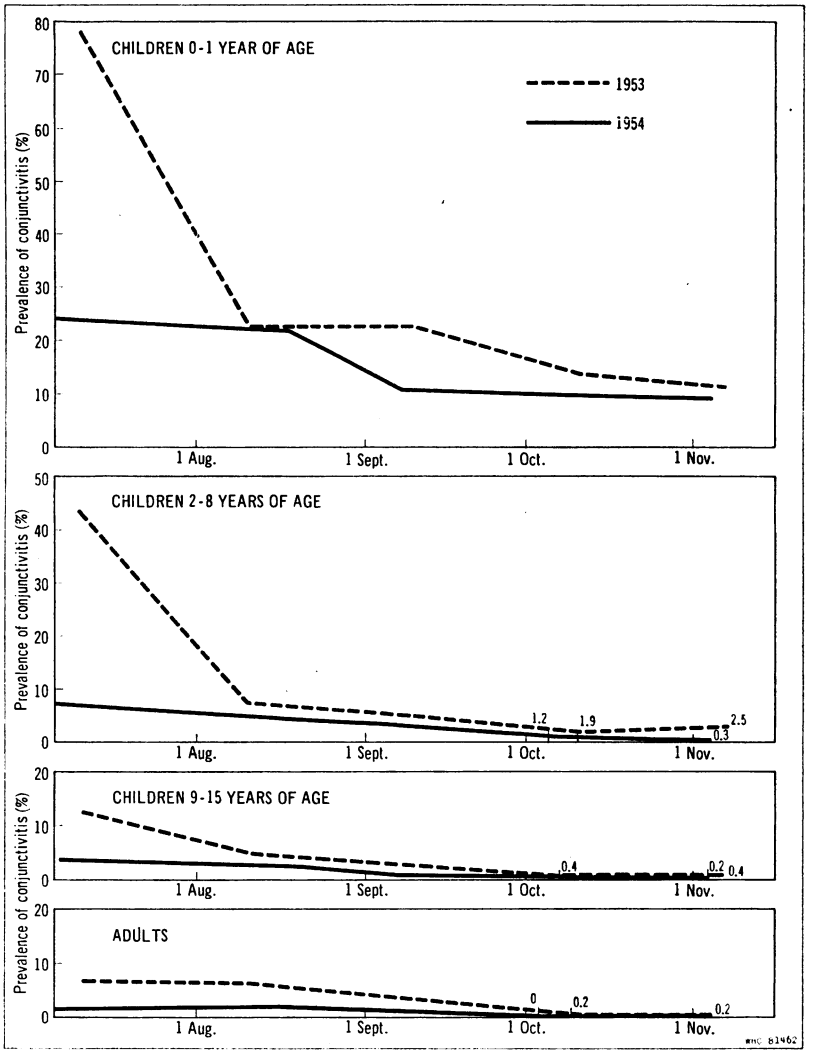
Changes in the clinical picture of trachoma during the period of observation can be seen from Tables 26 and 27.

Table 28 shows, for comparison, the results in the Ouarzazate sector and those in the sector of Skoura, each after at least 2 seasons of treatment. It will be seen that there was little difference between the 2 sectors in the results obtained in persons over 8 years of age. In younger children, however, the response to treatment was less satisfactory in Ouarzazate than in Skoura. The reason for this no doubt lies in the fact that in Ouarzazate, where administration of the second season's treatment was entrusted for the first time to the people themselves, it was used primarily on adults and older children.

It has been observed repeatedly in several surveys in the south that the very young children were neglected in this respect. At first, conjunctivitis was so common among them that parents tended to look upon it as a natural phenomenon, and they often denied that a child had any disease even when the eyelids were swollen and full of purulent secretion. Trachoma—invariably contracted in infancy, insidious in onset, and mild in its early course—usually went unnoticed at this stage. The parents who attempted to treat their infants found difficulty in applying the ointment through small and oedematous lids and too little if any may have reached the conjunctival sac.

[1] During the 3rd phase of the operation standard 5-g tubes of ointment were put on sale at 30 F (6 US cents) each—equivalent locally to the price of 10 cigarettes or 500 g of bread.

FIG. 10
THE CLINICAL COURSE OF THE SEASONAL EPIDEMICS OF CONJUNCTIVITIS IN OUARZAZATE IN 1953 AND 1954



The above comparison of results would suggest that application of ointment twice daily for 3 consecutive days at monthly intervals for 6 months is about the minimum effective schedule for keeping a conjunctivitis epidemic low and to bring slow improvement in trachoma in that part of the country.

Notes on pannus

It was impossible to carry out detailed examination of the cornea and upper limbus in all people involved. This was partly due to the general difficulties of field conditions, partly to the difficulties under any circumstances in examining the upper limbus of small children. Women also were generally timorous and reluctant to submit to examination at close quarters. Every examination of the cornea was carried out with the aid of the Zeiss hand-model monocular loupe with a small fixed-angle slit-lamp.

From the scant data available we do not feel justified in making any definite statement on the results of collective treatment on lesser corneal and

TABLE 26

PREVALENCE OF TRACHOMA IN OUARZAZATE IN FEBRUARY 1953, BEFORE TREATMENT

Trachoma		Age-group (years)					
Stage	Intensity	≥ 51	16–50	9–15	2–8	0–1	Total
Tr 0		0	0	0	0	1 0.6 %	1 0.05 %
Tr I	+	0	0	0	37 6.3 %	69 42.3 %	106 5.6 %
	++	0	0	0	0	0	0
	+++	0	0	0	0	0	0
Total Tr I		0	0	0	37 6.3 %	69 42.3 %	106 5.6 %
Tr II	+	1 1.1 %	2 0.3 %	11 3.4 %	235 39.7 %	84 51.5 %	333 17.5 %
	++	0	0	24 7.4 %	154 26.0 %	9 5.5 %	187 9.8 %
	+++	0	0	1 0.3 %	6 1.0 %	0	7 0.4 %
Total Tr II		1 1.1 %	2 0.3 %	36 11.1 %	395 66.7 %	93 57.1 %	527 27.6 %
Tr III	+ F_o	46 49.5 %	403 54.8 %	109 33.5 %	33 5.6 %	0	591 31.0 %
	+ F_+	0	6 0.8 %	14 4.3 %	16 2.7 %	0	36 1.9 %
	++	23 24.7 %	186 25.3 %	148 45.5 %	109 18.4 %	0	466 24.6 %
	+++	6 6.5 %	13 1.8 %	2 0.6 %	0	0	21 1.1 %
Total Tr III		75 80.6 %	608 82.7 %	273 84.0 %	158 26.7 %	0	1 114 58.4 %
Tr IV	0	0	0	0	0	0	0
	+	4 4.3 %	47 6.4 %	10 3.1 %	2 0.3 %	0	63 3.3 %
	++	13 14.0 %	75 10.2 %	6 1.8 %	0	0	94 4.9 %
	+++	0	3 0.4 %	0	0	0	3 0.2 %
Total Tr IV		17 18.3	125 17.0	16 4.9 %	2 0.3 %	0	160 8.4 %
Total		93 100.0 %	735 100.0 %	325 100.0 %	592 100.0 %	163 100.0 %	1 908 100.0 %

TABLE 27

PREVALENCE OF TRACHOMA IN OUARZAZATE IN FEBRUARY 1955, AFTER 2 YEARS OF TREATMENT

Trachoma		Age-group (years)					
Stage	Intensity	≥ 51	16–50	9–15	2–8	0–1	Total
Tr 0		0	0	0	0	0	0
Tr I	+	0	0	0	2 0.3 %	10 6.1 %	12 0.6 %
	++	0	0	0	0	0	0
	+++	0	0	0	0	0	0
Total Tr I		0	0	0	2 0.3	10 6.1 %	12 0.6 %
Tr II	+	0	0	0	8 1.4 %	19 11.7 %	27 1.4 %
	++	0	0	0	14 2.4 %	15 9.2 %	29 1.5 %
	+++	0	0	0	0	1 0.6	1 0.1
Total Tr II		0	0	0	22 3.7 %	35 21.5 %	57 3.0 %
Tr III	+ F_0	41 44.1 %	277 37.7 %	129 39.7 %	166 28.0 %	22 13.5 %	635 33.3 %
	+ F_+	1 1.1 %	6 0.8 %	11 3.4 %	64 10.8 %	46 28.2 %	128 6.7 %
	++	11 11.8 %	83 11.3 %	76 23.4 %	239 40.4 %	40 24.5 %	449 23.5 %
	+++	0	6 0.8 %	0	8 1.4 %	0	14 0.7 %
Total Tr III		53 57.0 %	372 50.0 %	216 66.5 %	477 80.6 %	108 66.3 %	1 226 64.3 %
Tr IV	0	0	0	0	1 0.2 %	3 1.8 %	4 0.2 %
	+	6 6.5 %	65 8.8 %	24 7.4 %	47 7.9 %	7 4.3 %	149 7.9 %
	++	24 25.8 %	256 34.8 %	75 23.1 %	40 6.8 %	0	395 20.7 %
	+++	10 10.8 %	42 5.7 %	10 3.1 %	3 0.5 %	0	65 3.4 %
Total Tr IV		40 43.0 %	363 49.4 %	109 33.5 %	91 15.4 %	10 6.1 %	613 32.1 %
Total		93 100.0 %	735 100.0 %	325 100.0 %	592 100.0 %	163 100.0 %	1 908 100.0 %

TABLE 28

RESPONSE TO TREATMENT IN SKOURA AND OUARZAZATE AMONG PERSONS WITH ACTIVE TRACHOMA AFTER TREATMENT FOR 2 AND 3 SEASONS

Category of response [a]	Age-group (years)					
	≥ 51	16–50	9–15	2–8	0–1	Total
Skoura, after 2 seasons of treatment						
A	17 35.4 %	130 38.7 %	53 46.5 %	86 29.2 %	19 27.1 %	305 35.3 %
B	9 18.8 %	48 14.3 %	17 14.9 %	90 30.5 %	28 40.0 %	192 22.2 %
X	22 45.8 %	158 47.0 %	44 38.6 %	119 40.3 %	23 32.9 %	366 42.4 %
Total	48 100 %	336 100 %	114 100 %	295 100 %	70 100 %	863 100 %
Skoura, after 3 seasons of treatment						
A	25 46.3 %	171 58.2 %	56 59.6 %	97 34.9 %	29 43.3 %	378 48.0 %
B	10 18.5 %	37 12.6 %	10 10.6 %	69 24.8 %	25 37.3 %	151 19.2 %
X	19 35.2 %	86 29.3 %	28 29.8 %	112 40.3 %	13 19.4 %	258 32.8 %
Total	54 100 %	294 100 %	94 100 %	278 100 %	67 100 %	787 100 %
Ouarzazate, after 2 seasons of treatment [b]						
A	28 36.8 %	267 43.8 %	98 31.7 %	89 15.1 %	10 7.1 %	492 28.1 %
B	12 15.8 %	93 15.2 %	87 28.2 %	335 56.8 %	131 80.4 %	658 37.6 %
X	36 47.4 %	250 41.0 %	124 40.1 %	166 28.1 %	22 13.5 %	598 34.2 %
Total	76 100 %	610 100 %	309 100 %	590 100 %	163 100 %	1 748 100 %

[a] Category A (success) = clinical cure at the end of the prescribed post-treatment follow-up period (3–6 months); category B (failure) = signs of active trachoma at the end of the follow-up period; category X (doubtful) = cases which at the end of the prescribed follow-up period show no active corneal lesions but in which papillae or follicles, not pathognomonic of trachoma, persist, and which require further observation or investigation.

[b] 1 season intermittent treatment: 1 season self-treatment.

TABLE 29
CORNEAL COMPLICATIONS OF TRACHOMA [a]

Age-group (years)	Time of examination	Pannus, with or without infiltration [b]										
		nil	0.5 mm–2 mm		3 mm–4 mm		5 mm–6 mm		> 6 mm		Total pannus	
			–	+	–	+	–	+	–	+	–	+
2–8 (n = 144)	Before treatment	3	8	66	1	56	2	7	0	1	11	130
	After treatment	3	70	4	52	7	6	1	1	0	129	12
9–15 (n = 198)	Before treatment	2	42	67	6	67	—	7	3	4	51	145
	After treatment	2	118	0	65	3	1	2	7	0	191	5
16–50 (n = 529)	Before treatment	26	243	83	35	90	3	19	4	26	285	218
	After treatment	26	335	0	120	0	15	2	29	2	499	4
≥ 50 (n = 47)	Before treatment	2	8	9	4	6	1	4	2	11	15	30
	After treatment	2	20	0	8	0	0	2	10	3	40	5
Total (n = 918)	Before treatment	33	301	225	46	219	6	37	9	42	362	523
	After treatment	33	543	4	245	10	24	7	47	5	859	26

[a] Examinations carried out with Zeiss hand-model slit-lamp.
[b] – = without infiltration; + = with infiltration.

limbal lesions, but merely state that all gross corneal infiltrations rapidly resolved under treatment with recurrence in only a negligible proportion of cases (Table 29).

One of the lessons to be learnt from these first experiences of collective self-treatment of the population is that, while the method has proved to be practicable and reasonably effective in the higher age-groups, it has not immediately been sufficiently directed towards the infants and young children. This suggests that, not only should sufficient antibiotic ointment be distributed to ensure that every member of the family could be treated at least 3 days each month, but also that special health education and more intensive campaign propaganda should be devoted to the needs of young children.

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RÉSUMÉ

Dans le cadre d'un programme de lutte contre les ophtalmies transmissibles auquel participaient conjointement le Gouvernement du Maroc, l'OMS et le FISE, des études détaillées ont été effectuées dans plusieurs secteurs pilotes du Sud marocain.

On a constaté qu'avant l'introduction du traitement de masse, la quasi-totalité des habitants étaient victimes, à intervalles réguliers, d'épidémies de conjonctivite saisonnière dont *Haemophilus* était l'agent causal prédominant. Les jeunes enfants, en particulier ceux de 0 à 2 ans, étaient les plus gravement atteints. Dans ce groupe d'âge, l'incidence de la conjonctivite ne diminuait guère pendant l'hiver si la maladie n'était pas traitée et ce fait a probablement joué un rôle important dans l'apparition annuelle des épidémies.

Tous les enfants, ou presque, contractaient le trachome pendant les trois premiers mois de leur existence. La conjonctivite bactérienne exerçait un effet aggravant sur l'évolution du trachome et constituait en elle-même la principale cause de cécité totale. Par comparaison, le trachome représentait la cause unique la plus importante d'atteinte grave de l'acuité visuelle n'allant pas jusqu'à la cécité.

Sur une population totale de 10 776 habitants, 4,1% présentaient une acuité visuelle bilatérale inférieure à 10/200 (« cécité économique »), et le quart d'entre eux étaient complètement aveugles; 10,1% présentaient une diminution importante de l'acuité visuelle avec, dans 3,6% des cas, cécité totale d'un œil. L'incidence de la perte d'acuité visuelle augmentait dans chaque groupe d'âge successif, les femmes étant le plus fréquemment atteintes.

Les trois mesures de lutte antitrachomateuse suivantes ont fait l'objet d'investigations en vue de déterminer leur valeur pour la prévention ou la guérison des ophtalmies transmissibles: *a*) destruction des mouches; *b*) traitement de masse par des applications locales d'antibiotiques; *c*) chimioprophylaxie par les sulfamides.

Rôle des mouches

Les essais effectués au Maroc ont apporté la preuve du rôle joué par les mouches dans la transmission des infections ophtalmiques.

L'élimination des mouches a progressivement abouti à une diminution de la fréquence des infections oculaires chez les nourrissons qui se défendent particulièrement mal contre leurs attaques. A la fin d'une période de 5 à 6 mois pendant laquelle l'absence de mouches a été assurée au moyen d'insecticides chimiques, la réduction de l'incidence des conjonctivites saisonnières était presque comparable à celle obtenue par un traitement local intermittent à la chlortétracycline.

Cette expérience est venue confirmer les observations antérieures selon lesquelles le virus du trachome est transmis par l'intermédiaire des sécrétions contagieuses de la conjonctivite bactérienne lorsque les deux infections coexistent. On a constaté que l'apparition du trachome chez les jeunes enfants, si elle n'était pas prévenue, était en tout cas retardée dans les villages débarrassés des mouches.

Associée à d'autres moyens, la lutte contre les mouches exerce une action préventive supplémentaire et augmente l'effet curatif de la chlortétracycline sur le trachome.

Traitement de masse de la population

Depuis le début de la campagne antitrachomateuse au Maroc, en 1953, le traitement de base par les antibiotiques est resté le même, à savoir des applications de pommade à la chlortétracycline deux fois par jour pendant trois jours consécutifs, répétées chaque mois pendant toute la saison des épidémies. Pour des raisons pratiques, il est apparu que c'était le nombre maximal d'applications qui pouvait être effectué dans les campagnes de masse au Maroc.

L'effet de ce schéma de traitement a été spectaculaire: l'épidémie saisonnière de conjonctivite a été supprimée. Il suffit à guérir la majorité des cas aigus ou subaigus et prévient efficacement les complications cornéennes graves, ce qui lui a immédiatement valu l'adhésion de la population. Répétée chaque année, cette thérapeutique permet de gagner régulièrement du terrain sur la maladie. A condition qu'ils appliquent soigneusement le traitement, les malades peuvent se soigner eux-mêmes avec des résultats semblables.

Cependant, à la fin de la saison épidémique, il reste un réservoir de porteurs de germes qui seront à l'origine de nouvelles poussées de l'infection lors de la prochaine saison de pullulation des mouches. On sait maintenant que tant que l'on n'aura pas éliminé les mouches et que l'on n'aura pas apporté d'autres améliorations fondamentales aux conditions de vie et d'hygiène des populations, le traitement de masse ne saurait à lui seul amener la disparition totale des ophtalmies transmissibles. Pour juguler la maladie, il faudrait donc le recommencer chaque année; c'est pourquoi il a été décidé d'inviter progressivement les malades à se soigner eux-mêmes. Jusqu'à présent on n'a observé aucun signe clinique d'acquisition par les agents pathogènes d'une résistance aux antibiotiques utilisés.

Même dans les pires conditions de milieu rencontrées dans le sud du Maroc, le trachome aussi réagit au traitement de masse intermittent: l'apparition de la maladie est retardée, son intensité est atténuée dans presque tous les cas, la tendance à la résolution apparaît plus tôt et le processus de guérison est accéléré.

Il est possible que la chlortétracycline administrée aux doses indiquées exerce un effet direct sur le virus du trachome.

Résultats à long terme

Dans le secteur pilote de Skoura, après trois saisons successives de traitement intermittent, 48% des cas de trachome actif étaient guéris tandis que chez 33% des malades la guérison était probable mais non confirmée; 19% seulement des cas sont restés évolutifs.

A Goulmima et à Skoura, après 10 années supplémentaires au cours desquelles les malades se sont traités eux-mêmes, le trachome apparaît beaucoup plus tardivement: chez 60% des enfants, la maladie ne se manifeste plus avant un an, 40% ne la contractent qu'après 2 ans et 20% après 3 ans. Chez les enfants qui n'ont pas échappé à l'infection, un nombre croissant de sujets âgés de plus de 3 ans présentent maintenant un trachome guéri et cette proportion atteint 20% chez les sujets âgés de 8 ans. Chez les autres, l'intensité des symptômes évolutifs, et en particulier la gravité relative, est maintenant très inférieure à ce qu'elle était avant, comme le montre l'absence presque totale de cicatrisation excessive conduisant au trichiasis chez les sujets de moins de 15-17 ans. Les opacités cornéennes centrales ont également diminué.

Le taux de guérison après automédication a été évalué chez les adultes à Skoura: il se situe entre 60 et 90%. Le fait que les cicatrices graves constituent un trait prédominant dans ces groupes d'âge s'explique peut-être par la gravité des lésions encourues avant l'instauration du traitement. Il faudra poursuivre les recherches en vue de déterminer si, dans certaines formes de trachome, les malades appartenant à ces groupes d'âge courent un risque plus grand d'être atteints de trichiasis.

Prophylaxie de masse par les sulfamides

L'objectif de cette prophylaxie, consistant en un traitement unique de 4 jours aux sulfamides par voie orale administré au début de la saison des épidémies, est d'éliminer les porteurs de bacilles pathogènes.

L'expérience montre que les ophtalmies présentant les signes cliniques les plus graves guérissent plus souvent que les infections subaiguës et chroniques. L'effet de la thérapeutique se traduit par une chute immédiate du taux de conjonctivite et celui-ci reste à un niveau faible pendant les 2 mois qui suivent le traitement dont l'action est surtout marquée dans le groupe d'âge de 2 à 15 ans. La sulfamidothérapie à faible dose n'exerce, à elle seule, aucun effet sur le trachome avéré.

On a observé que les résultats du traitement de la conjonctivite aiguë et subaiguë par une association de chlortétracycline et de sulfamides différaient très peu de ceux du traitement par une seule de ces substances; cependant la thérapeutique associée réduit le nombre des cas présentant des frottis positifs.

Les traitements combinés ont également augmenté le nombre des guérisons en cas de trachome.

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