

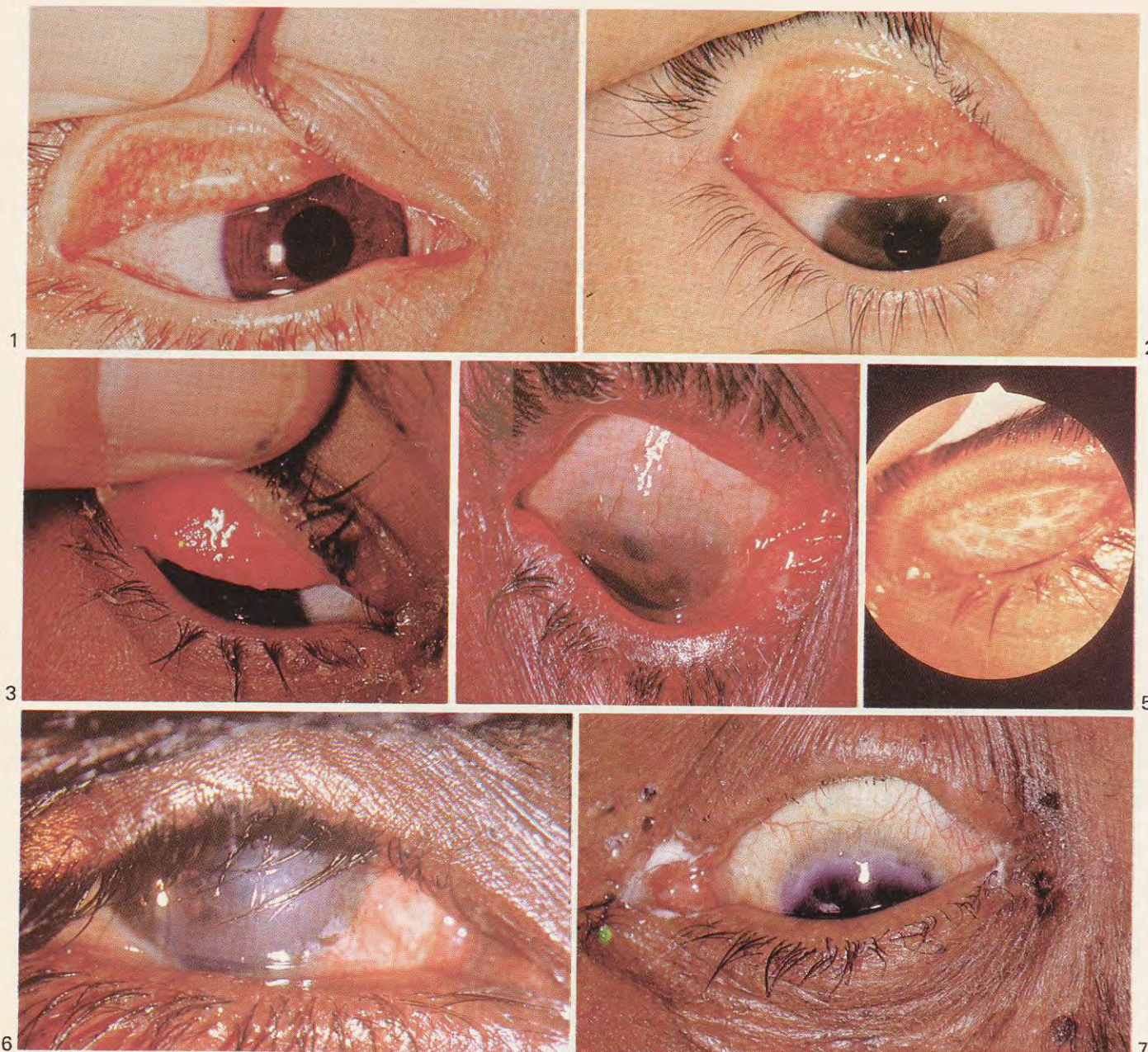


Figure 1
This person has trachoma follicles, which are the small round white objects visible in the central area of the everted upper eyelid. The person has follicular trachoma, the first stage in the disease.

Figure 2
The presence of limbal follicles - often grey or yellow round objects at the limbus, the region on the eye itself where the white and the coloured part of the eye meet - is also a sign of follicular trachoma.

Figure 3
Another sign which helps to diagnose follicular trachoma: papillae, the small round red dots seen here

with trachoma follicles. Some believe that the amount of papillae reflects the degree of inflammation associated with follicular trachoma.

Figure 4
Trachoma has led to the development of a pannus: the crescent shaped white area in the region where the white and the coloured part of the eye meet. A small pannus can be seen, caused by trachoma; in more severe cases, pannus can extend across the eye until it interferes with vision.

Figure 5
Severe scarring of the lid surface is shown here: the lines of scarring are wide and obvious, and have al-

ready caused some contraction of the eyelid. Once scarring has started, a person has cicatricial (scarring) trachoma.

Figure 6
Progressive scarring as a result of trachoma can lead to trichiasis, where the eyelid buckles and the lash rubs against the eyeball.

Figure 7
The resolution of limbal follicles can cause dark round depressions or divots to occur on the limbus. These depressions, known as Herbert's Pits, frequently appear as notches on the pannus.



to develop severity for each of the forms of trachoma. By convention, severity is expressed for the eye.

In follicular trachoma, the most severe category was called follicular trachoma, and research findings that the likely severity of the consequences is closely related to the follicle and papillae grades.²

Category A follicular trachoma was said to exist when a person had, in their worse eye:

- Follicles grade 3
- or Limbal follicles grade 3
- or Papillae grade 3 with follicles grade 1 or 2
- or Papillae grade 3 with limbal follicles grade 1 or 2

An intermediate category of follicular trachoma involving marked, but less marked, signs of follicular trachoma was called Category B. This was when a person did not have follicular trachoma Category A, but had, in their worse eye:

- Papillae grade 2 with follicles grade 1 or 2
- or Papillae grade 2 with limbal follicles grade 1 or 2
- or Papillae grade 1 with follicles grade 2
- or Papillae grade 1 with limbal follicles grade 2

The final severity category of follicular trachoma involved those in whom the diagnosis of follicular trachoma had been made but who did not fit into Categories A or B. These were those in whom the consequences of scarring could be expected to be least severe. These were people with the following signs:

- Follicles 2 with no other signs of follicular trachoma
- Limbal follicles 2 with no other signs of follicular trachoma
- Follicles 1, limbal follicles 1 and papillae 1
- Follicles 1, limbal follicles 1 and papillae 0
- Follicles 1 with Herbert's Pits grade 2 or 3

A similar system was used for assessing the severity of cicatricial trachoma. The most severe category consisted of people with such marked cicatricial signs that their vision was threatened or had already been substantially impaired. Such people were said to have cicatricial trachoma

Category A, or, as some trachoma experts have called it, "blinding or potentially blinding trachoma".³

Category A Cicatricial Trachoma (CTA) is said to exist when a person has in their worse eye:

- Trichiasis 1, 2 or 3
- or Pannus grade 5
- or Scarring grade 3

The intermediate severity category is Cicatricial Trachoma Category B (CTB), diagnosed when a person does not have CTA but has:

- Scarring grade 2
- or Pannus grade 3 or 4
- or Scarring 1 with pannus 2

The third category is Cicatricial Trachoma Category C (CTC), for persons who have neither CTA or CTB, but in whom a diagnosis of cicatricial trachoma has been made. These are those with:

- Pannus grade 1 and scarring grade 1
- or Scarring grade 1 with Herbert's Pits 1, 2 or 3
- or Herbert's Pits grade 2 or 3

There is a very clear relationship between the various cicatricial trachoma severity categories and the level of blindness and disability which results. This is discussed in detail in a later section.

The relationship between the various severity categories of follicular trachoma and visual disability is rather more difficult to establish because the blinding consequences of cicatricial trachoma may take up to 50 years to develop.

What can be said with certainty, however, is that follicular trachoma leads to cicatricial trachoma, and that is strongly associated with visual disability. If follicular trachoma can be prevented, cicatricial trachoma will not occur and trachomatous visual disability and blindness will disappear.

The Trachoma Organism

Follicular trachoma develops after infection with an organism known as Chlamydia trachomatis, a member of the Chlamydia family of organisms.

This family falls between the virus and the bacterium and has attributes of each. It differs from viruses in having a discrete cell wall, rather similar to bacteria, but, like viruses, chlamydial organisms can only reproduce within other cells. Their capacity to provide themselves with their own metabolic requirements is limited; to survive they must divert the metabolic activity of their host cells to their own requirements, so that the activity of the host cell is turned away from its own function and reproduction into the support and production of more chlamydial organisms.⁴

Members of the trachoma family of organisms reproduce most readily in mucous-membrane systems throughout the body. Strains of chlamydia are to be found in most of the body's mucous-membrane systems, and are associated with such diseases as inclusion conjunctivitis, urethritis, epididymitis, proctitis and pneumonia, as well as trachoma. The spectrum of diseases associated with chlamydial organisms is constantly expanding, as is the range of sites where they are found.^{5 6 7 8 9 10}

The trachoma organism reproduces during a cycle in which one form of the organism, called an elementary body, changes from its small, rigid-walled shape into a larger, thin-walled, non-infectious shape, called an initial body. The initial body then divides by binary fission, with the daughter cells then re-organising and condensing to form elementary bodies. These elementary bodies, which are infectious, can survive outside the cell to infect other cells. In the right conditions, chlamydial elementary bodies can survive for several days before finding another host cell.

Elementary bodies shed from one mucous-membrane system may infect other mucous-membrane systems and become associated with particular disease entities there. The hygiene practices of the host - the extent to which he or she permits the easy shedding and spreading of the organism - may be more important in determining whether the organism survives than the host's cell defence system.

Some of the factors which appear to favour the development of clinically evident ocular trachoma are:

1. Conditions within the environment which favour the free exchange of bodily secretions between susceptible persons. These include poor personal and community hygiene; prolonged body contact between persons harbouring the organism and those who are susceptible to it, especially between women and children and between children; the absence of sufficient essential health amenities such as water, shelter and separated living and breathing space; and conditions which prevent the proper use of these facilities, if they exist.

2. Prolonged and repeated exposure to the organism. Although chlamydiae are very persistent organisms, and cause chronic infections, reinfection plays a major role in maintaining the disease. If there is a large infectious pool of the organism within a community, those who manage to get rid of it, whether naturally or as a result of treatment, are likely to be quickly reinfected.

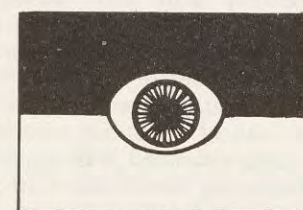
3. Arid climates: heat, low humidity, bright sunshine and dust. All these place an abnormal load on the eye's lubricative and defence mechanism, making it less able to counter infection when it is present.

These factors all add to the intensity and severity of the follicular form of trachoma, and ultimately to the severity of the scarring which results. They add, moreover, to the severity of scarring and other cicatricial changes which already exist.

The same conditions, additionally, favour other bacterial and viral eye infections which may aggravate the clinical response to infection and help further the transmission of chlamydial disease. Secondary bacterial infections increase secretions from the eye's mucous-membrane system, making the transmission of the trachoma organism easier.

In some countries the link between trachoma and secondary eye infections is such that trachoma workers have adopted a term, 'communicable ophthalmia' to refer to the presence of either. At the core of communicable ophthalmia is blinding hyperendemic trachoma, considered to be trachoma complicated by other eye infections.

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Chapter 4: (B)

A Report on Microbiological Findings

by Dr. D.M. Graham, Department of Microbiology, University of Melbourne.

The aims of the microbiological studies conducted during the program were:

1. To provide laboratory back-up to the clinical diagnosis of trachoma, as a monitor of the load of infectious organisms as disease causing agents and as stimulators of the immune response before and after treatment.
2. To isolate *Chlamydia trachomatis* (*C. trachomatis*) agents from cases of clinical trachoma in different areas of Australia in order to
 - (a) determine their sensitivity to sulphonamides before and after treatment.

- (b) determine which serotypes of *C. trachomatis* were present throughout Australia.

- (c) determine whether the virulence of each strain isolated could be correlated with the severity of the disease in the appropriate area from which it came.

3. To determine if there were a correlation between the levels of antibody to *C. trachomatis* in eye secretions and in serum of children of different ages with and without trachoma follicles in different areas throughout Australia.

Collection of specimens

Throughout the field work, specimens were collected mainly from Aboriginal children. In order to attempt to isolate *C. trachomatis* agents, conjunctivae of children with follicle scores 2 or 3 were scraped or swabbed and specimens placed into saline containing sucrose as a protective agent.

To determine the load of *C. trachomatis* in different communities conjunctival scrapings were placed onto microscope slides and fixed in acetone.

For estimation of level and serotype of antibodies to *C. trachomatis*, blood for serum was obtained either by venepuncture or finger prick, and eye secretions were collected in Weckel sponges, and placed into buffered saline. Conjunctival specimens for isolation and eye secretions were transported in liquid nitrogen, -196°C , serum was sent on wet ice, 4° , and conjunctival scrapings on microscope slides were sent dry to the Department of Microbiology, University of Melbourne.

Because of the speed at which the clinical team had to work and the amount of work involved in each laboratory test, it was not possible to collect specimens from each child examined.



A microbiologist takes a specimen from a child with follicular trachoma, at Utopia in the Northern Territory.

Results of attempts to isolate *C. trachomatis* agents

Isolation attempts were made in embryonated eggs from 113 specimens and in HeLa 229 cells from 21 specimens.

Seven isolates were obtained in embryonated eggs, 6 per cent, and none in HeLa cells (Table 1). Isolates were designated by the standard international method of nomenclature.¹

All but one, MUCO-6, were readily passaged in embryonated eggs and in HeLa cells and were serotyped by the two-way test described by Wang and Grayston.² Antisera against each isolate were made by inoculating each separately into mice and collecting their serum after 12 days. Sera were titrated by the micro immunofluorescence test against standard antigens, and preparations of each isolate made from infected HeLa cells used as antigen against standard antisera. Standard antisera against antigens of 3 serotypes, A, B and C of *C. trachomatis* isolated from ocular trachoma cases throughout the world (serotype Ba was not included because of its extensive cross reactivity) and the 7 serotypes isolated from genital tract infections were used. Four of the isolates were serotype B, 1 was serotype C and 1 cross-reacted with both B and C antigens. Four isolates were from Zone 1, 1 was from Zone 4 and 2 from Zone 7.

Six of the isolates were obtained from children aged between 3 and 9

years whose trachoma was graded "follicles 2, papillae 1 or 2" placing their trachoma as Grade 2 "mild" by severity index.³ One of them was obtained from an 8 year old child with "follicles 2, papillae 3" which classified her trachoma as Grade 4 "severe".

These isolation rates were somewhat lower than was expected, for reasons that are obscure. The methods used are both well established ones for the isolation of *C. trachomatis* agents with the HeLa cell technique being generally considered more sensitive than embryonated eggs. Embryonated eggs were used initially as the HeLa cell technique was not fully established in the laboratory at that time, and a 32 per cent isolation rate had been achieved with this technique with conjunctival scrapings taken in Western Australia.⁴

Several laboratories overseas use irradiated McCoy cells as their host cell system for isolation purposes but in our hands we have found that the HeLa 229 cells are 2-4 times more sensitive than McCoys. This is attributed to our use of much richer medium than the overseas workers which increases the sensitivity of the HeLa cells much more than McCoys.⁵

The 6 isolates that were passaged were sensitive to sulphadiazine, when tested in HeLa cell cultures. Because of the low isolation rate it was impracticable to attempt to assess the sulpha sensitivity of isolates made after treatment with Co-trimoxazole as was planned initially.

TABLE 1

Details of children from whom *Chlamydia trachomatis* agents were isolated

Place	State ¹	Zone	Age	Sex ²	Trachoma Grading ³	Strain Designation ⁴	Sulphonamide Sensitivity
Mimili	S.A.	1	3	M	2204010	TRIC/B/AUS-SA/MUCO-1/OT	Sensitive
Mimili	S.A.	1	6	F	2212010	TRIC/B-C/AUS-SA/MUCO-2/OT	Sensitive
Mimili	S.A.	1	8	F	2314030	TRIC/B/AUS-SA/MUCO-3/OT	Sensitive
Wilcannia	N.S.W.	7	5	F	2203200	TRIC/C/AUS-NSW/MUCO-4/OT	Sensitive
Mt. Ebenezer	N.T.	1	9	M	2111100	TRIC/B/AUS-NT/MUCO-5/OT	Sensitive
Wilcannia	N.S.W.	7	7	M	2122300	TRIC/ /AUS-NSW/MUCO-6/OT	Not done
Leonora	W.A.	4	6	F	2201000	TRIC/B/AUS-WA/MUCO-7/OT	Sensitive

1. S.A. = South Australia, N.S.W. = New South Wales, N.T. = Northern Territory, W.A. = Western Australia

2. M = male, F = female

3. Trachoma graded by follicles, papillae, conjunctival scarring, pannus, Herbert's pits, limbal follicles, trichiasis

4. Five element designation of isolate of *C. trachomatis* accepted internationally. 1st element = trachoma & inclusion conjunctivitis; 2nd - serotype; 3rd - country and state of origin; 4th = laboratory designation - Melbourne University - College of Ophthalmology; 5th = ocular trachoma

Microscope slides containing conjunctival scrapings were stained with anti-*C. trachomatis* serum by the indirect immunofluorescence test and examined for the typical, cytoplasmic inclusions of *C. trachomatis* agents. No inclusions were found in over 60 slides examined despite the presence of many conjunctival epithelial cells per slide. The reasons for this failure to find inclusions is not known but is an agreement with that found by Graham and co-workers in their longitudinal study of trachoma at 2 centres in Northern Territory (1975-1979) (to be published). It seems to indicate that the load of infectious organisms in the cases examined was less than in trachoma in the Middle East for example.

Thus, despite the presence of extensive clinical trachoma, the methods for isolating the causal agent and identifying its growth in conjunctival epithelial cells proved unsuitable as monitors of the load of infectious organisms carried. This was somewhat unfortunate as they had proven useful in studies of trachoma in laboratories in other countries.

Results of titrating and serotyping of antibodies against *C. trachomatis* in serum and eye secretions

A total of 2,442 specimens was examined from Aborigines, 792 sera and 1,688 eye secretions (Table 2) and 252 from non-Aborigines, 67 sera and 185 eye secretions. Each specimen was titrated with the indirect microimmunofluorescence test⁶ against antigens of the 10 known sero-

TABLE 2
Numbers of sera and eye secretions collected from Aborigines of different ages.

Age in Years	Number of Specimens	
	Eye Secretions	Serum
0-4	154	23
5-9	854	302
10-14	531	256
15-19	85	73
Over 20	64	69 + 69 age unknown
Totals:	1688	792

types of *C. trachomatis* isolated from ocular and genital trachoma grown in HeLa 229 cells.

Serotypes of *C. trachomatis* detected

Antibodies were detected mainly against serotypes B and C in approximately equal numbers of specimens. One serotype pre-dominated over the other at some centres.

The only other serotypes detected were F/G in one 10 year old girl at Palm Island in Queensland and cross reactive anti-bodies to B/D/E (probably due to serotype Ba) in 3 children in Queensland and in 20% of 98 adults and 38 children under 21 years at Yuendumu, Northern Territory, in Zone 1, where 5 adults also had low titres to the D/E serotype.

D/E and F/G are serotypes associated with genital tract infections. It was of considerable interest that so little evidence was obtained to indicate that genital tract infections with *C. trachomatis* agents were present among the Aboriginal populations studied. While the vast majority of these children were children under 15 years of age, 98 adults were examined at Yuendumu, and a small number also at other centres. This finding is in contrast to what would be expected in the city populations of whites in Australia, where ocular trachoma is virtually unknown but where genital tract infections caused by *C. trachomatis* agents are very common.

Relationships between antibody levels, trachoma follicle gradings, age of children and zones.

In order to assess whether correlations existed between presence or levels of antibody in sera and in eye secretions, the presence or severity of the clinical disease, the age of the person, and the zone in which the

person lived, results were submitted to statistical analysis.

Data was arranged in contingency tables and analysed by the X² analysis for correlation.

There was a significant correlation ($p = < 0.01$) between the presence or absence of antibody in eye secretions and the follicle score when results from all zones and all ages were pooled (Table 3). This showed that

while 33% of persons without trachoma follicles had antibody in eye secretions, 37%, 58% and 65% of persons with follicles 1, 2 and 3 respectively had antibodies. Forty three per cent of secretions from follicles 1, 2 and 3 trachoma had antibody, compared with 33% of those from no-follicle trachoma; 40% of all secretions had antibody.

There was no correlation with follicle scores between the presence and absence of antibodies in sera when data from all ages and zones were analysed (Table 4). Forty four per cent of sera from persons with follicles 1, 2 and 3 trachoma had antibody, while 39% of sera from persons without follicles had antibody; 42% of all sera had antibody to *C. trachomatis*.

These results could be interpreted as indicating that the immune response in eye secretions is more directly related to the severity of the clinical eye disease and hence the amount of antigenic stimulus present in the eye than is the immune response in the serum.

TABLE 3

Relationship between presence and absence of antibodies in eye secretions and follicle scores of clinical trachoma - all zones, all ages.

Antibody status	Follicle Scores				Total
	0	1	2	3	
Present	171	313	177	17	678
Absent	350	524	127	9	1010
Total	521	837	304	26	1688
Percentage with Antibody	32.8	37.4	58.2	65.4	40

$$X^2 = 62.5, \text{ dF} = 3, P = < 0.01$$

TABLE 4

Relationship between presence and absence of antibodies in serum and follicle scores of clinical trachoma - all zones, all ages.

Antibody Status	Follicle Scores				Total
	0	1	2	3	
Present	104	152	76	2	334
Absent	162	207	83	6	458
Total	266	359	159	8	792
Percentage with Antibody	39.1	42.3	47.8	25.0	42

$$X^2 = 4.01, \text{ dF} = 3, \text{ Not significant}$$

When titres of eye secretions were analysed for all children with the same follicle scores in relation to age, no correlation was found among 521 specimens taken from children with no follicles, or among 304 from children with follicles 2, but among 837 eye secretions from children with follicles 1, X^2 was significant at the 1% level (Table 5). It was apparent that higher titres were more prevalent among children aged less than 10 years than among older children.

When data was examined by zones there were only 3 combinations in which there were sufficient samples of eye secretions for X^2 analysis to be carried out. These showed that in Zone 3 among children with follicles 1, X^2 was significant at the 5% level in relation to age and titre (Table 6), indicating again that children under 10 years of age had higher titres of antibody in eye secretions than did children over 10 years.

In Zone 7 there was no significant correlation between age and titre of antibody in secretions of children with either no follicles or follicles 1 (Tables 7 and 8).

These results probably indicate that there is greater antigenic stimulus in the younger children with earlier stages of trachoma than in the older children. Other workers overseas detect more inclusions in conjunctival scrapings from younger children with earlier stages of trachoma than from older ones in whom clinical trachoma usually contains scars as well as follicles.

Significant differences were not detected when sera from all zones were combined and analysed in

TABLE 5				
Relationship of titre of antibody in eye secretions and age of children with follicles 1 in all zones				
Age	Titre of Eye Secretions			Total
	< 5	5,10	20+	
0-4	44	3	19	66
5-9	272	53	139	464
10-14	169	31	54	254
Over 15	39	9	5	53
Total	524	96	217	837
Percent of Total	62.6	11.5	25.9	

$$X^2 = 18.09 \text{ dF} = 6 \text{ P} = 0.01$$

TABLE 6				
Relationship between titre of antibody in eye secretions and age of children with follicles 1 in Zone 3.				
Age	Titre of Eye Secretions			Total
	< 5	5,10	20+	
0-9	21	10	21	52
10-19	44	10	12	66
Total	65	20	33	118
Percent of Total	55.1	16.9	28.0	

$$X^2 = 9.06 \text{ dF} = 2 \text{ P} = 0.05$$

relation to titre of antibody and age of children with follicles F_0 , F_1 and F_2 , although 210, 348 and 157 specimens respectively were examined (Tables 9, 10, 11).

When titres of antibody in serum were analysed in relation to age and zones only the combinations in Zone 7 contained sufficient data to be anal-

ysed statistically. No significant correlation with age was detected among 65, 39 and 30 serum samples from children with follicles 0, 1 and 2 respectively (Tables 12, 13, 14).

Results of examining serum from the whole population at Yuendumu, Northern Territory.

Serum samples were obtained from many adults as well as children at Yuendumu in conjunction with a survey conducted by Dr. H. Tom of the Central Australian Aboriginal Congress Medical Service, Alice Springs. This enabled the antibody status of the whole population to be studied.

Unfortunately, since this survey was conducted after the field team had visited Yuendumu, trachoma gradings were available for only 129 of the total of 255 for whom age and sex were known. Therefore comparisons of follicle rate and percentage of persons with antibody could be made only on these persons, while determinations of the overall

TABLE 7				
Relationship between of titre of antibody in eye secretions and age of children with no follicles in Zone 7.				
Age	Titre of Eye Secretions			Total
	< 5	5,10	20,40	
0-9	91	13	14	118
10-14	70	16	22	108
Over 15	16	4	6	26
Total	177	33	42	252
Percent of Total	70.2	13.1	16.7	

$$X^2 = 5.43 \text{ dF} = 4 \text{ Not significant}$$

TABLE 11				
Relationship between titre of antibody in serum and age of children with follicles 2 - all zones				
Age	Titre of Serum			Total
	< 5	5,10	Over 20	
0-9	51	8	43	102
10-14	29	5	12	46
Over 15	3	3	3	9
Total	83	16	58	157

$$X^2 = 9.15 \text{ dF} = 4, \text{ Not significant}$$

TABLE 12				
Relationship between titre of antibody in serum and age of children with no follicles in Zone 7.				
Age	Titre of Serum			Total
	< 5	5,10	> 5	
5-9	20	5	5	25
10-14	15	9	3	27
15-19	8	3	3	14
Over 20	2	3	3	8
Total	45	20	20	85

$X^2 = 3.94 \text{ dF} = 3 \text{ Not significant}$
N.B. Only 3 sera collected from children under 5 years - titres were < 5 - results not included in test.

TABLE 13				
Relationship between titre of antibody in serum and age of children with follicles 1 in Zone 7.				
Age	Titre of serum			Total
	< 5	5,10	12	
5-9	12	12	10	34
10-14	5	10	15	30
Total	17	22	25	64

$X^2 = 0.48 \text{ dF} = 1 \text{ Not significant}$
N.B. Only 1 serum collected from children under 5 years - titre was < 5 - result not included in test

TABLE 8				
Relationship of titre of antibody in eye secretions and age of children with follicles 1 in Zone 7.				
Age	Titre of Eye Secretions			Total
	< 5	5,10	20+	
0-4	10	3	6	19
5-9	57	14	63	134
10-14	27	7	13	47
Total	94	24	82	200
Percent of Total	47.0	12.0	41.0	

$$X^2 = 6.25 \text{ dF} = 4 \text{ Not significant}$$

TABLE 9				
Relationship between titre of antibody in serum and age of children with no follicles - all zones				
Age	Titre of Serum			Total
	< 5	5,10	> 5	
0-4	4	4	0	8
5-9	40	40	16	96
10-14	43	24	24	91
15-19	25	15	15	55
Over 20	28	15	15	58
Total	140	70	70	280

$$X^2 = 3.12 \text{ dF} = 4, \text{ Not significant}$$

TABLE 10				
Relationship between titre of antibody in serum and age of children with follicles 1 - all zones.				
Age	Titre of Serum			Total
	< 5	5,10	Over 80	
0-9	96	18	18	132
10-14	78	17	20	115
Over 15	29	5	6	40
Total	203	40	44	287

$$X^2 = 0.99 \text{ dF} = 6, \text{ Not significant}$$

TABLE 14

Relationship between titre of antibody in serum and age of children with follicles 2 in Zone 7.

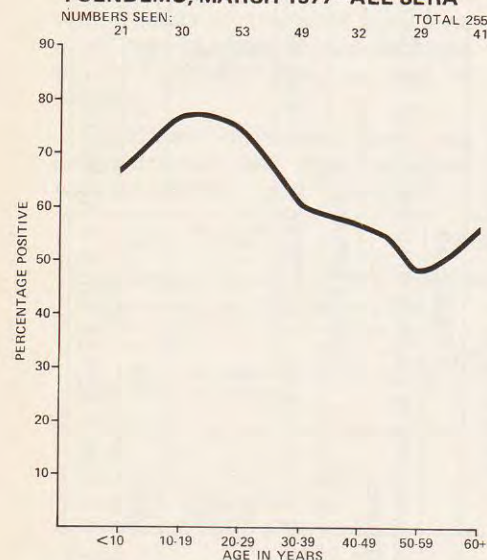
Age	Titre of serum		Total
	< 5	Over 10	
0-9	5	17	22
10-14	4	4	8
Total	9	21	30

$X^2 = 0.98$ dF = 1, Not significant

percentages of persons with antibody were made on 255 sera giving a better indication of the real distribution of antibody positivity in the population.

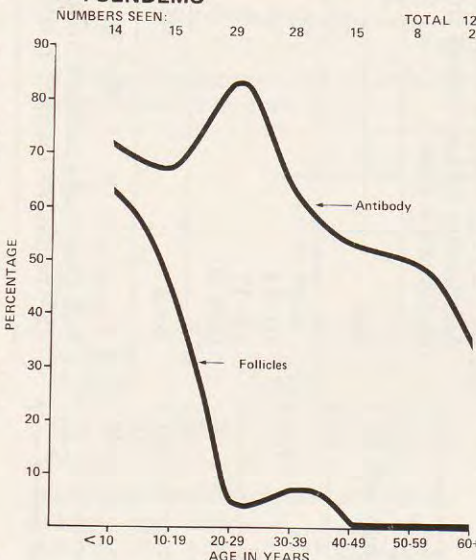
Including all sera examined 64 per cent were positive, 69 per cent of females, 57 per cent of males, 73 per cent of the under 19 year age group and 62 per cent of those over 19 years of age. The highest positivity rates were detected in the 10-19 and 20-29 year age groups, 77 per cent (30 persons) and 75 per cent (53 persons) respectively (Figure 1). Thereafter, there was an overall decline in the percentage positivity to 48 per cent and 56 per cent in the 50-59 and over 60 year age groups respectively.

Figure 1.
DISTRIBUTION OF ANTIBODIES
TO C. TRACHOMATIS BY AGE
YUENDEMU, MARCH 1977—ALL SERA



In most age groups rates in females were somewhat higher than that in males, but numbers examined were too small to be analysed statistically. These findings of a considerable

Figure 2.
PERCENTAGE OF PERSONS WITH
(1) TRACHOMA FOLLICLES
(2) ANTIBODIES TO C. TRACHOMATIS
— YUENDEMU



number of adults with antibody in their sera were of interest since trachoma follicles were detected to a degree greater than 10 per cent only in the under 20 year age group (Figure 2). The geometric mean titres of antibody in positive sera showed a general decline with increasing age (Figure 3) — there was no consistent difference between the titres in sera from males and from females.

These findings suggest that there is a continuing antigenic stimulus by *C. trachomatis* organisms in these individuals despite the fact that they do not carry the disease in the acute follicular form. This stimulus may come from organisms shed from young children in the community with the acute disease or from an internal residual source of antigen, persisting after the acute stage of the disease had passed in their childhood. Virtually all persons without trachoma follicles had evidence of previous trachoma infection. It has

been shown that human serum albumin injected into animals persists in lymphoid follicles in an immunogenic form for many months.⁷ This persistence of antigen has been postulated as the mechanism whereby serum antibody levels are maintained and regulated for months or years after immunisation.

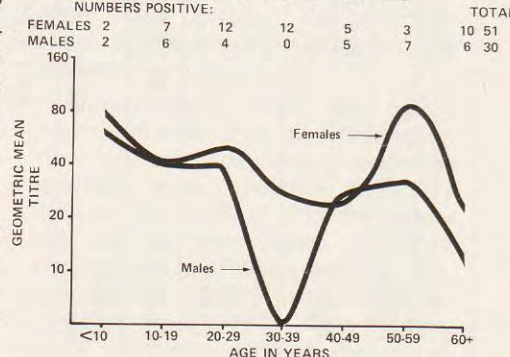
These results obtained at Yuendumu do however contrast with findings made by Graham and co-workers (to be published) who found that the point prevalence rates of antibodies in sera of adults at Hooker Creek, 1975, decreased markedly after the age of 20 years, and that less than 20 per cent of sera were positive after the age of 30 years. It is difficult to understand the reasons for these differences in antibody levels of these 2 communities since the Aborigines at these 2 centres are both of the Wailpiri tribe, and though separated by the Tanami desert they mix quite freely since there are considerable family linkages between the two populations. However, while the standards of living would be approximately the same, the weather at Hooker Creek (Zone 2) is influenced by the north west monsoon rains, while Yuendumu experiences a much drier climate (Zone 1).

Specimens taken from non-Aborigines

A total of 252 specimens were taken from non-Aborigines, 185 eye secretions and 67 sera. Of these the majority, 137 eye secretions and 51 sera, were taken in Zone 7, the Arid East.

Fourteen secretions (6%), all from children under 12 years of age, and 2 (3%) serum from a 19 year old female and a 20 year old male only had antibodies to *C. trachomatis* agents.

Figure 3.
GEOMETRIC MEAN TITRES OF SERA POSITIVE
FOR ANTIBODIES TO C. TRACHOMATIS



Titres in eye secretions ranged from 10 to 640, geometric mean 43, and in serum titres of 10 and 40 gave a geometric mean of 20.

Eight of the antibody reactions were serotype B, 7 serotype C and one was untypable.

Of the 15 children who exhibited positive antibody titres, 9 had trachoma follicles, another 5 had conjunctival scars and/or Herbert's pits and the remaining 2 had pannus and papillae only. Eleven of the children with positive eye secretions were males, mean age 8.8 years, with a geometric mean titre of 28; the other three were females, mean age 7.7 years, with a geometric mean titre of antibody of 220 — all these females had follicles — grade 1 or 2.

Findings among children on Torres Strait Islands

Of interest was the finding that among 31 children from the Torres Strait Islands all of whom had trachoma follicles, 26 of them graded 2 or 3, none had antibodies in either their eye secretions or serum. These results were unexpected since throughout the rest of Australia 59% of children with F2 or F3 had antibodies in eye secretions and 47% had antibodies in serum. Examination of more specimens from this area would be necessary to determine whether or not this is a general finding for these island environments. The possibility that the trachoma in this area was caused by a new serotype of trachoma that does not cross react with any of the known serotypes could not be tested as no specimens were taken for isolation attempts from this area.

Results of examining specimens from dogs

Because many dogs are usually found in Aboriginal settlements the possibility that they might be carriers of trachoma organisms was investigated briefly. Eye secretions were collected from 20 dogs in Western Australia. No antibody against any of the *C. trachomatis* serotypes tested was found strongly suggesting that dogs do not carry *C. trachomatis* organisms in their eyes.

SUMMARY OF RESULTS

Isolation Studies

- Seven isolates of *C. trachomatis* were made in embryonated eggs from 113 specimens collected; none was made in HeLa cells from 21 specimens. All were susceptible to sulphadiazine.
- Four isolates were serotype B, one was serotype C and one cross reacted with both B and C. One isolate could not be passaged.
- No *C. trachomatis* inclusions were detected in epithelial cells in conjunctival scrapings taken onto microscope slides.

Antibody Studies

- Throughout the country, antibodies detected were mostly directed against *C. trachomatis* serotypes B and C.
- Antibodies cross-reactive to serotypes B/D/E (probably due to serotype Ba) were detected in sera from 20% of 156 adults and children at Yuendumu and against D/E only in 5 adults there.
- Among all specimens examined, 40% both of eye secretions and of sera were positive for *C. trachomatis* antibodies, 33% of each from persons with follicles 0, and 43% with follicles 1, 2 and 3.
- A significant correlation was obtained between follicle score and the presence or absence of antibody in eye secretions but not in sera, when results from all zones and all ages were examined.
- No correlation was found between titres of eye secretions and age among all children with follicles 0 or 2, but among children with follicles 1 there was a significant correlation.
- In Zone 3, among children with follicles 1, there was a significant correlation between age and titre of antibody in eye secretions — children under 10 years of age had higher titres of antibody than did children over 10 years of age.
- In Zone 7, there was no correlation between age and titre of antibodies in eye secretions of children with either no follicles or follicles 1.
- No correlation was found between titres of antibody in serum and age and follicle scores when data from all sera were combined or in Zone 7, the only one in which sufficient sera were collected for the results to be submitted to statistical analysis.
- No significant difference was detected in the overall percentage positivity rates of eye secretions and sera in children with follicles grade 0, 1 or 2.
- When an adult population at Yuendumu, Northern Territory, was examined 53% of children under 19 years and 3% of adults over 20 years had trachoma follicles. Sixty-four percent were positive for antibodies against *C. trachomatis*; the highest positivity rates were found in the under 30 year age groups, then as age increased the percentage positivity declined to about 50% amongst the oldest age groups.
- The positivity rates were somewhat higher in females than males but the differences were not significant.
- Among 252 specimens taken from non-Aborigines only 6% of eye secretions and 3% of sera were positive for antibodies. Of these 15 children 9 had trachoma follicles.
- Among the 31 children from Torres Strait Islands who had trachoma follicles none had

antibodies to *C. trachomatis* agents.

14. No antibodies to *C. trachomatis* were detected from eye secretions of 20 dogs from Aboriginal settlements in Western Australia.

Conclusions and some discussion

The aims of the microbiological studies carried out during the program were partly achieved and some interesting and unexpected findings were also obtained.

The low isolation rate of *C. trachomatis* agents, the failure to find inclusions in conjunctival scrapings and the relatively low percentage positivity of antibody in eye secretions and serum of children with trachoma follicles compared with findings made from children with trachoma in countries like those of the Middle East suggest that the load of infectious organisms in clinical trachoma throughout Australia is less than in some other areas of endemic trachoma.

It was of interest that the isolates passaged were susceptible to sulphadiazine, but unfortunate that the isolation rate was so low that this method was not a practical one with which to determine the sensitivity of isolates made after mass treatment with Co-trimoxazole. Because there were so few isolates this method was also not applicable to determining whether the virulence of each isolate was correlated with the severity of the clinical trachoma in the area from which it was isolated.

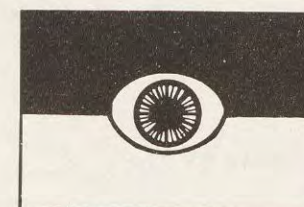
The finding of such a low percentage of sera and eye secretions from

Aborigines which contained antibodies to the serotypes associated with genital tract trachoma was also of interest in view of the widespread nature of these infections among white city dwellers in Australia. Since gonorrhoea and syphilis are prevalent in some Aboriginal communities it is difficult to understand why it is that venereal disease due to *C. trachomatis* agents appears to be present at a very low frequency. These findings are in agreement with those of workers in Saudi Arabia, Tunisia, and Gambia, who have noted the virtual absence of inclusion conjunctivitis of the newborn, which is caused by *C. Trachomatis* infection of their parents' genital tracts. They have postulated that the existence of endemic ocular trachoma in a community prevents, by immunization or physiological mechanisms, the establishment of the genital tract infection.

The lack of correlation between age of child, presence, absence or titre of antibodies in serum and trachoma follicle grade meant that the examination of serum for antibodies against trachoma was not a useful diagnostic test for the presence of the acute clinical disease. However, the finding of a considerable number of adults, in the one community studied, with these antibodies suggests that there is a continuing source of antigenic stimulation in the community. Whether this comes from external or internal sources could not be determined.

It was found also that the presence of antibody in eye secretions did correlate with the trachoma follicle score, indicating that this test could provide a better diagnostic tool than examination of sera.

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6. Wang, S-P and Grayston, J.T., "Excerpta Medica" Ed. R.L. Nichols p. 305 (1971).
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Chapter 5:

The prevalence of Trachoma in Australia

Trachoma may be considered to consist of two forms both of which may be present at the same time. Usually, however, follicular trachoma precedes cicatricial trachoma, which may affect vision. If follicular trachoma has been long-standing, cicatricial signs may be present. A person with follicular or cicatricial trachoma, or both, is said to have trachoma according to the diagnostic standards discussed in the previous chapter.

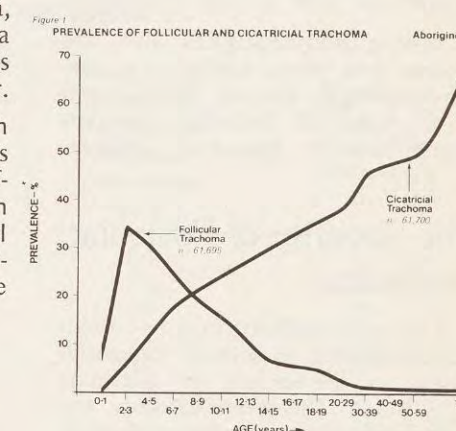
This section deals firstly with follicular trachoma among Aborigines and non-Aborigines, by age, in different areas of Australia. It then turns to the prevalence of cicatricial trachoma, before discussing the prevalence of one or both forms of the disease.

Follicular Trachoma

Follicular trachoma was mostly a disease of childhood and early adolescence, with a peak prevalence in children age two and three.

A total of 7,762 Aborigines examined by the program had follicular trachoma; 73 per cent of these were

under the age of 10. A further 23 per cent of cases of follicular trachoma found were in people aged between 10 and 19, with only 4 per cent seen in people aged 20 or more. Table FT 1 and Figure FT 1 show the pattern.



Twenty-nine per cent of pre-school Aboriginal children examined by the program had follicular trachoma (with pre-school children having 38.5 per cent of all cases of follicular trachoma found).

TABLE FT 1 – FOLLICULAR TRACHOMA BY AGE: ABORIGINES

AGE	Number Examined	Number Affected	Percentage Affected
0 & 1	2,240	388	17.3
2 & 3	3,182	1,096	34.4
4 & 5	4,877	1,503	30.8
6 & 7	6,453	1,540	23.9
8 & 9	5,785	1,109	19.2
10 & 11	5,400	840	15.6
12 & 13	4,580	510	11.1
14 & 15	3,639	250	6.9
16 & 17	2,196	129	5.9
18 & 19	1,690	87	5.1
20-29	6,573	156	2.4
30-39	4,568	59	1.3
40-49	3,898	53	1.4
50-59	2,698	18	0.7
60+	3,916	24	0.6
TOTAL	61,695	7,762	12.6

A total of 297 non-Aborigines examined by the program were also found to have follicular trachoma. Table FT 2 shows the different overall prevalences.

TABLE FT 2 – FOLLICULAR TRACHOMA BY RACE

RACE	Number Examined	Number Affected	Percentage Affected
Aboriginal	61,695	7,762	12.6
Non-Aboriginal	38,415	297	0.8
TOTAL	100,110	8,059	8.0

However, when the age prevalence is examined, as in Table FT 3, the same age-dependent prevalence rate changes are seen as with Aborigines.

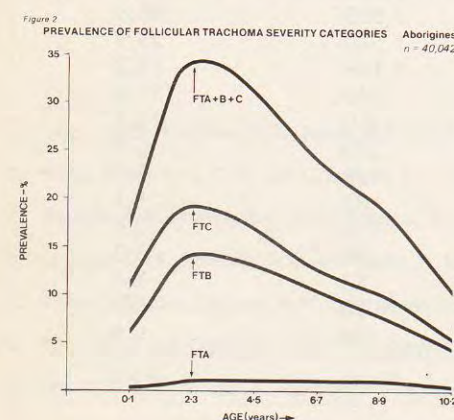
Among non-Aborigines also, the disease was most common in pre-school children. Overall, 38.5 per cent of all cases of follicular trachoma found was in pre-school children.

The Severity of Follicular Trachoma

Follicular trachoma may be considered according to severity categories based on the extent of trachoma signs found. The severe category was termed follicular trachoma category A, or FTA, the less severe category FTB, and the least severe category FTC.

Table FT 4, and Figure 2 show the distribution of the various severity categories in the age groups where follicular trachoma was most commonly found.

With FTA a peak prevalence was seen at ages six and seven. When both FTA and FTB are considered, it can be seen that the pattern of severe follicular trachoma follows the same trend as follicular trachoma



generally: the highest prevalence was found among children aged two and three, with a steady fall thereafter.

There was a tendency, though not a strong one, for FTA and FTB

The program's results were analysed over 13 regions or zones of the continent, communities in each zone being more or less similar in terms of geography and demography.

High prevalences of follicular trachoma were found in the more arid, drier areas of the continent, especially among the young.

Table FT 6 and Figure 3 show the zone-by-zone findings of follicular trachoma among Aborigines.

TABLE FT 3 – FOLLICULAR TRACHOMA BY AGE: NON-ABORIGINES

AGE	Number Examined	Number Affected	Percentage Affected
0 & 1	302	3	1.0
2 & 3	503	10	1.9
4 & 5	2,831	39	1.4
6 & 7	6,281	82	1.3
8 & 9	5,988	55	0.9
10 & 11	5,662	42	0.7
12 & 13	4,996	29	0.6
14 & 15	3,359	18	0.5
16 & 17	925	0	0
18 & 19	229	2	0.9
20-29	2,387	7	0.3
30-39	1,962	5	0.3
40-49	1,240	0	0
50-59	855	2	0.2
60+	895	3	0.3
TOTAL	38,415	297	0.8

TABLE FT 4 – SEVERITY CATEGORIES OF FOLLICULAR TRACHOMA

Age break-up of FT categories: Aborigines				
AGE	PERCENTAGE OF PERSONS AFFECTED			
	FTA	FTB	FTC	FTA+B+C
0 & 1	0.2	6.0	11.2	17.3
2 & 3	0.8	14.4	19.2	34.4
4 & 5	0.8	13.2	16.8	30.8
6 & 7	0.9	10.5	12.5	23.9
8 & 9	0.8	8.1	10.3	19.2
10-20	0.4	4.6	5.4	10.4
ALL AGES	0.4	5.4	6.8	12.6

to be somewhat more severe on average when found in older age groups, than in younger ones. This trend is almost, but not quite, statistically significant.

More males than females had follicular trachoma, and, as Table FT 5 shows, the difference was significant in some age groups.

Zone 3, Zone 1, and Zone 2, stand out as having high levels of follicular trachoma. Six adjoining zones, Zone 4, Zone 6, Zone 5, Zone 7, Zone 8, and Zone 10, had high levels, although considerably less than the first three. The remaining four; Zone 9, Zone 12, Zone 11 and Zone 13, had low levels.

The region with the highest prevalence, Zone 3, showed almost one-third of the people seen as having follicular trachoma; among children under 10, the prevalence was almost two in every three.

Only 19 of 127 children in the peak-prevalence age group, two and three years, did not have trachoma follicles.

Zone 3 was also where the highest prevalence of FTA and FTB were found. Overall, 20 per cent of the Aborigines seen in this zone had either FTA or FTB, with 41 per cent of children under the age of 10 in this zone having such signs.

TABLE FT 5 – SEX DIFFERENCES WITH FOLLICULAR TRACHOMA: ABORIGINES

AGE	SEX	Number Examined	Number Affected	Percentage Affected	Significance
0-9	Males	11,286	2,863	25.4	$\chi^2 = 1.3; p < 0.1$
	Females	11,219	2,772	22.7	
10-19	Males	8,411	948	11.3	$\chi^2 = 14; p < 0.001$
	Females	9,122	868	9.5	
20+	Males	9,745	109	1.1	$\chi^2 = 12; p = 0.001$
	Females	11,908	201	1.7	
TOTAL	Males	29,442	3,920	13.3	$\chi^2 = 27; p < 0.001$
	Females	32,249	3,841	11.9	

TABLE FT 6 – FOLLICULAR TRACHOMA BY ZONE: ABORIGINES

ZONE	Total Aborigines seen	Total Aboriginal children Ages 0-9	Follicular trachoma prevalence percentage All ages	Prevalence of follicular trachoma in children percentage 0-9	Prevalence of FTA & FTB in children percentage 0-9
3. Western Desert	2,084	715	32	64	41
1. Red Centre	7,982	2,934	26	50	24
2. Cattle Country	5,424	1,788	22	52	24
4. Goldfields	1,544	553	17	37	20
6. Coastal Towns WA	3,078	1,116	17	32	14
5. Coastal Missions WA	2,151	827	15	32	14
7. Arid Eastern	10,378	4,246	12	22	10
8. Top End NT	7,304	2,517	10	21	6
10. Torres Strait	2,227	708	10	19	7
9. Gulf and Cape Country	3,532	1,230	3	8	2
12. Coastal NSW	2,505	960	2	3	1
11. Coastal Qld	9,414	3,497	2	3	1
13. Southern Mainland	3,420	1,191	2	3	0.4
ALL ZONES	61,043	22,282	13	25	11.3

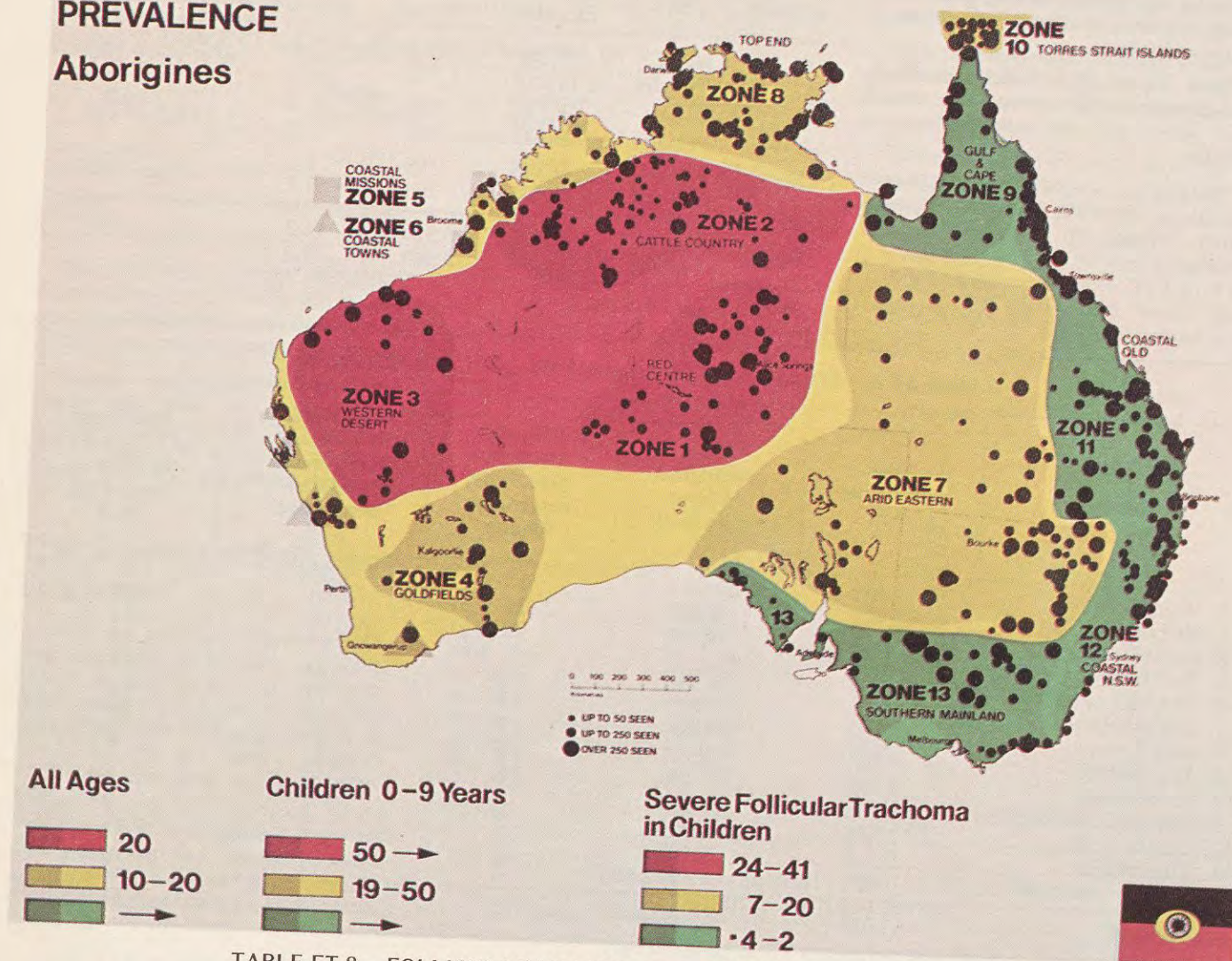
TABLE FT 7 – FOLLICULAR TRACHOMA BY AGE, ZONES 3, 1, 2: ABORIGINES

ZONE	AGE	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	TOTAL
3	Number Seen	76	127	147	192	173	180	120	72	50	58	1,195
	FT	31	108	110	118	94	97	41	17	9	7	632
	Percentage	40.8	85.0	74.8	61.5	54.3	53.9	34.2	23.6	18.0	12.1	52.9
1	Number Seen	378	480	676	679	721	648	492	350	248	259	4,931
	FT	122	318	401	337	300	237	160	88	36	31	2,030
	Percentage	32.3	66.3	59.3	49.6	41.6	36.6	32.5	25.1	14.5	12.0	41.2
2	Number Seen	261	328	387	432	380	316	206	183	189	202	2,884
	FT	94	223	257	204	156	108	41	15	30	16	1,144
	Percentage	36.0	68.0	66.4	47.2	41.1	34.2	19.9	8.2	15.9	7.9	39.6

Figure 3

FOLLICULAR
TRACHOMA
PREVALENCE

Aborigines

TABLE FT 8 – FOLLICULAR TRACHOMA A AND FOLLICULAR TRACHOMA
A AND B BY AGE BY ZONES 1, 2, 3: ABORIGINES

ZONE	AGE										TOTAL
	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	
1. Number Seen	378	480	676	679	721	648	492	350	248	259	4,931
FTA	1	6	10	19	20	8	15	5	3	2	89
Percentage	0.3	1.3	1.5	2.8	2.8	1.2	3.0	1.4	1.2	0.8	1.8
FTA & B	41	127	195	175	178	142	102	57	19	20	1,056
Percentage	10.8	26.5	28.8	25.8	24.7	22.0	20.7	16.3	7.6	7.7	21.4
2. Number Seen	261	328	387	432	380	316	206	183	189	202	2,884
FTA	1	4	7	4	5	4	0	1	1	1	28
Percentage	0.4	1.2	1.8	0.9	1.3	1.3	0	0.5	0.5	0.5	1.0
FTA & B	24	99	131	99	68	50	18	7	16	7	519
Percentage	9.2	30.2	33.8	22.9	17.9	15.8	8.7	3.8	8.5	3.4	18.0
3. Number Seen	76	127	147	192	173	180	120	72	50	58	1,195
FTA	0	10	2	13	3	5	0	0	0	0	33
Percentage	0	7.9	1.4	6.8	1.7	2.8	0	0	0	0	2.7
FTA & B	17	77	70	77	51	58	20	10	3	3	386
Percentage	22.4	60.6	47.6	40.1	29.5	32.2	16.7	13.8	6.0	5.2	32.3

In Zone 1, the Red Centre, which included Pitjantjatjara regions of South Australia and Western Australia, 26 per cent of all Aborigines seen had follicular trachoma, including just over half all children under the age of 10. The peak prevalence was found among two and three-year-olds, with 66 per cent having follicular trachoma. (See Table FT 7).

In Zone 2, the Cattle Country, in the Kimberleys and Northern Territory, 22 per cent of all Aborigines seen, including 52 per cent of all children under the age of 10, had follicular trachoma. In the peak prevalence age group, again two and three-year-olds, 68 per cent had follicular trachoma.

The follicular trachoma seen in Zone 1 was significantly more severe on average than in Zone 2, though significantly less severe than that in Zone 3. (See Table FT 8). In Zone 1, 21 per cent of Aborigines under 20 years had FTA or FTB, while in Zone 2, 18 per cent of Aborigines the same age did.

More than half the cases of follicular trachoma seen by the program were found in these three zones, although the people there comprised only a quarter of the Aboriginal people seen during the screening.

By comparison, 43 per cent of those seen lived in the next six zones to be considered. These people provided 43 per cent of the cases of follicular trachoma seen by the program.

The three highest of these intermediate zones had prevalences of follicular trachoma not significantly different from each other. In Zone 4, the Goldfields, Western Australia, 17 per cent of the Aboriginal people seen had follicular trachoma, including 37 per cent of those under the age of 10. (See Table FT 6).

In Zone 6, Coastal Towns, Western Australia, 17 per cent of those seen had follicular trachoma, including 32 per cent of children under 10. (See Table FT 6).

And in Zone 5, Coastal Missions of Western Australia, 15 per cent of Aborigines seen had follicular trachoma, including 32 per cent of children under 10. (See Table FT 6).

In each of these zones, peak prevalences were found among two and three-year-olds. (See Table FT 9).

However, in Zone 4, significantly more children had FTA or FTB than either of the two other zones. (See Table FT 6).

Another region of high prevalence was Zone 7, the Arid Eastern, where overall, 12 per cent of Aborigines had follicular trachoma, including 22 per cent of children under 10. (See Table FT 6).

Among two and three-year-olds, the peak prevalence group, 140 of 505 children screened, or 28 per cent, had follicular trachoma.

In this zone, 6 per cent of the population overall, had FTA or FTB, including 10 per cent of children under 10.

In Zone 8, the Top End of the Northern Territory, 10 per cent of Aborigines seen, including 21 per cent of children under 10, had follicular trachoma. (See Table FT 6).

Peak prevalence was found among four and five-year-olds, with 27 per cent of those examined having follicular trachoma. (See Table FT 10).

Overall, 3 per cent of those seen in Zone 8 had FTA or FTB, including 6 per cent of children under the age of 10. (See Table FT 6).

The per cent prevalence of follicular trachoma in Zone 10, was not significantly different from Zone 8, with follicular trachoma being found in 10 per cent of the overall population.

TABLE FT 9 – FOLLICULAR TRACHOMA BY AGE, ZONES 4,6,5:
ABORIGINES

ZONE	AGE										TOTAL
	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	
4. Number Seen	69	69	140	134	141	137	80	64	47	53	934
FT	20	41	74	39	29	27	13	3	5	2	253
Percentage	29.0	59.4	52.9	29.1	20.6	19.7	16.3	4.7	10.6	3.8	27.1
6. Number Seen	116	139	236	332	293	386	278	219	122	74	2,195
FT	28	70	94	89	81	59	45	16	5	8	495
Percentage	24.1	50.4	39.8	26.8	27.6	15.2	16.2	7.3	4.1	10.8	22.5
5. Number Seen	93	119	200	200	215	168	156	116	62	63	1,392
FT	16	54	76	58	59	28	18	5	3	2	319
Percentage	17.2	45.4	38.0	29.0	27.4	16.7	11.5	4.3	4.8	3.2	22.9

TABLE FT 10 – FOLLICULAR TRACHOMA BY AGE, ZONES 7, 8, 10:
ABORIGINES

ZONE	AGE										TOTAL
	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	
7. Number Seen	304	505	890	1556	991	923	896	789	357	181	7,392
FT	34	140	202	145	141	112	85	50	14	7	930
Percentage	11.2	27.7	22.7	9.3	14.2	12.1	9.5	6.3	3.9	3.9	12.5
8. Number Seen	342	407	552	598	618	626	455	319	283	252	4,452
FT	32	83	149	140	136	94	49	18	7	6	714
Percentage	9.4	20.4	27.0	23.4	22.0	15.0	10.8	5.6	2.5	2.4	16.0
10. Number Seen	57	71	133	229	218	188	206	174	93	71	1,440
FT	1	16	38	43	35	23	25	18	4	3	206
Percentage	1.8	22.5	28.6	18.8	16.1	12.2	12.1	10.3	4.3	4.2	14.3

TABLE FT 11 –
FOLLICULAR TRACHOMA BY AGE, ZONES 9, 12, 11, 13:
ABORIGINES

ZONE	AGE	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	TOTAL
9	Number Seen	115	150	249	376	340	316	246	149	102	94	2,137
	FT	4	14	34	25	16	7	3	1	2	1	107
	Percentage	3.5	9.3	13.7	6.6	4.7	2.2	1.2	0.7	2.0	1.1	5.0
12	Number Seen	62	118	220	296	264	272	218	173	100	52	1,775
	FT	1	3	9	11	8	5	2	5	2	1	47
	Percentage	1.6	2.5	4.1	3.7	3.0	1.8	0.9	2.9	2.0	1.9	2.6
11	Number Seen	275	440	745	1009	1028	944	895	781	383	195	6,695
	FT	2	7	37	38	34	31	20	8	9	2	188
	Percentage	0.7	1.6	5.0	3.8	3.3	3.3	2.2	1.0	2.4	1.0	2.8
13	Number Seen	70	197	263	331	330	323	275	227	139	122	2,277
	FT	0	10	11	8	11	6	3	5	1	1	56
	Percentage	0	5.1	4.2	2.4	3.3	1.9	1.1	2.2	0.7	0.8	2.4

ion, including 19 per cent of children under 10. The peak-prevalence age group in this zone also, was the four and five-year-olds, with 27 per cent affected. (See Table FT 10).

There was, however, significantly more FTA and FTB in this zone, in 4 per cent of those seen, including 7 per cent of those under 10. (See Table FT 6).

The remaining four zones – 9, 12, 11 and 13 – had comparatively low rates of follicular trachoma. (See Table FT 6). In none, however, was the prevalence of follicular trachoma among children less than two-and-a-half times the overall prevalence among non-Aboriginal children (1.2 per cent). About 31 per cent of those screened by the program lived in these four zones, in which 6 per cent of the cases of follicular trachoma were found.

The highest prevalence of these four zones was found in Zone 9 Gulf and Cape zone of Northern Queensland, including the Cape York Peninsular country, where 3 per cent of Aborigines seen, including 8 per cent of children under 10, had follicular trachoma. The peak prevalence was found among children aged between four and five, with 14 per cent affected.

Overall, 1 per cent of those seen, including 2 per cent of children under 10, had FTA or FTB (See Table FT 6). The overall rate for the more severe forms of follicular trachoma was not significantly higher than found in the remaining three zones, although the prevalence rate among children was.

The next highest prevalence of follicular trachoma was found in

Zone 12, Coastal New South Wales, with 2 per cent of Aborigines screened, including 3 per cent of children under 10, affected. Peak prevalence was found among four and five-year-olds with 4 per cent affected. FTA and FTB were found in 1 per cent of persons seen, including 1 per cent of children under 10.

In Zone 11, Coastal Queensland, 2 per cent of all Aborigines seen, including 3 per cent of those under 10, had follicular trachoma. The peak prevalence was found in children aged four and five with 5 per cent being affected.

Overall, 1 per cent of those examined in this zone had FTA or FTB.

Zone 13, the Southern Mainland, had the lowest prevalence of follicular trachoma. Two per cent of those examined, including 3 per cent of children under the age of 10, were affected. The peak prevalence was

among children aged two and three, with 5 per cent affected. (See Table FT 11).

Overall, 0.2 per cent of those seen in this zone, including 0.4 per cent of children under the age of 10, had FTA or FTB. (See Table FT 6).

The findings show a strong tendency for follicular trachoma to be more severe in areas of high prevalence. In areas of lower overall prevalence, proportionately more cases of follicular trachoma found are of the least severe form, FTC.

It is also seen that as overall prevalence falls, there is a tendency for peak prevalences to be found in four and five-year-olds, rather than two and three-year-olds. However, even this later age peak is within the pre-school range. This is important to remember when treatment programs are being considered. If these are based on school programs, and pre-school child-

TABLE FT 12: FOLLICULAR TRACHOMA BY ZONE: NON-ABORIGINES

ZONE	Total non-Aborigines seen	Total non-Aboriginal children seen	Overall follicular trachoma prevalence (Percentage)	Prevalence of follicular trachoma in children (Percentage)
5	564	287	4	6
3	526	221	4	7
1	843	265	1	2
7	10,804	4,598	1	2
6	3,498	1,445	1	1
2	1,369	576	1	2
4	2,330	1,312	1	1
10	332	102	1	0
8	5,003	1,959	0	1
9	1,163	472	0	1
11	8,775	3,321	0	0
13	2,061	972	0	0
12	1,180	405	0	0
ALL ZONES	38,448	15,935	1	1

ren are ignored, a substantial pocket of infection will be missed.

Follicular Trachoma among Non-Aborigines

In no zone was the prevalence of follicular trachoma among non-Aborigines more than a seventh of the prevalence found among Aboriginal children in the same zone. Overall, the rate averaged less than a twentieth of the Aboriginal rate.

Of the non-Aboriginal people overall, 0.3 per cent were found to have FTA or FTB including 0.5 per cent of children under 10.

The Relevance of Follicular Trachoma

Follicular trachoma leads to cicatricial trachoma, and thus to possible visual impairment in later life. Its severity gives an indication of the likely level of cicatricial trachoma. Generally, the more severe the follicular trachoma the more severe the cicatricial trachoma. It is possible to improve the prospects of a person suffering from follicular trachoma by reducing its severity and by helping to avoid other eye infections which strain the protective systems of the eye.

Follicular trachoma can be treated and follicles made to disappear. If treatment does this, present generations of trachoma sufferers will have less severe cicatricial trachoma and future generations may not have it at all.

Thus, the prevalence of follicular trachoma within a community is probably the best indicator for 'erradicative' treatment, and will give some clues as to how treatment programs should be organised. When only relatively few have follicular trachoma, the most appropriate method of treatment might be through small-scale, family living unit-based treatment programs. When a substantial proportion of the community is affected, however, as in Zones 1, 2, and 3, it is necessary to organise community-based treatment programs capable of reaching everyone at risk from follicular trachoma.

Cicatricial Trachoma

Cicatricial trachoma, the scarring consequence of follicular trachoma, was found mainly among Aborigines. Table CT 1 shows the relative distrib-

TABLE CT 1 – CICATRICIAL TRACHOMA BY RACE:

	Number Examined	Number Affected	Percentage Affected
Aborigines	61,700	18,822	30.5
Non-Aborigines	38,444	386	1.0
TOTAL:	100,144	19,208	19.2

TABLE CT 2 – CICATRICIAL TRACHOMA BY AGE: ABORIGINES

AGE	Number Examined	Number Affected	Percentage Affected
0-2	3,605	76	2.1
3-5	6,690	624	9.3
6-9	12,241	2,539	20.7
10-14	11,897	3,187	26.8
15-19	5,608	1,855	33.1
20-29	6,573	2,521	38.4
30-39	4,568	2,100	46.0
40-49	3,897	1,873	48.1
50-59	2,698	1,347	49.9
60 and over	3,923	2,700	68.8
TOTAL	61,700	18,822	30.5

ution of cicatricial trachoma among persons examined by the program.

The steep rise in the proportion of people with cicatricial trachoma occurs two or three years after the peak age of follicular-trachoma infection.

As Table CT 2 and Figure 4 show, few young children are affected but the proportion steadily climbs with the peak prevalence being found in those aged 60 or more.

A similar trend occurred with non-Aborigines, though on a considerably reduced scale.

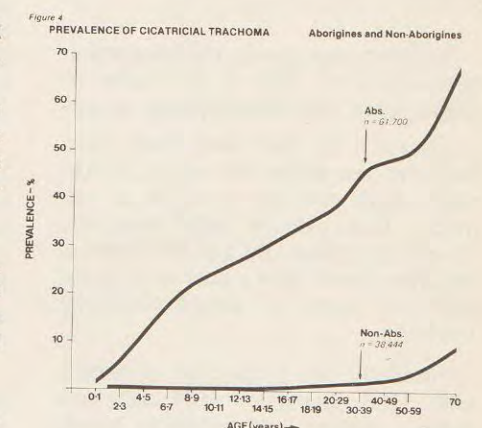
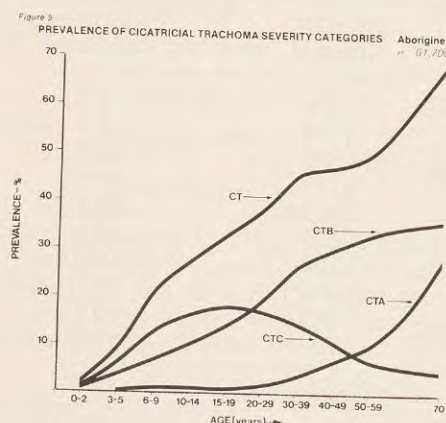


TABLE CT 3 – CICATRICIAL TRACHOMA BY AGE: NON-ABORIGINES

AGE	Number Examined	Number Affected	Percentage Affected
0-2	527	0	0
3-5	3,136	8	0.3
6-9	12,271	64	0.5
10-14	12,591	70	0.6
15-19	2,580	32	1.2
20-29	2,386	36	1.5
30-39	1,962	32	1.6
40-49	1,240	33	2.7
50-59	855	28	3.3
60 and over	896	83	9.3
TOTAL	38,444	386	1.0

The Severity of Cicatricial Trachoma

When the various severity categories of cicatricial trachoma were examined, the more severe was in older age groups. It was categorised similarly to follicular trachoma: severe was termed CTA, less severe CTB, and least severe CTC. Table CT 4 and Figure 5 show the trend.



In every age group, the proportion with CTA or CTB is the same or higher than the preceding age group.

Overall, 3.6 per cent had CTA, but very few under the age of 20 had such signs and the prevalence was higher than average only from the 30-39 age group. By age 60 or more, however, more than a quarter of those seen had signs of severe cicatricial trachoma.

Similarly, the proportion of people with CTB increased with each age group, reaching by age 60 or more, 36.3 per cent, as compared to 0.7 per cent in children under two.

Overall, 14.4 per cent of Aborigines seen had CTB, nearly half (actually 47 per cent) of those in whom cicatricial trachoma was found.

On the other hand, the prevalence of CTC increased with each age group until the 15 to 19-year-olds when it began to fall to reach 4.7 per cent of those aged 60 or more.

The reason for this would appear to be that persons initially having only mild cicatricial trachoma develop worse scars with increasing age, so that trachoma signs presenting as CTC in early age increase in severity with age.

These findings illustrate the progressive nature of cicatricial trachoma.

TABLE CT 4 - CICATRICIAL TRACHOMA BY SEVERITY AND AGE: ABORIGINES*

AGE	Per cent with CTA	Per cent with CTB	Per cent with CTC	Total per cent with cicatricial trachoma
0-2	0	1	1	2
3-5	0	3	6	9
6-9	1	7	13	21
10-14	1	10	16	27
15-19	1	14	18	33
20-29	2	19	17	38
30-39	4	27	15	46
40-49	7	30	11	48
50-59	10	33	7	50
60 and over	28	36	5	69
ALL AGES	4	14	12	30

* Percentages have been taken to the nearest whole number.

Although one cannot necessarily use the age-group by age-group prevalences to predict the future course of the disease in younger generations, nor even to "read back" the earlier history of trachoma in the old, there are many areas where trachoma was found where it seemed fairly certain that the nature of the disease was basically unchanged over the past 50 years.

Cicatricial trachoma which follows follicular trachoma is at first less severe, but in later age a substantial proportion of the population have cicatricial trachoma severe enough to impair vision.

Sex Differences

Table CT 5 shows the distribution of cicatricial trachoma among men and women.

There was a significant difference between the sexes in the 60 years and over group, with 70.9 per cent of women having significantly more cicatricial trachoma ($p = < 0.001$) than men, with 66.6 per cent affected.

TABLE CT 5 - SEX DIFFERENCES WITH CICATRICIAL TRACHOMA: ABORIGINES

AGE		Number Examined	Number with CT	Per cent with CT	Significance
0-19	Males	19,697	4,028	20.4	Not significant
	Females	20,340	4,253	20.9	
20-39	Males	4,683	1,977	42.2	Not significant
	Females	6,458	2,644	40.9	
40-59	Males	3,164	1,531	48.4	Not significant
	Females	3,431	1,689	49.2	
60+	Males	1,899	1,265	66.6	Significant $p = < 0.001$
	Females	2,024	1,435	70.9	

CTA affected 4.2 per cent of females compared with 3 per cent of males. The difference becomes significant ($p = < 0.025$) in each group over the age of 30. In the 60 years and over age group, 32.4 per cent of the women seen had CTA compared with 23 per cent of the men.

Zone-by-Zone Prevalence

The zones showed different patterns of cicatricial trachoma prevalence. The broad pattern is shown in Figure 6, and Table CT 7.

The zone with the highest prevalence of cicatricial trachoma was Zone 1, with 65 per cent of the population, including, including 95 per cent of those aged 60 or more, affected.

In this zone 36 per cent of children under the age of 10 had cicatricial trachoma. Of those aged between 10 and 20, 74 per cent had cicatricial trachoma, while 85 per cent of those aged 20 or more were affected. (See Figure 7).

A significant portion of the cicatricial trachoma seen in Zone 1 was severe, CTA or CTB. Overall, nearly 44 per cent had CTA or CTB, and 10 per cent had CTA. In the 60 or over age group, 49 per cent had CTA, while 41.4 per cent had CTB. In the remainder of the age groups, 6 per cent had CTA, including almost a quarter of those aged 50-59, and 34 per cent had CTB.

More females had cicatricial trachoma than males, with 66 per cent affected compared with 63 per cent. The difference was significant for all those over the age of 19.

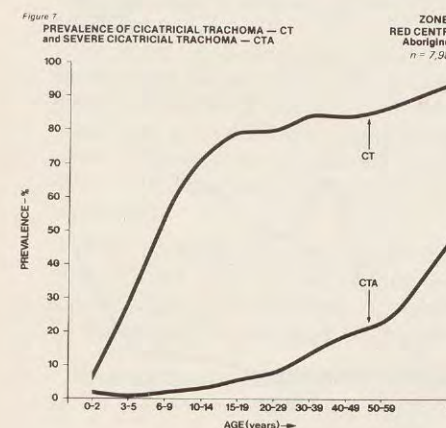
There was also a significant trend for cicatricial trachoma to be more severe for women than men. Apart from a strong trend overall for more women to have CTA or CTB, the difference was significant in the

TABLE CT 6 - SEX DIFFERENCES WITH MOST SEVERE CICATRICIAL TRACHOMA: ABORIGINES

AGE		Number Examined	Number with CTA	Percentage Affected
0-19	Males	19,697	132	0.7
	Females	20,340	165	0.8
20-29	Males	2,781	49	1.8
	Females	3,792	78	2.1
30-39	Males	1,902	47	2.5
	Females	2,666	135	4.1
40-49	Males	1,766	96	5.4
	Females	2,131	173	8.1
50-59	Males	1,398	112	8.0
	Females	1,300	157	12.1
60+	Males	1,899	436	23.0
	Females	2,024	656	32.4
ALL AGES	Males	29,443	872	3.0
	Females	32,253	1,364	4.2

TABLE CT 7: CICATRICIAL TRACHOMA BY ZONES: ABORIGINES

ZONE	Number Examined	Number with CT	Per cent with CT	Per cent of 60+ with CT	Per cent of 60+ with CTA
1. Red Centre	7,986	5,149	65	95	49.3
2. Cattle Country	5,423	3,169	58	92	47.3
3. Western Desert	2,084	1,026	49	85	27
6. Coastal Towns W.A.	3,081	1,167	38	82	38
4. Goldfields	1,544	580	38	86	23
7. Arid Eastern	10,378	3,608	35	71	21
5. Coastal Missions W.A.	2,151	639	30	62	13.5
8. Top End	7,303	1,938	26	65	23
9. Gulf & Cape	3,532	478	14	43	8
13. Southern Mainland	3,420	267	8	24	7
12. Coastal NSW	2,505	147	6	12	0
10. Torres Strait	2,227	118	5	26	2.1
11. Coastal Queensland	9,415	454	5	23	4
ALL ZONES	61,049	18,740	31	69	28



30-39, 50-59 and 60 and over age groups, being most significant for those 60 or over.

Almost twice as many women had CTA than men, with 12 per cent of women affected, compared with 7 per cent of men. In the over-60 age group, 58 per cent of women had CTA, compared with 39 per cent of men.

The second highest zone in terms of cicatricial trachoma prevalence was Zone 2. Compared with Zone 1, this zone had a significantly lower prevalence of cicatricial trachoma overall.

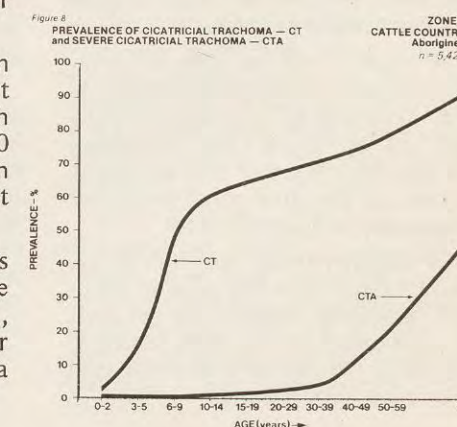
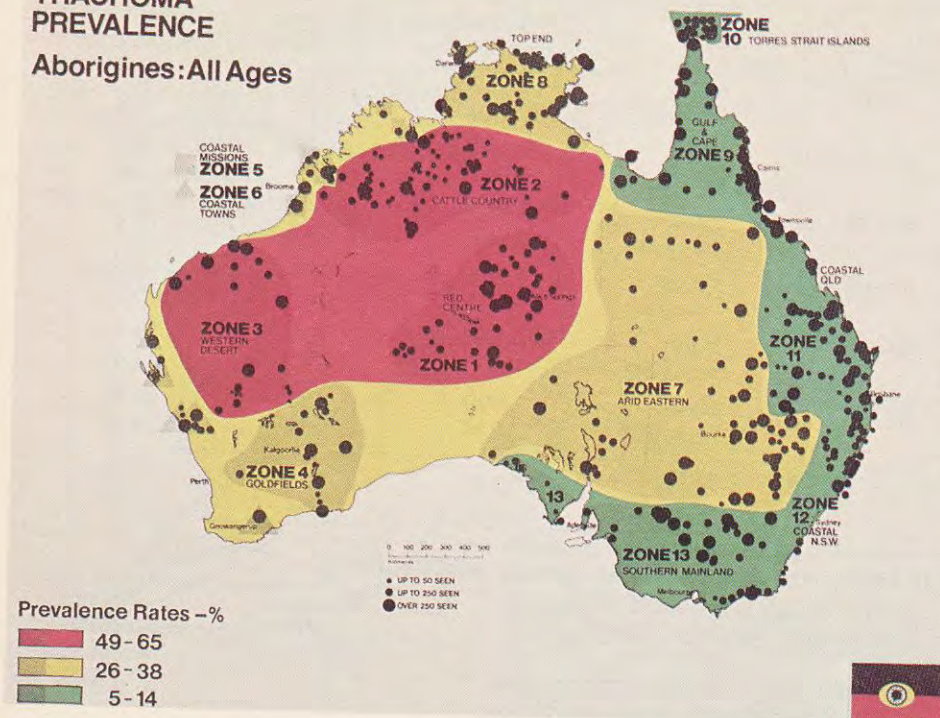


Figure 6
CICATRICIAL TRACHOMA PREVALENCE
Aborigines: All Ages



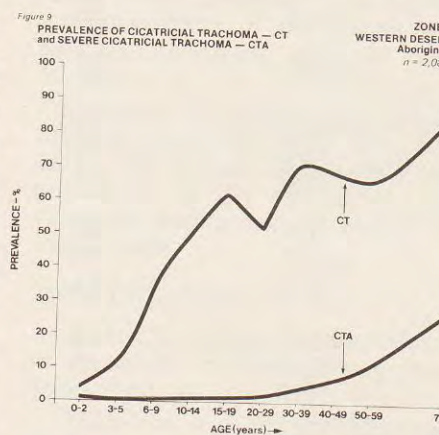
Of those seen, 58 per cent had cicatricial trachoma, including 92 per cent of those aged 60 or more. Signs were observed in 28 per cent of children under 10; nearly 63 per cent of those aged 10 to 19; and nearly 77 per cent of adults 20 years or older were affected.

Overall, 9 per cent of people seen had CTA and a further 27 per cent had CTB. This included 47 per cent of those aged 60 or more having CTA and 41 per cent having CTB.

Females had significantly more cicatricial trachoma than men, with 60 per cent affected, compared with 56 per cent. The trend was significant in those over the age of 15. Significantly more women had CTA than men, with 10 per cent affected compared with 8 per cent.

In Zone 3, 49 per cent of Aborigines examined had cicatricial trachoma, including 85 per cent of those aged 60 or more. The prevalence was significantly lower than in Zone 2, as were all the other zonal prevalence rates shown in Table CT 7.

Of children under the age of 10, nearly 22 per cent had signs of cicatricial trachoma. Nearly 53 per cent of those aged 10-19 were affected, and nearly 70 per cent of those aged 20 or more were affected.



Overall, 6 per cent of those seen, including 27 per cent of those aged 60 or more, had CTA. There was also a considerable proportion of people with CTB: 26 per cent overall, including 53 per cent of those over the age of 60.

Twenty-five per cent of the Aborigines screened for trachoma lived in these three zones, the same zones in which the highest prevalences of follicular trachoma were found. Also 50 per cent of all people found by the program to have cicatricial trachoma lived in these zones. Of all the cases of CTA found, 62 per cent came from these zones, as well as 53 per cent of the cases of CTB.

Of those over the age of 60, 41

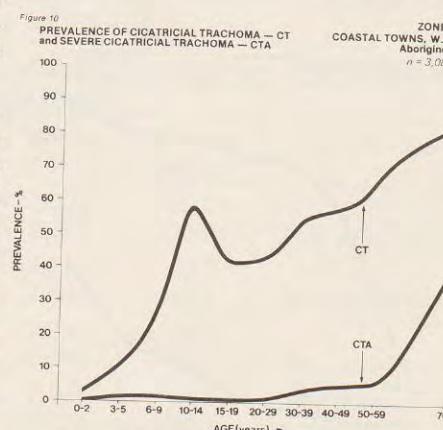
per cent lived in one of these zones. Fifty-five per cent of the cases of cicatricial trachoma seen among Aborigines over 60 lived in these zones, including 67 per cent of CTA found. Cicatricial trachoma was thus not only more prevalent in these zones, it was also more severe.

These adjoining zones, which extend from Central Australia, the Cattle Country on the Queensland, Northern Territory border across the Kimberleys of Western Australia, and across the western desert country of South and Western Australia, are clearly the areas where the problem of trachoma is at its greatest. Just as the cicatricial trachoma figures show the consequences of past years of infection with the trachoma organism, the follicular trachoma prevalence figures suggest that the problem is a continuing one.

In the next five zones considered, 6, 4, 7, 5, and 8, all adjoining the last three zones, the prevalence of cicatricial trachoma overall varied from 38 per cent to 26 per cent, with an average prevalence of 32 per cent, slightly less than half the average prevalence found in the first three zones considered.

In three of these zones the prevalence of cicatricial trachoma among those aged 60 or more is similar to that found in the first three zones, while that for younger age groups is less, a finding which permits speculation as to whether or not the pattern of the disease has changed in these five zones.

In Zone 6, 38 per cent of the population overall, including 82 per cent of those 60 years or over, had cicatricial trachoma. The proportion of the population affected was seen to be higher in each succeeding age group.

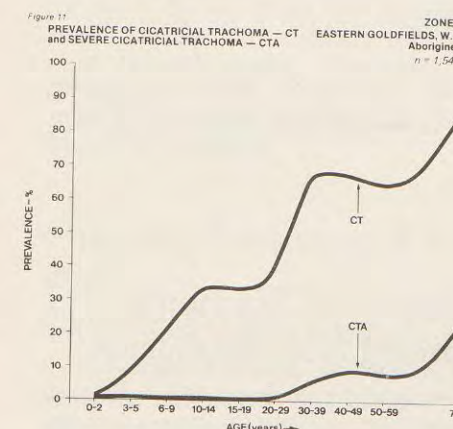


Four per cent of those seen had CTA including 38 per cent of those aged 60 or more, a figure which is significantly higher than that found in Zone 3.

This difference may reflect a drift by some of the more handicapped old from Zone 3 into this zone. One per cent of those under the age of 60 had CTA, compared with 2 per cent of those in Zone 3.

Females had significantly more CTA than males, with 5 per cent affected compared with 3 per cent. In the 60 over age group, 42 per cent of the women seen had CTA, while 33 per cent of the men were affected.

The next highest zone in terms of cicatricial trachoma prevalence was Zone 4, with 38 per cent of the Aboriginal population, including 86 per cent of those aged 60 or more, affected.

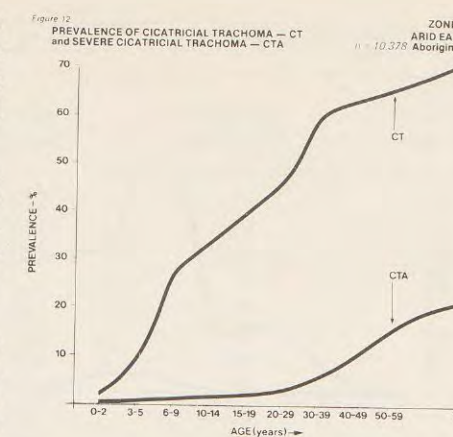


Overall, 14 per cent of children under the age of 10 had cicatricial trachoma, 34 per cent of those aged 10-19 were affected, and 61 per cent of those aged 20 or more were affected.

Overall, 20 per cent of those seen had CTB and 3 per cent had CTA, with the proportion of those affected having CTA or CTB increasing with each successive age group. Of those aged 60 or more, 23 per cent had CTA while 2 per cent of those under the age of 60 did. Significantly more women over 40 had CTA than men: 19 per cent compared with 9 per cent.

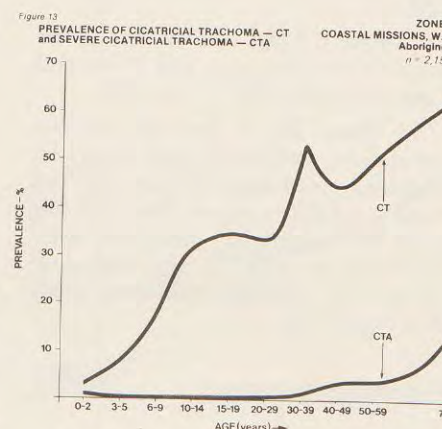
The next highest zone was Zone 7, with 35 per cent of Aborigines seen having cicatricial trachoma, including 71 per cent of those aged 60 or more.

Overall, 3 per cent had CTA, made up of 21 per cent of those aged 60



or more and 3 per cent of those under the age of 60. Overall, 15 per cent of those seen had CTB, including 42 per cent of those aged 60 or more.

There was a significant fall in cicatricial trachoma prevalence in the next region, Zone 5, where 30 per cent of those examined had signs of cicatricial trachoma, including 62 per cent of those aged 60 or more.

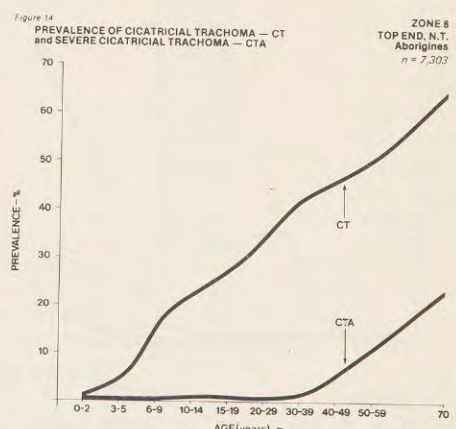


There was no steady pattern of increased cicatricial trachoma prevalence over the age of 20; 33 per cent of those aged 20 to 29 were affected, 52 per cent of those aged 30-39, 44 per cent of those aged 40-49 and 51 per cent of those aged 50-59. These differences were not significant, as relatively small numbers are involved, but they do suggest some sort of changed disease pattern in this zone.

Overall, 2 per cent of those seen had CTA, including 13 per cent of those aged 60 or more, and 14 per cent of the population examined overall had CTB, including 44 per cent of those over the age of 60. Although women had more cicatricial trachoma than men (31 per cent to 28 per cent), the difference was only significant among persons aged 40 or more, with 58 per cent compared with 47

per cent. The trend seen in other zones, of more women having cicatricial trachoma and having it more severely, was also seen in this zone.

The last zone in this group was Zone 8, where 26 per cent of those seen, including 65 per cent of those aged 60 or more, had cicatricial trachoma.



Overall, 3 per cent of the population, significantly more than in Zone 5, had CTA, while 23 per cent of those aged 60 or more had CTA and CTB. Women over the age of 40 had significantly more CTA than men: with 15 per cent compared with 10 per cent.

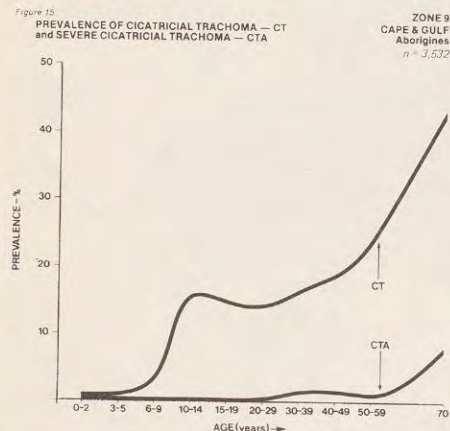
Forty per cent of the Aboriginal population seen lived in the above five zones. Forty-two per cent of all cases of cicatricial trachoma, including 34 per cent of all cases of CTA and 39 per cent of all cases of CTB, also lived in these zones.

Thus, not only was cicatricial trachoma seen less frequently in these five zones than in the first three, but the trachoma seen, on average, was less severe.

About 34 per cent of Aborigines screened for cicatricial trachoma lived in the lowest five zones - 9, 13, 12, 10 and 11, but less than 8 per cent of the cases of cicatricial trachoma seen came from these zones. The CT was, on average, less severe than that elsewhere: only 4 per cent of the cases of CTA seen were from these zones and only about 7 per cent of the cases of CTB.

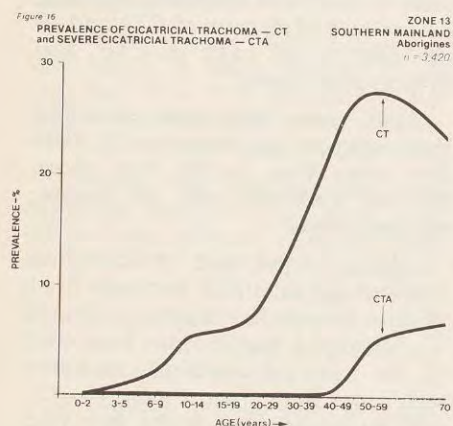
In all these zones, the prevalence of cicatricial trachoma was significantly lower than found in any of the zones previously mentioned. Prevalences ranged from 14 per cent in Zone 9, to 5 per cent in Zone 11, averaging 7 per cent overall. (See Table CT 7).

In Zone 9, 3 per cent of those under the age of 10 had cicatricial trachoma; 15 per cent of those aged 10-19 were affected; 17 per cent of those aged 20-59 were; 43 per cent of those aged 60 or more were affected. (See Figure 15).



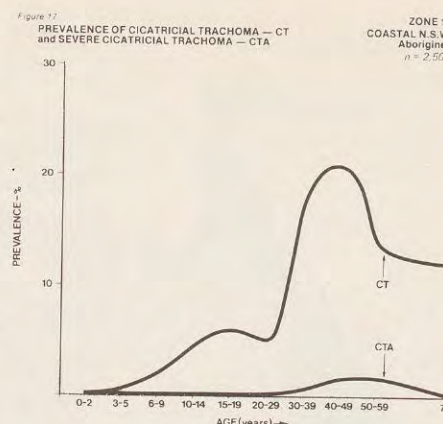
Overall, 1 per cent had CTA, including 8 per cent of those aged 60 or more. Another 5 per cent of those seen had CTB, with 7 per cent having CTC. Cicatricial trachoma was more severe with increasing age.

Significantly lower in prevalence for cicatricial trachoma than Zone 9 was Zone 13, in which 8 per cent of those seen were affected. Of those aged 10-19, 6 per cent were affected, while 17 per cent of those aged 20 or more were. (See Figure 16).



Overall, 0.5 per cent had CTA, including 7 per cent of those aged 60 or more, and 3 per cent had CTB, including 15 per cent of those aged 60 or more. Cicatricial trachoma was more severe with increasing age.

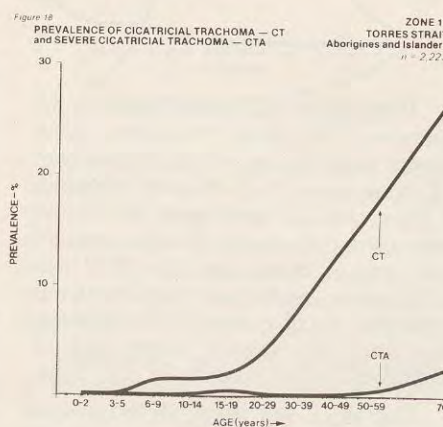
The next highest zone was Zone 12, in which 6 per cent of all seen, including 12 per cent of those aged 60 or more, had cicatricial trachoma. (See Figure 17).



The peak prevalence was found in persons aged 40-49 with 21 per cent affected. This was significantly higher than the age-60 prevalence although only to a $p = 0.1$ level. The trachoma seen in the 40-49 age group also the most severe, with 1 per cent having CTA, 14 per cent having CTB, and 6 per cent having CTC. By comparison, no cases of CTA were found in those 60 or older, and only 11 per cent had CTB.

Overall, 0.2 per cent of Aborigines examined in this zone had CTA, and 2 per cent had CTB.

In Zone 10, 5 per cent of the population examined had cicatricial trachoma, including 26 per cent of those aged 60 or more. The low findings of cicatricial trachoma were surprising in view of the high prevalence of follicular trachoma seen. (See Figure 18).

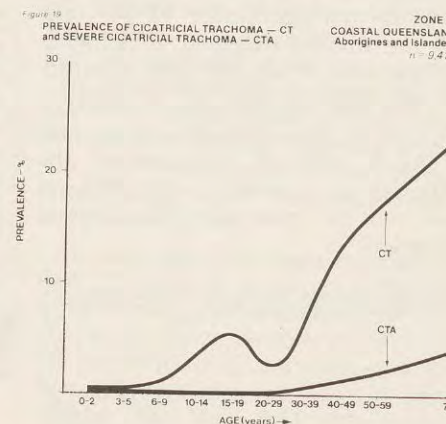


Overall, 0.2 per cent of those seen had CTA, 4 per cent had CTB, and 1 per cent had CTC.

In Zone 11, of those under the age of 10, 1 per cent had signs of cicatricial trachoma, 4 per cent of those aged 10-19 did, and 11 per cent of those over 20 did. (See Figure 19).

Except among the 20-29 group, among whom the prevalence of cicatricial trachoma was 2 per cent, (significantly lower than in the age group above and below it), prevalence increased with age, and, with the same exception, was on average more severe with increasing age.

Overall, 0.4 per cent of those seen had CTA, including 4 per cent of those aged 60 or more, and 2 per cent overall had CTB, including 14 per cent of those aged 60 or more.



Cicatricial Trachoma among Non-Aborigines

Table CT 8 shows the distribution of cicatricial trachoma among non-Aborigines, according to zone.

In no zone was the overall prevalence of cicatricial trachoma higher than the prevalence found in the lowest prevalence zone for Aborigines.

Overall, 65 non-Aborigines had CTA, 182 CTB and 139 CTC. Cicatricial trachoma was more severe in the later age groups.

Thus prevalence of cicatricial trachoma indicates the need for surveillance to prevent the corneal blindness which occurs in its advanced stages. High prevalence of severe grades of cicatricial trachoma indicate a need for close surveillance of the old, and when CTA or CTB affect the young they need to be especially watched and treated instantly and/or routinely during conjunctivitis epidemics that are frequent in Zones 1, 2, 3, 4, 5, 6, 7, 8 and 9.

TABLE CT 8 - CICATRICIAL TRACHOMA BY ZONES: NON-ABORIGINES

ZONE	Number Examined	Number with CT	Per cent with CT	Number of 60+ with CT	Number of 60+ with CTA
10. Torres Strait	332	11	3	7 (30%)	0
1. Red Centre	843	25	3	3 (14%)	0
7. Arid Eastern	10,803	194	2	38 (16%)	9 (3%)
3. Western Desert	526	9	2	1 (6%)	0
2. Cattle Country	1,369	19	1	5 (15%)	1 (3%)
6. Coastal Towns W.A.	3,498	33	1	3 (13%)	0
9. Gulf & Cape	1,164	10	1	3 (8%)	1 (3%)
8. Top End	5,003	29	1	6 (5%)	1 (1%)
4. Goldfields	2,331	13	1	5 (9%)	0
5. Coastal Missions W.A.	564	3	0	2 (20%)	1 (10%)
11. Coastal Queensland	8,776	38	0	8 (3%)	4 (2%)
12. Coastal NSW	1,174	1	0	1 (6%)	1 (6%)
13. Southern Mainland	2,061	1	0	1 (2%)	2 (2%)
TOTAL	38,444	386	1	83 (9%)	18 (2%)

Topical antibiotics should be "instantly available on a family basis" for every red or sticky eye in these areas. Surgery for trichiasis will be a continuing necessity for cohorts of persons moving up the age pyramid in the zones of high cicatricial trachoma prevalence.

Follicular Trachoma (FT) and Cicatricial Trachoma (CT)

Follicular trachoma is mostly a disease of childhood and early adolescence, and cicatricial trachoma which follows becomes prevalent two or three years after the age of peak prevalence of follicular trachoma in children, climbs steadily in late childhood and adolescent years, and peaks in the elderly.

The restrictions on categorisation of both follicular and cicatricial trachoma need to be remembered when considering the results outlined in this section.

TABLE T 1 - TRACHOMA AMONG ABORIGINES BY AGE

AGE	Number Examined	Number Affected	Per cent Affected
0-9	22,544	7,228	32.1
10-19	17,505	5,781	33.0
20-29	6,573	2,555	38.9
30-39	4,568	2,114	46.3
40-49	3,898	1,888	48.4
50-59	2,698	1,352	50.1
60+	3,923	2,701	68.9
ALL AGES	61,709	23,619	38.3

1. Jones B.R.: Report to the Australian College of Ophthalmologists on certain aspects of the National Trachoma and Eye Health Program, 1977 6:2

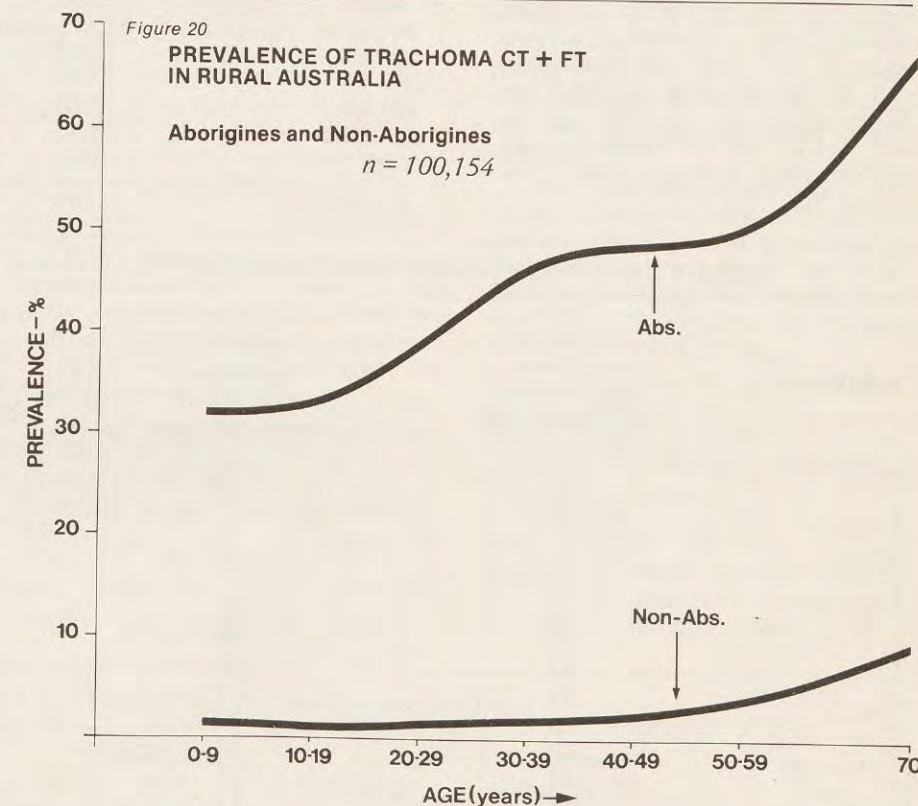


Table T 1 and Figure 20 show the prevalence of trachoma - the presence of follicular or cicatricial trachoma or both - in Aborigines examined by the program.

The lowest prevalence was found among children under the age of 10 increasing in each age group until almost 69 per cent of those aged 60 or more showed signs of the disease.

By contrast, 663 non-Aborigines had trachoma, with the average prevalence less than 5 per cent the Aboriginal rate. (See Table T2 and Figure 20).

Less than 1.5 per cent of non-Aborigines under the age of 40 were affected, with prevalences higher in each succeeding age group: 2.7 per cent between 40 and 49 years; 3.5 per cent of those aged 50 - 59; 9.5 per cent of those aged 60 or more.

Among Aborigines, most of the trachoma found in the very young was follicular trachoma alone. As age increased, however, the proportion of children with both follicular trachoma and cicatricial trachoma increased, as did the proportion of cicatricial trachoma alone. Then the proportion of both follicular and cicatricial trachoma began to fall, with the increase in each age group being cicatricial trachoma alone. In the later age groups almost all the trachoma seen was cicatricial trachoma only. (See Table T 3).

TABLE T 3 - COMPOSITION OF TRACHOMA IN DIFFERENT AGE GROUPS: ABORIGINES

AGE	Follicular trachoma only: per cent of trachoma cases	Follicular & cicatricial trachoma: per cent of trachoma cases	Cicatricial trachoma only: per cent of trachoma cases	Per cent of age group with trachoma
0	88	4	8	9.4
1	90	3	7	26.2
2	94	4	2	35.6
3	87	9	4	35.6
4	79	15	7	35.3
5	60	26	15	34.1
6	44	30	26	35.1
7	39	30	31	31.2
8	33	31	36	31.6
9	26	31	43	31.6
10	22	29	49	32.7
11	18	26	56	32.3
12	14	21	64	33.0
13	14	18	68	32.0
14	10	13	77	29.4
15	7	13	79	34.7
16	7	12	81	34.4
17	6	9	85	33.8
18	6	11	82	38.6
19	2	8	90	35.3
20-29	1	5	94	38.9
30-39	1	2	97	46.3
40-49	1	2	97	48.4
50-59	0	1	99	50.1
60+	0	1	99	68.9
ALL AGES	20	13	67	38.3

There is a very significant compositional difference in trachoma found among non-Aborigines, as Tables T4 and T 5 show. Only a small proportion of trachoma cases seen among non-Aborigines were both cicatricial and follicular.

In Aboriginal children under the age of 10 with trachoma, 23 per cent had follicular and cicatricial trachoma. By comparison, only 6 per cent of non-Aborigines with trachoma in this age group had both follicular and cicatricial trachoma. Similarly in the 10 - 19 age group,

TABLE T 2 - TRACHOMA AMONG NON-ABORIGINES BY AGE

AGE	Number Examined	Number Affected	Per cent Affected
0- 9	15,934	247	1.6
10-19	15,171	188	1.2
20-29	2,387	43	1.8
30-39	1,962	37	1.9
40-49	1,240	33	2.7
50-59	855	30	3.5
60+	896	85	9.5
ALL AGES	38,445	663	1.7

19 per cent of Aborigines with trachoma had both follicular and cicatricial trachoma, compared with 3 per cent of the non-Aboriginal trachoma cases in this age group.

The differences in Table T 5 are highly significant statistically, and suggest a different course of the disease in Aborigines and non-Aborigines. If the presence of both follicular and cicatricial trachoma indicates that follicular trachoma has been present for a considerable time, then it appears that follicular trachoma among Aborigines is more

chronic and of longer duration than among non-Aborigines. The implication of this is that cicatricial signs seen in non-Aboriginal children with follicular trachoma are less likely to be severe than those in Aboriginal children. This may be because the duration of follicular trachoma is a factor in determining the extent and severity of scarring.

Trachoma among Aborigines was differently distributed according to zones, with a peak prevalence of 77 per cent being found in the highest zone, Zone 1, and a lowest prevalence of 6.7 per cent in Zone 11. (See Table T 6).

TABLE T 5 - TRACHOMA IN ABORIGINAL AND NON-ABORIGINAL CHILDREN UNDER THE AGE OF 10

RACE	Follicular trachoma only	Follicular & cicatricial trachoma	Cicatricial trachoma only	Total trachoma cases
Aborigines	3,989	1,647	1,592	7,228
Non-Aborigines	175	14	58	247
TOTAL	4,164	1,661	1,650	7,475

In three regions, Zone 1, Zone 2, and Zone 3, seven of every 10 people seen had trachoma. The prevalence among the young was not markedly different from the overall prevalence, indicating that there has probably been little change in the overall prevalence of the disease for many years.

In the next five regions, Zone 4, Zone 6, Zone 7, Zone 5, and Zone 8, the prevalence of trachoma ranged from one in every two people to one in every three.

The prevalence among the young compared with the overall prevalence and the prevalence among the elderly suggests that the prevalence of trachoma, though still high, has been falling over the years.

In the remaining five areas, Zone 9, Zone 10, Zone 13, Zone 12, and Zone 11, the overall prevalence of trachoma ranged from one in every 15 to one in every 10. Except for Zone 10, the prevalence of trachoma among the young was significantly below both that found in

TABLE T 4 - SUMMARY: COMPOSITION OF TRACHOMA BY AGES: NON-ABORIGINES

AGE	FT ONLY Per cent of cases	FT AND CT Per cent of cases	CT ONLY Per cent of cases	PER CENT IN AGE GROUP AFFECTED
0- 9	71	6	23	1.6
10-19	46	3	52	1.2
20-29	16	0	84	1.8
30-39	14	0	86	1.9
40-49	0	0	100	2.7
50-59	7	0	93	3.5
60+	2	1	97	9.5
ALL AGES	42	2	55	1.7

the elderly and overall, suggesting a falling prevalence over the years.

The chief factor in the marked difference of Zone 10 was that, although there was a relatively high follicle rate among the children leading to a high prevalence of trachoma, the rate of cicatricial trachoma was very low.

The average proportion with cicatricial trachoma, and follicular trachoma with cicatricial trachoma, in the other zones was 64 per cent of all cases of trachoma seen among those aged 20 or less; in Zone 10, the proportion was only 8 per cent.

Assuming that the epidemiological picture shown by Zone 10 is an accurate picture of the progress of the disease in individuals, it appears that follicular trachoma of the sort found in there only rarely leads to scarring and cicatricial trachoma, follicles possibly resolving without clinical evidence of their ever having been present, at least not for many years.

TABLE T 6 - TRACHOMA BY ZONES: ABORIGINES

ZONE	Number Examined	Number with trachoma	Percentage	Per cent of under 20's with trachoma	Per cent of 60+ with trachoma
1. Red Centre	7,988	6,148	77.0	71.6	94.6
2. Cattle Country	5,425	3,909	72.1	66.7	91.7
3. Western Desert	2,084	1,455	69.8	69.3	85.4
4. Goldfields WA	1,545	778	50.4	42.7	86.1
6. Coastal Towns WA	3,081	1,446	46.9	40.5	82.1
7. Arid East	10,379	4,335	41.8	35.0	71.2
5. Coastal Missions	2,151	892	41.5	38.2	62.2
8. Top End NT	7,305	2,489	34.1	27.9	64.6
9. Gulf and Cape	3,532	577	16.3	12.7	43.0
10. Torres Strait	2,227	324	14.5	14.9	26.4
13. Southern Mainland	3,420	318	9.3	5.6	23.5
12. Coastal NSW	2,505	192	7.7	5.1	12.3
11. Coastal Qld	9,415	632	6.7	5.0	23.1

The possibility is that the disease was present many years ago but then disappeared, to be reintroduced only recently. If this is the case, the high proportion of trachoma among the elderly (mostly cicatricial trachoma), the fall in prevalence among young adults by comparison with both the elderly and the young, and the relative absence of cicatricial trachoma among the young might be accounted for.

There was a close relationship between the proportion of the young with trachoma, and the proportion of young trachoma cases having both follicular and cicatricial trachoma, which as discussed earlier must be considered as follicular trachoma of long standing, or chronic follicular trachoma. Table T 7 shows the distribution of chronic follicular trachoma as a proportion of the trachoma cases in the various zones.

In the zones where the highest prevalence of trachoma was found, the proportion of children and adolescents with both cicatricial and follicular trachoma of the total number of cases of trachoma, was the highest. In zones of lower prevalences, the proportion was lower.

Trachoma was also distributed among non-Aborigines according to zone, as Table T 8 shows:

In no zone was the prevalence of trachoma as high as the prevalence in the lowest Aboriginal zone, although the two highest areas, Zone 3 and Zone 5, had prevalences of trachoma among non-Aborigines under the age of 20 slightly higher than the prevalence of trachoma found among Aborigines under the age of 20 in two zones, Zone 12 and Zone 11.

Trachoma In Australia: A Summary

Trachoma remains a prevalent disease among Aborigines in Australia, particularly in three major areas of the Continent: the Red Centre, including the Pitjantjatjara homelands communities in South and Western Australia, the Western Desert communities

ZONE	UNDER 10 Frequency	Per cent	10-19 Frequency	Per cent
1. Red Centre	592/1,926	31	434/1,565	28
3. Western Desert	156/602	26	137/377	36
7. Arid East	357/1,428	25	156/1,230	13
2. Cattle Country	271/1,171	23	143/758	19
6. Coastal Towns WA	84/425	20	71/410	17
5. Coastal Missions	35/219	16	16/141	11
4. Goldfields WA	38/263	14	22/173	13
8. Top End NT	93/675	14	72/569	13
13. Southern Mainland	3/53	6	2/75	3
12. Coastal NSW	2/43	5	7/52	13
9. Gulf and Cape	5/122	4	4/149	3
10. Torres Strait	6/151	4	3/87	3
11. Coastal Queensland	4/138	3	10/197	5
ALL ZONES	1,646/7,216	23	1,077/5,783	19

ZONE	Number Examined	Number Affected	Per Cent	Percent of under 20 with trachoma
3. Western Desert	526	28	5.3	7.8
5. Coastal Mission WA	564	28	5.0	5.8
1. Red Centre	843	34	4.0	4.0
10. Torres Strait	332	13	3.9	0.7
7. Arid East	10,804	308	2.9	2.1
2. Cattle Country	1,369	32	2.3	2.7
6. Coastal Towns WA	3,498	66	1.9	1.6
4. Goldfields WA	2,331	30	1.3	1.1
9. Gulf and Cape	1,164	12	1.0	0.8
8. Top End NT	5,003	50	1.0	0.9
11. Coastal Qld	8,776	58	0.7	0.5
12. Coastal NSW	1,174	2	0.2	0.1
13. Southern Mainland	2,061	2	0.1	0.1
ALL ZONES	38,445	663	1.7	1.4

in the inland Pilbara region of Western Australia, and the Cattle Country of the Kimberleys WA, and the Northern Territory.

In these areas more than two in every three people seen had trachoma, with very high prevalences of follicular trachoma among the young and with up to 95 per cent of the elderly bearing the scars of cicatricial trachoma.

Surrounding these areas were seven regions in which the prevalence of trachoma was also very high, though not as high as the first three. These were the Goldfields region of Western Australia, the Coastal Towns and Missions of Western Australia, the Top End of the Northern Territory,

and the arid inland regions of Queensland, New South Wales and South Australia. In these areas the prevalence of trachoma ranged from three to five of every 10 Aborigines seen, with prevalences among the elderly which suggest that in former years the disease was more common than now. In spite of this evidence of declining prevalences, however, a large proportion of children and adolescents have follicular trachoma and are developing cicatricial trachoma, indicating that without further intervention, the disease will continue to persist and cause visual loss for many years.

Two zones in the north of Queensland, the Gulf and Cape Country and Torres Strait Islands, have pre-

valences of trachoma among Aborigines averaging about 15 per cent, significantly higher than in the three remaining areas screened, Coastal Queensland and New South Wales, and the south eastern mainland areas, where the average prevalence of the condition was about 8 per cent.

Overall, 38 per cent of all Aborigines seen had trachoma, including about one in three of all Aborigines under the age of 20 and over the age of 60. A significant proportion of the elderly had very marked cicatricial trachoma, of the sort conventionally described as blinding or potentially blinding lesions.

By comparison, less than two in every 100 non-Aborigines seen had trachoma, and in no area was the prevalence of the condition among Aborigines lower than in the highest area of prevalence of non-Aborigines.

The trachoma seen tended to be most severe in the areas where the prevalence was highest; in the zones with lower prevalences, and in all

zones for non-Aborigines, the more severe categories of trachoma were quite uncommon.

The next section of the report will deal with the program's findings of the visual status of rural Australians. It will be seen that in areas where the prevalence of trachoma is high, there are high rates of blindness, especially among the elderly, while in the zones of lower trachoma prevalence, fewer people are blind or have poor vision.

The chapter following will link the two: examining the role of trachoma in causing visual loss and disability in the various zones of Australia.





Chapter 6:

Vision in Rural Australia

The most important measure of the function of the human eye is that of visual acuity or sharpness of vision.

Testing of Visual Acuity

The measurement of visual acuity involves the recognition of symbols of known sizes at a measured distance. Symbols have been devised so that, at a particular distance, a symbol has a known angular dimension at the tested eye. The measurement is recorded as a fraction, such as 6/4, 6/6 or 6/60, known as the Snellen

fraction, in which the first number (the numerator) represents the test distance in metres and the second number (the denominator) represents the size of the smallest symbol recognised by the person being tested.

By convention denominator number is that distance in metres at which a symbol subtends an angular size of five-sixtieths of a degree (five minutes of arc) and each part of the symbol has an angular size, at the tested eye, of one-sixtieth of a degree, or one minute of arc. Normal visual acuity is when the tested eye can discern symbols that subtend at the eye five minutes of arc, with each part of the symbol subtending one minute of arc.

It is usual for the test distance to be six metres so that normal vision is recorded as a Snellen fraction as 6/6. Snellen fractions with numerators greater than denominators, such as 6/4 or 6/2, indicate visual acuity better than average, while those with numerators smaller than denominators indicate visual acuity less than average.

The symbol used for acuity testing was the illiterate E chart (see illustration Fig V 1). This series of symbols, in which the person being tested is asked to indicate, with a hand movement, the direction which the legs of the E were facing, has been widely used in many different cultures because it is readily taught to the person being tested and does not require literacy. Aboriginal people, with their heightened directional sense, responded readily to the E tests.

The visual acuity scores able to be recorded by the E chart were 6/6, 6/9, 6/12, 6/18, 6/24, 6/36 and 6/60, the last being the ability to read the top letter on the chart at six metres.

Those unable to read the top letter on the E chart were given further tests:

The ability to count a finger a metre away (CF) was considered to be vision approximately equal to 3/60.

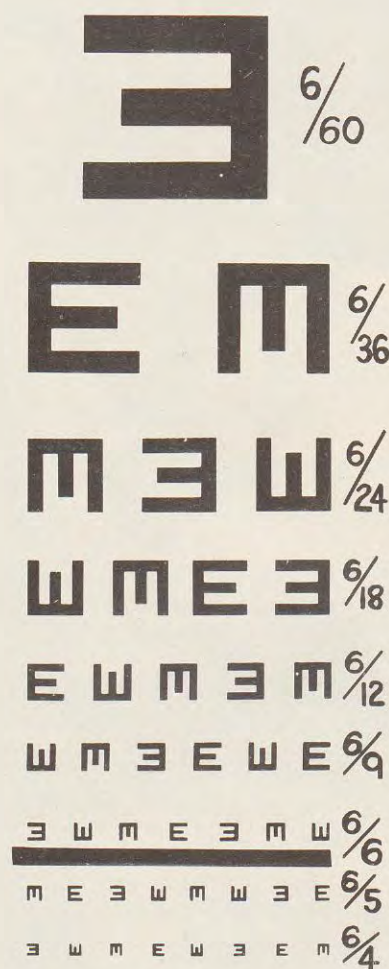


Figure V 1
The Snellen Illiterate E Chart.

TABLE V1: PERSONS NOT TESTED FOR VISUAL ACUITY

AGE	ABORIGINES			NON-ABORIGINES		
	Not tested	Total seen	Per Cent not tested	Not tested	Total seen	Per Cent not tested
0-9	9,277	22,778	41	1,326	16,034	8.0
10-19	670	17,554	4	58	15,185	0.4
20-29	77	6,593	1	11	2,400	0.5
30-39	55	4,590	1	4	1,977	0.2
40-49	41	3,913	1	5	1,249	0.4
50-59	46	2,716	2	4	867	0.5
60+	80	3,972	2	7	904	0.8
ALL AGES	10,246	62,116	16	1,415	38,616	4.0

The ability to see a hand moving at less than a metre (HM) was next tested.

A person unable to see a hand movement was tested, with a torch held in front of the eye, for the ability to perceive light (PL).

When vision was such that light was not perceived by the eye, the record was entered as "no perception of light".

Testing was started at six metres, and due care was taken to avoid contrast or glare and to achieve adequate illumination of the chart.

In most instances, children under the age of six years were not able to be tested for visual acuity, although all such children were given a complete medical eye examination and checked for ocular pathology and other conditions likely to impair vision. Such persons have been considered as having good vision.

For the purpose of this report, the program considered vision in each eye according to three categories:

Vision of 6/6, 6/9 or 6/12 in an eye was considered good visual acuity in that eye.

Vision of 6/18, 6/24 or 6/36 in an eye was considered poor vision in that eye.

Vision of 6/60 or worse was considered to be blindness in that eye.

The report, however, deals with binocular visual status, or vision in both eyes, and accordingly, the program's findings are discussed in the following groups:

1. Those with good vision in both eyes.
2. Those with satisfactory vision (good vision in at least one eye).

3. Those with poor vision (vision in one's better eye of 6/18, 6/24 or 6/36 with the other eye either blind or also having poor vision).

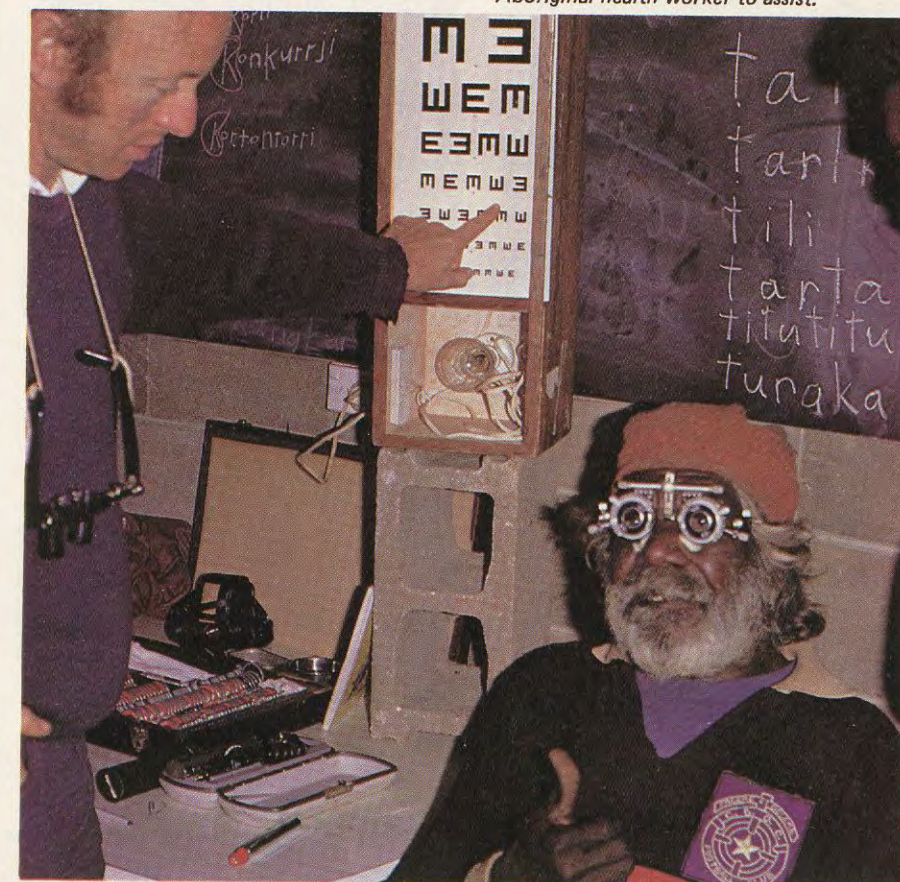
4. Those who were blind (vision no better than 6/60 in each eye).

5. Those monocularly blind (vision in worse eye no better than 6/60 with the better eye having either good or poor vision).

6. Those who were visually handicapped (persons who were blind or had poor vision).

It can be seen that not all vision groups are mutually exclusive: those who were monocularly blind, for instance, might belong also to the satisfactory or the poor vision group because of their visual status in their other eye. Similarly, the blind are included in the visually handicapped group, and the persons with good vision are included in the satisfactory group.

Fig V2: An elder of the Strelley community indicates the direction of the E Chart symbol to Dr. Ken Tarr. On hand is an Aboriginal health worker to assist.



The Program's Findings

The program's findings are presented in each of the six vision groups discussed above. A total of 62,116 Aborigines and 38,616 non-Aborigines were screened by the program, located in the 13 zone areas of rural Australia.

As discussed earlier, not all these were given a vision test; those not tested were mostly too young. Table V1 shows the distribution by age and race of those not tested.

The high proportion (41%) of Aboriginal children aged 0-9 years not tested, reflects the higher numbers of babies and pre-school Aboriginal children seen as distinct from the non-Aboriginal children of whom a lesser proportion were too young to be vision tested.

Good Vision

Persons considered to have good vision were those whose visual acuity was 6/12 or better in both eyes. The visual acuity used was that attained after a spectacle correction of any refractive error had been done.

Included in this category were persons who were examined by program ophthalmologists but who, for some reason or another, were not given a visual acuity test. The great majority of these were infants too young to be tested. These were, however, given a medical eye examination, and pathology or other ocular conditions likely to substantially impair vision were excluded.

PREVALENCE OF GOOD VISION RATE PER 1000

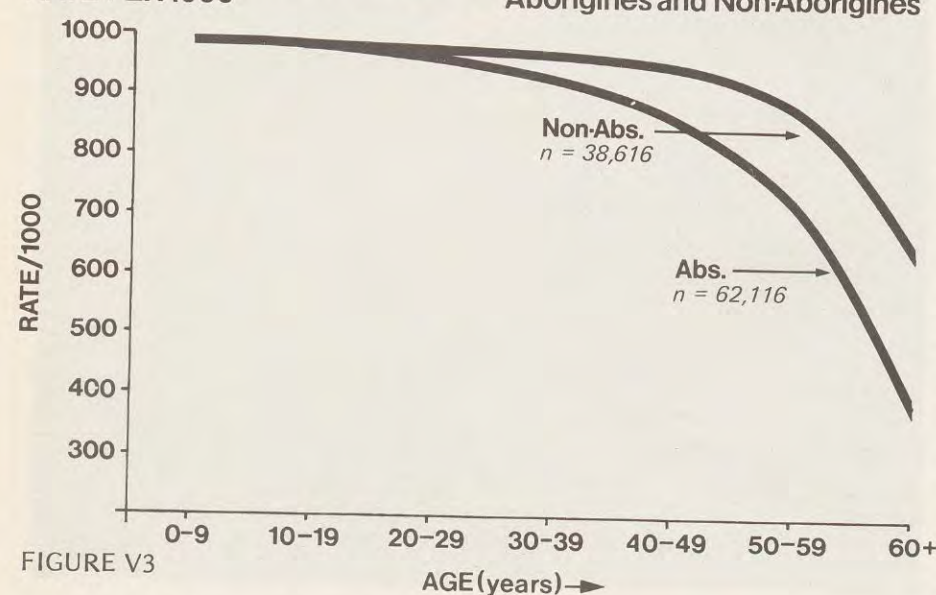


FIGURE V3

1. H.R. Taylor: Vision of Australian Aborigines, thesis submitted to University of Melbourne, 1978.

TABLE V2: GOOD VISION: ABORIGINES VS NON-ABORIGINES

AGE	ABORIGINES Number	Rate/ 1000	NON-ABORIGINES Number	Rate/ 1000
0-9	22,604/22,778	992	15,847/16,034	988
10-19	17,212/17,554	981	14,858/15,185	978
20-29	6,342/ 6,593	962	2,322/ 2,400	967
30-39	4,249/ 4,590	926	1,909/ 1,977	966
40-49	3,367/ 3,913	860	1,183/ 1,249	947
50-59	1,978/ 2,716	728	764/ 867	881
60+	1,575/ 3,972	397	576/ 904	637
ALL	57,327/62,116	923	37,459/38,616	970

Table V2 and Figure V3 show the findings in the various age groups for Aborigines and non-Aborigines. There were variations between zones with good visual acuity rates among Aborigines; with non-Aborigines there were no significant variations in the proportions of persons with good vision in any of the zones, permitting the grouping of all non-Aborigines and avoiding small number problems. This condensed group can be compared with Aboriginal groups.

Significantly more Aboriginal children aged 0-9 have good vision than non-Aboriginal children of the same age ($p < 0.001$). There is no statistically significant difference between Aborigines and non-Aborigines in the 10-19 or 20-29 age groups but beyond that significantly more non-Aborigines proportionately in every age group have good vision than Aborigines in the same age group. The difference in the overall rates is largely composed of the lower pro-

portion of elderly Aborigines with good vision compared with non-Aborigines.

Dr. Hugh Taylor, while working with the NTEHP, has shown that a greater proportion of young Aborigines have super-sight (vision of 6/2 or better) than young non-Aborigines. He has also shown that young Aborigines show a greater increase in visual acuity when both eyes are tested together than do non-Aborigines of the same age and sex.

Taylor found that 111 young Aborigines in every thousand would have binocular vision of 6/2 or better, while only 29 of every thousand non-Aborigines had such a visual capacity. (1)

Good vision rates were differently distributed throughout the zones, as Table V3 shows.

For all ages, the good vision rate ranged from 863 per thousand in Zone 2, the Cattle Country, to 955 per thousand in Zone 12, Coastal NSW.

In three zones, the Cattle Country, the Western Desert zone and Coastal Missions, less than nine of every 10 persons examined had good vision, while in three other zones, Zone 4 Goldfields, Zone 6 Coastal Towns WA, and Zone 1 the Red Centre, the overall rate was only just above nine in 10.

Next follow the Torres Strait Island zone, with 920 per thousand having good vision, the Gulf and Cape zone, with a rate of 929/1,000, the Top End zone, with a rate of 934/1,000 and the Arid Eastern zone with 937 per thousand having good vision.

In the final three zones, the good vision rate is about 950 per thousand - about 19 in every 20 persons having good vision. Coastal Queensland has a

TABLE V3: GOOD VISION RATES BY ZONE: ABORIGINES

ZONE	AGE 0-9	(Rates per thousand)			ALL AGES
		10-19	60+		
1. Red Centre	994	987	361		908
2. Cattle Country	994	980	296		863
3. Western Desert	991	994	342		873
4. Goldfields	992	975	364		905
5. Coastal Missions	982	983	347		892
6. Coastal Towns (WA)	990	969	300		910
7. Arid Eastern	990	979	464		937
8. Top End	998	982	423		934
9. Gulf and Cape	997	986	402		929
10. Torres Strait	980	973	458		920
11. Coastal Qld.	993	979	545		947
12. Coastal NSW	991	985	582		955
13. Southern Mainland	994	978	564		954
ALL ZONES	992	981	397		923

rate of 947/1,000, the Southern Mainland zone, with 954/1,000, and in the best zone, Coastal NSW, 955 of every thousand Aborigines seen by the program had good vision.

Taking the figures for all ages, it can be seen that in no zone was the good vision rate of 923 per thousand as high as it was overall for non-Aborigines, at 970 per thousand.

There is little correlation between good vision rates in the 0-9 age group, or the 10-19 age group and the overall rates: the chief factor influencing the overall rate being the rate for persons 60 years and over.

With Aborigines aged 0-9, good vision rates were higher than average in seven of the zones, including some of the zones with the lowest overall good vision rates. In 11 zones, including five of the six with the lowest good vision rates for all ages, the good vision rates for Aborigines aged 0-9 were higher than the rate for non-Aborigines aged 0-9 (988 per thousand).

Similarly, in 10 zones, Aborigines aged 10-19 had higher good vision rates than the rate for non-Aborigines of the same age (978 per thousand).

Among Aborigines aged 60 or more, the good vision rate ranged from a low of 296 per thousand in the Cattle Country zone to a high of 582 per thousand in the Coastal NSW zone. The pattern very closely resembles that of the overall rates: in Zones 1 to 6, good vision rates among the elderly range from 296 to 364 per thousand, an average of about one in three elderly Aborigines having good vision.

Then follow four zones, 7, 8, 9 and 10, in which at least four but less than five in every 10 elderly people have good vision. The rates range from 402 per thousand in the Gulf and Cape zone, to 464 per thousand in the Arid Eastern zone.

Finally, Zones 11, 12 and 13 have good vision rates significantly less than, but approaching, non-Aboriginal rates. In the best zone, Coastal NSW, the good vision rate among the elderly, at 582 per thousand, was about 50 per thousand lower than the non-Aboriginal rate for the 60+ age group of 637 per thousand.

Satisfactory Vision

Those said to have satisfactory vision were those with good vision

in at least one eye: that is, visual acuity of 6/12 or better in one eye.

This group includes those who have good vision in both eyes, and also those who have good vision in one eye and have poor vision or are blind in the other. This standard of vision allows most human functions, including driving a motor vehicle.

Table V4 and Figure V4 show the distribution of satisfactory vision in the various age groups for Aborigines and non-Aborigines.

For Aborigines, 59,755 of 62,116 examined, or 962 per thousand, had satisfactory vision. The rate was 998/1,000 in Aborigines age 0-9; then fell slowly at first until the 30-39 age group when the fall became more marked until, among

PREVALENCE OF SATISFACTORY VISION RATE PER 1000

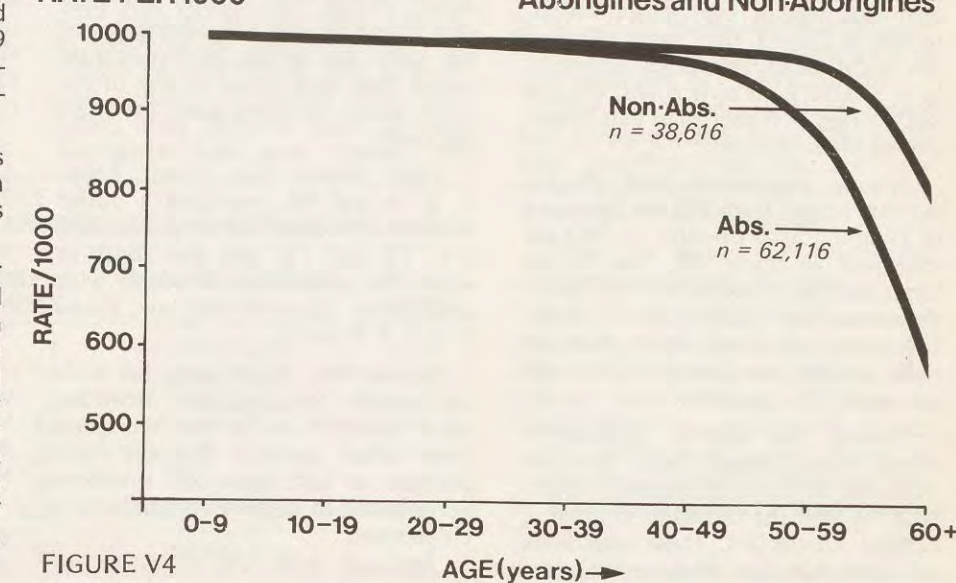


FIGURE V4

Aborigines aged 60 or more, only 585 of every 1,000 had satisfactory vision.

With non-Aborigines, 38,266 of 38,616 examined, or 991 per thousand, had satisfactory vision. The rate was 998/1,000 in children aged 0-9, then fell slowly in each successive decade until the 40-49 age group, falling more markedly in following age groups, until, by age 60 or more, 803 of every thousand had satisfactory vision.

Comparing Aborigines with non-Aborigines, it can be seen that the satisfactory vision rates are similar until the 30-39 age groups. Only among those aged 10-19 is there any difference - of 995 Aborigines in every thousand having satisfactory vision compared with 996 non-Aborigines, and this is not significant ($p = > 0.1$). In the 30-39 age group, however, a statistically significant higher proportion of non-Aborigines had satisfactory vision; the gap between Aborigines and non-Aborigines increased in each further age group.

Table V5 shows the distribution of satisfactory vision among the various zones.

Overall satisfactory vision ranges from 980 per thousand in Zone 13, the Southern Mainland zone, to 927 per thousand in Zone 2, the Cattle Country zone. In no zone was the overall rate as high as that found among non-Aborigines, of 991 per thousand.

Among children aged 0-9, the rate ranged from 1,000 per thousand in Zone 8, Top End, Northern Territory, with only one of 2,564 children seen not having satisfactory vision, to 994 in Zone 5, the Coastal Missions WA, a statistically significant difference ($p = < 0.001$). In nine zones, the rate was as high or higher than that found among white children.

Among adolescents aged 10-19, the rate ranged from 999 per thousand in Zone 2, Cattle Country, to 982 per thousand in Zone 10, the Torres Strait Islands, a statistically significant difference ($p = < 0.001$). Seven of the 13 zones had rates higher than or equal to the non-Aboriginal rate for persons in this age group.

Among the elderly, satisfactory vision rates ranged from 744 per thousand in Zone 13, Southern Mainland, to 499 per thousand in Zone 6, Coastal Towns WA. These rates were all lower than that found among non-

TABLE V4:
SATISFACTORY VISION: ABORIGINES VS NON-ABORIGINES

AGE	ABORIGINES Number	Rate/ 1000	NON-ABORIGINES Number	Rate/ 1000
0-9	22,739/22,778	998	15,995/16,034	998
10-19	17,461/17,554	995	15,126/15,185	996
20-29	6,541/ 6,593	992	2,380/ 2,400	992
30-39	4,522/ 4,590	985	1,969/ 1,977	996
40-49	3,772/ 3,913	964	1,235/ 1,249	989
50-59	2,398/ 2,716	883	835/ 867	963
60+	2,322/ 3,972	585	726/ 904	803
ALL AGES	59,755/62,116	962	38,266/38,616	991

TABLE V5:
SATISFACTORY VISION BY ZONE: ABORIGINES
AGE: Rates per thousand

ZONE	0-9	10-19	60+	Overall
1	999	997	555	952
2	999	999	499	927
3	999	998	536	928
4	998	998	523	960
5	994	994	500	944
6	996	989	487	951
7	998	996	677	975
8	1,000	998	595	969
9	998	997	619	965
10	997	982	614	957
11	997	993	712	975
12	999	995	703	978
13	999	992	744	980
ALL ZONES	998	995	585	962

Aborigines of the same age group, of 803 per thousand. See Figure V5 for the distribution of Aborigines, over 60 years of age who had satisfactory vision.

In Zones 11, 12 and 13, the proportion of elderly people with satisfactory vision, though significantly less than that found among non-Aborigines of the same age group, is significantly higher than that found in any of the other zones for Aborigines 60 years and over.

Then follow four zones, Zones 7, 8, 9 and 10, providing a buffer between the comparatively good zones, (11, 12 and 13) and the zones in which the proportion of people with satisfactory vision is very low, Zones 1, 2, 3, 4, 5 and 6.

Satisfactory vision rates fall with age, rapidly for Aborigines from the age of about 45 and for non-Aborigines from about age 55. The age composition of each zone will therefore be reflected in the overall satisfactory vision rates.

Although there was no difference

overall in the rates for elderly men and elderly women as far as satisfactory vision was concerned, there was one zone, the Red Centre, in which the satisfactory vision rate for women over 59 was significantly lower than that found in men. In this zone, 194 of 313 men examined, or 620 per thousand, had satisfactory vision, while only 190 of 379 women 60 years or older, or 501 per thousand, had satisfactory vision ($p = 0.001$).

Poor Vision

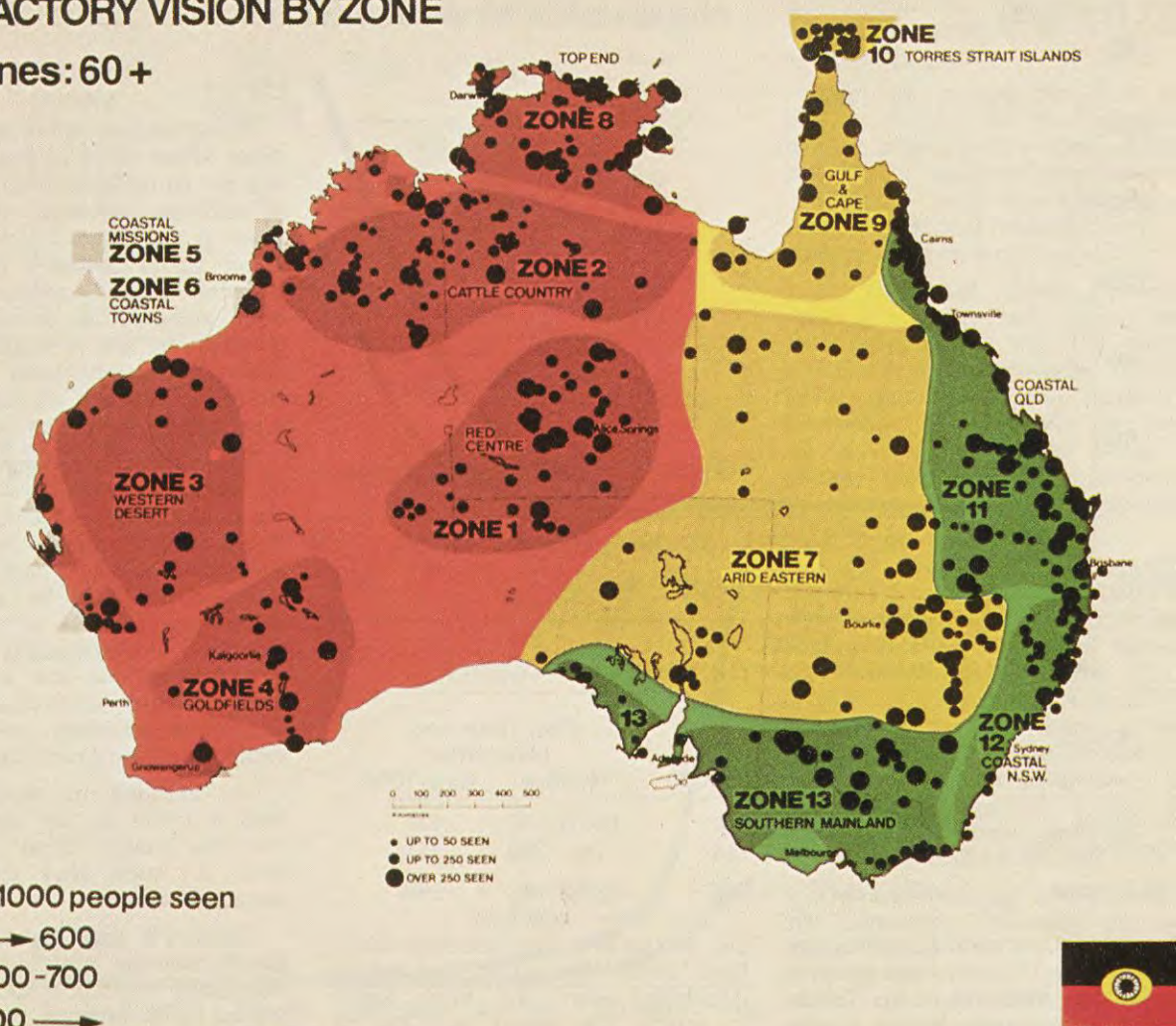
Persons said to have poor vision were those with vision in their better eye of 6/18 or 6/24 or 6/36. They might have a similar vision in their other eye, or be worse.

Those with such vision cannot be considered as blind. They could not, however, pass a vision test for a driving licence even if their vision was sufficient to carry out some tasks.

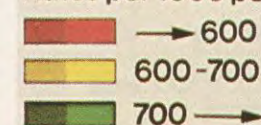
Table V6 and Figure V6 show the distribution of poor vision among Aborigines and non-Aborigines.

PREVALENCE OF SATISFACTORY VISION BY ZONE

Aborigines: 60+



Rates per 1000 people seen



Twenty-three of every thousand Aborigines seen had poor vision, while eight in every thousand non-Aborigines did.

With children aged between 0-9, a significantly lower proportion ($p = < 0.025$) of Aboriginal children have poor vision than non-Aboriginal children, but there is no significant difference between the rates for

Aborigines and non-Aborigines in the 10-19 and 20-29 age groups. There is a significant difference ($p = 0.001$) in each of the later age groups.

In both groups, the rates were low in the younger age groups and increased in older years. Two in every nine elderly Aborigines had poor vision, while three in every 20 non-Aborigines had poor vision: the

TABLE V6:
POOR VISION IN BETTER EYE: ABORIGINES AND NON-ABORIGINES

AGE	ABORIGINES Number	Rate/ 1000	NON-ABORIGINES Number	Rate/ 1000
0-9	29/22,778	1	37/16,034	2
10-19	76/17,554	4	55/15,185	4
20-29	42/ 6,593	6	17/ 2,400	7
30-39	51/ 4,590	11	7/ 1,977	4
40-49	95/ 3,913	24	12/ 1,249	10
50-59	243/ 2,716	89	26/ 867	30
60+	900/ 3,972	227	136/ 904	150
ALL AGES	1,436/62,116	23	290/38,616	8

Aboriginal rate among the elderly being over 1.5 times the non-Aboriginal rate.

A significantly higher proportion ($p = < 0.001$) of Aborigines with poor vision in their best eye were blind in their other eye, as Table V7 shows.

Thus, not only did Aborigines have proportionately more poor vision than non-Aborigines, but the poor vision they suffered was more severe than that of non-Aborigines.

Table V8 shows the distribution of poor vision among the zones.

The 21 Aboriginal children with poor vision were distributed about the zones with no obvious pattern. The highest zone rate was in Zone 5, Coastal Missions, and Zone 10, Torres Strait, while two zones, Zone 4, Goldfields, and Zone 8, Top End, had no children classified as having poor vision.

There was again no obvious pattern

Figure V5

PREVALENCE OF POOR VISION IN BETTER EYE RATE PER 1000 Aborigines and Non-Aborigines

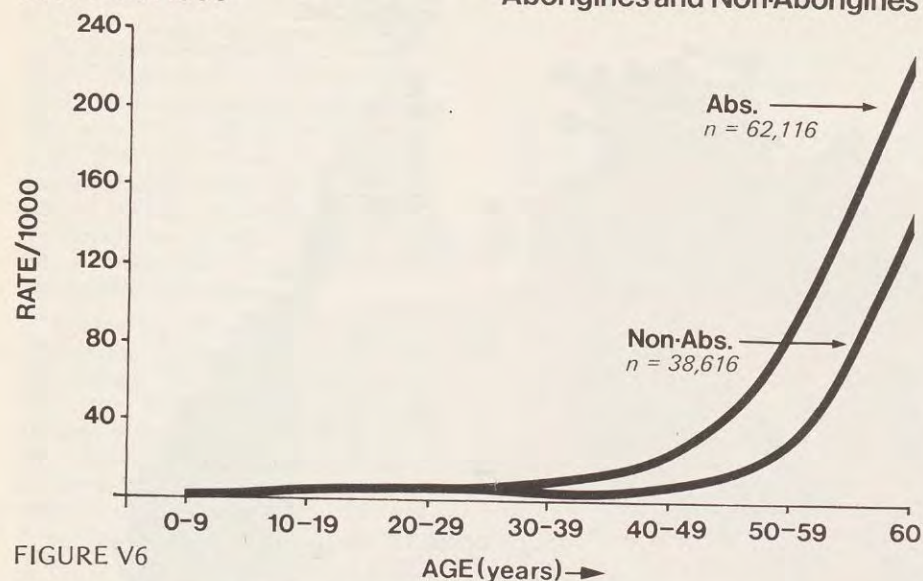


FIGURE V6

TABLE V7:
MONOCULAR BLINDNESS IN THE POOR VISION GROUP

RACE	Poor vision both eyes		Poor vision one, blind other	
	Number	Rate/1000	Number	Rate/1000
Aborigines	830/1,436	578	606/1,436	422
Non-Aborigines	216/ 290	745	74/ 290	255
Both Groups	1,046/1,726	606	680/1,726	394

in the zone-by-zone rates for Aborigines aged 10-19, with rates ranging from 16 per thousand in the Torres Strait zone to none in the Cattle Country zone.

Poor vision among elderly Aborigines ranged from 288 per thousand in the Coastal Missions zone to 188

per thousand in the Southern Mainland zone. The rates for elderly Aborigines were the main factor in setting the overall rates for all ages, which ranged from 38 per thousand in Zones 2 and 3, the Cattle Country and Western Desert, to 15 per thousand in Zones 12 and 13,

Coastal NSW and the Southern Mainland.

Blind

Those persons said to be blind were those whose vision in their better eye was no better than 6/60, the ability to read the top letter of the vision chart at six metres. Such a level of vision would entitle a person to a blindness invalid pension and has been accepted as a definition of blindness by the Australian Ophthalmological Society (now the Royal Australian College of Ophthalmologists) and the Australian Government.

There are many different definitions of blindness and different grades of visual incapacity. Absolute blindness, that is no perception of light in either eye, occurs in only a portion of those classified as blind by any of the definitions. The use of the pensionable level of visual acuity as a blindness measure has the advantage of being readily understood and is already a reference point in the sociology of visual handicaps.

No account of reduced visual field is taken in this report. Whenever the words "blind" or "blindness" are used, they indicate pensionable blindness.

Table V9 and Figure V7 show the distribution of blindness among Aborigines and non-Aborigines examined by the program.

For Aborigines, the blindness rate was low in the younger age groups, with less than one in every thousand children aged between 0 and 9 being

TABLE V9: ABORIGINAL AND NON-ABORIGINAL BLINDNESS RATES

AGE	ABORIGINES Number	Rate per thousand	NON-ABORIGINES Number	Rate per thousand
0-9	10/22,778	0	2/16,034	0
10-19	17/17,554	1	4/15,185	0
20-29	10/ 6,593	2	3/ 2,400	1
30-39	17/ 4,590	4	1/ 1,977	1
40-49	46/ 3,913	12	2/ 1,249	2
50-59	75/ 2,716	28	6/ 867	7
60+	750/ 3,972	189	42/ 904	46
ALL AGES	925/62,116	15	60/38,616	2

PREVALENCE OF BLINDNESS RATE PER 1000 Aborigines and Non-Aborigines

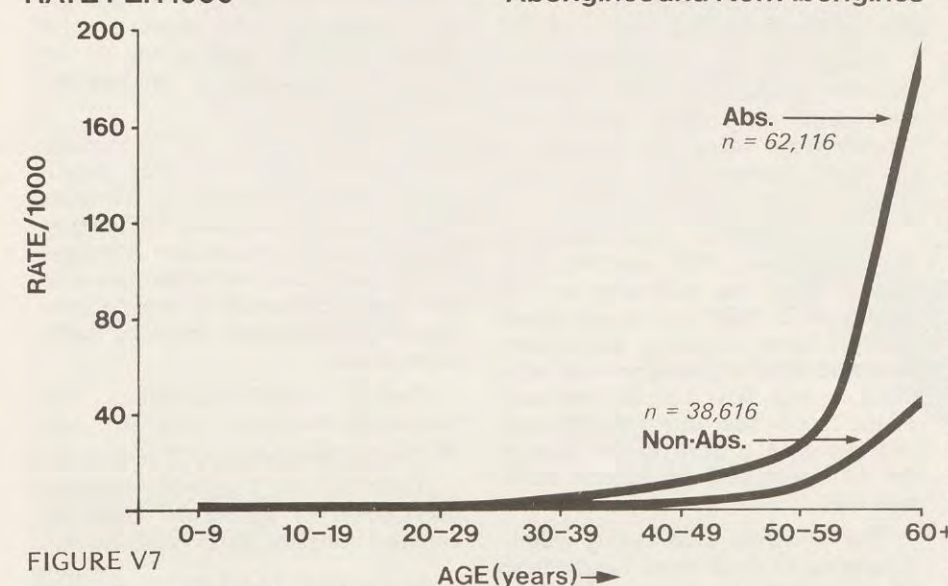


FIGURE V7

blind (the rate was 0.44 per thousand), with one in every thousand in the 10-19 age group being blind and two in every thousand in the 20-29 group. The rate continued to increase in the higher ages until the 60+ age group, when 189 in every thousand seen was found to be blind.

By comparison, 60 blind non-Aborigines were seen. Less than one in every thousand non-Aborigines in the 0-9 and 10-19 age group were blind (the rates were 0.12 per thousand and 0.26 per thousand respectively). The rate increased to one per thousand in the 20-29 and 30-39 age groups, then rose to two per thousand in the 40-49 group, to seven per thousand in the 50-59 group and 46 per thousand in the 60+ group.

The non-Aboriginal blindness rates found by the program, particularly in the older age groups, may be higher than is the case in the general popu-

lation. The program attempted to screen the entire Aboriginal population, but made no strong effort

TABLE V10: ABORIGINAL BLINDNESS, ZONE BY ZONE

ZONE	Rate per thousand All ages	Rate per thousand Age 60 and over
1. Red Centre	23	225
2. Cattle Country	35	252
3. Western Desert	34	227
4. Goldfields	19	262
5. Coastal Missions (WA)	22	212
6. Coastal Towns (WA)	26	321
7. Arid East	7	115
8. Top End (NT)	13	187
9. Gulf and Cape	11	131
10. Torres Strait	11	118
11. Coastal Qld.	5	81
12. Coastal NSW	7	88
13. Southern Mainland	5	68
ALL ZONES	15	189

to do likewise with the non-Aboriginal population: instead it made its services available to those who wished to be seen.

Two age groups, the 0-9 and 10-19 groups, are the exception to this; large numbers of non-Aboriginal school children were screened during the program's screening of Aboriginal school children with no obvious selection factors at work.

In older age groups, however, those who attended clinics were those who decided that they wanted a free, full eye examination. It seems likely that those who considered themselves to have eye problems would have been more likely to present themselves for examination than those who were having no visual difficulties.

Some measure of this selection factor is possible from the literature, with estimates of the overall non-Aboriginal blindness rate of between one and four per thousand. If the program's findings in various age groups were used in conjunction with census data of the age structure of the non-Aboriginal population, the blindness rate suggested is seven per thousand — probably between two and seven times the true rate.

The high coverage of the Aboriginal population, including the estimated 60 per cent coverage of the 60+ age group, the group among whom most blindness was found, permits considerably more confidence in estimating Aboriginal blindness rates.

During field work, program members and liaison staff specifically

sought out the old and blind. In subsequent field excursions, however, numbers of elderly Aborigines who were blind were seen who had not previously been seen. This may indicate an initial reluctance on the part of some of the visually handicapped to present or be presented for examination until the nature of the program's work had become evident.

On such data as is available about the age structure of Australia's rural Aboriginal population, the figures suggest a blindness rate of about 15 per thousand.

Overall there are probably between 1,300 and 1,500 blind Aborigines.

There were considerable differences in blindness rates between the zones, as Table V10 shows.

The overall blindness rate ranged from five per thousand in the Southern Mainland zone to 35 per thousand in the Cattle Country zone, while the rate among persons aged 60 or more ranged from 68 per thousand in the Southern Mainland zone to 321 per thousand in the Coastal Towns, W.A. zone.

The first six zones stand out for very high blindness rates, both among the elderly and overall. In each of these zones more than one in every five Aborigines aged 60 or more was blind; in three of these the rate was higher than one in every four. The overall blindness rate among persons aged 60 or more in these six zones was 246 per thousand, so that almost one in every four in these zones over the age of 60 was blind.

Taking all age groups into account, one person in every 37 seen by the program in these six zones was blind, as high as 35 per thousand in the Cattle Country zone (one person in every 29) and going as low, comparatively, as 19 per thousand (one in every 53) in the Goldfields zone.

The level of blindness in these six zones was 17 times the rate found among non-Aborigines overall.

In one zone, Zone 1, the Red Centre, there were significantly more elderly women blind than elderly men ($p = 0.025$). In this zone, 58 of 313 men over the age of 60 were blind, a rate of 185 per thousand, compared with 98 of 379 women being blind, a rate of 259 per thousand.

Although in some other zones and overall, the number of blind elderly women, and their proportion, was higher than the rate for elderly men, in no other zone was the difference significant.

In four other zones, apart from the six mentioned above, the rate of blindness among elderly Aborigines was more than one in every 10. These were Zones 7, 8, 9 and 10 to the east or north of the first six zones.

In these zones overall, the rate of blindness overall among elderly Aborigines was 141 per thousand, a little over half the rate found in the first six zones. The rate ranged from 187 per thousand in the Top End of the Northern Territory to 115 per thousand in the Arid Eastern zone.

Taking all ages into account, 10 in every thousand Aborigines in these four zones were blind, with a rate ranging from seven per thousand in the Arid Eastern zone to 13 per thousand in the Top End zone.

In the last three zones, taking in the Queensland, NSW and Victorian Coastal areas and extending to Riverina areas of NSW and closely settled areas of South Australia, 80 in every thousand elderly Aborigines seen were blind, a rate less than 60 per cent of the rate in four intermediate zones and less than a third of the rate in the six zones with the highest blindness rates.

The blindness rate among elderly Aborigines in these zones ranged from 68 per thousand in the Southern Mainland zone to 88 per thousand in Coastal NSW.

Taking all age groups into account, six in every thousand Aborigines seen were blind in these three zones, with two zones having rates of five per thousand and one, Coastal NSW, having a rate of seven per thousand. This rate was less than a quarter of

the rate found in Zones one to six, and less than two-thirds the rate found in Zones seven to 10. Figure V8 shows the distribution of blindness among Aborigines aged 60 years or more.

Monocular Blindness

Persons considered to belong to the monocular blind group were those with vision no better than 6/60 in their worse eye and vision better than 6/60 in their better eye.

Those considered monocularly blind may have good vision in their other eye (in which case they also belong to the monocular good vision — the satisfactory vision groups) or may have poor vision in their better eye (in which case they also belong to the poor vision, and visually handicapped groups).

The presentation of monocular blindness rates is warranted principally because monocular blindness may precede binocular blindness. Because some monocular blindness is due to trauma, its rates may also give some indication of the environmental circumstances faced by particular groups.

Overall, 1,667 Aborigines had monocular blindness, while 368 non-Aborigines did.

Table VII and Figure V9 show the distribution of monocular blindness among Aborigines and non-Aborigines.

In the 0–9 age group, more, but not significantly more, non-Aborigines were blind in one eye, with the rate being the same in the 10–19 age group.

From the 20–29 age group on, however, Aborigines had a higher rate of monocular blindness than non-Aborigines. In the 20–29 age group, 21 per thousand Aborigines were monocularly blind, compared

TABLE V11: ABORIGINAL AND NON-ABORIGINAL MONOCULAR BLINDNESS

AGE	ABORIGINES Number	Rate/ 1000	NON-ABORIGINES Number	Rate/ 1000
0–9	49/22,778	2	42/16,034	3
10–19	124/17,554	7	109/15,185	7
20–29	136/ 6,593	21	22/ 2,400	9
30–39	144/ 4,590	31	22/ 1,977	11
40–49	192/ 3,913	49	26/ 1,249	21
50–59	255/ 2,716	94	37/ 867	43
60+	767/ 3,972	193	110/ 904	122
ALL AGES	1,667/62,116	27	368/38,616	10

PREVALENCE OF BLINDNESS BY ZONE Aborigines: 60+

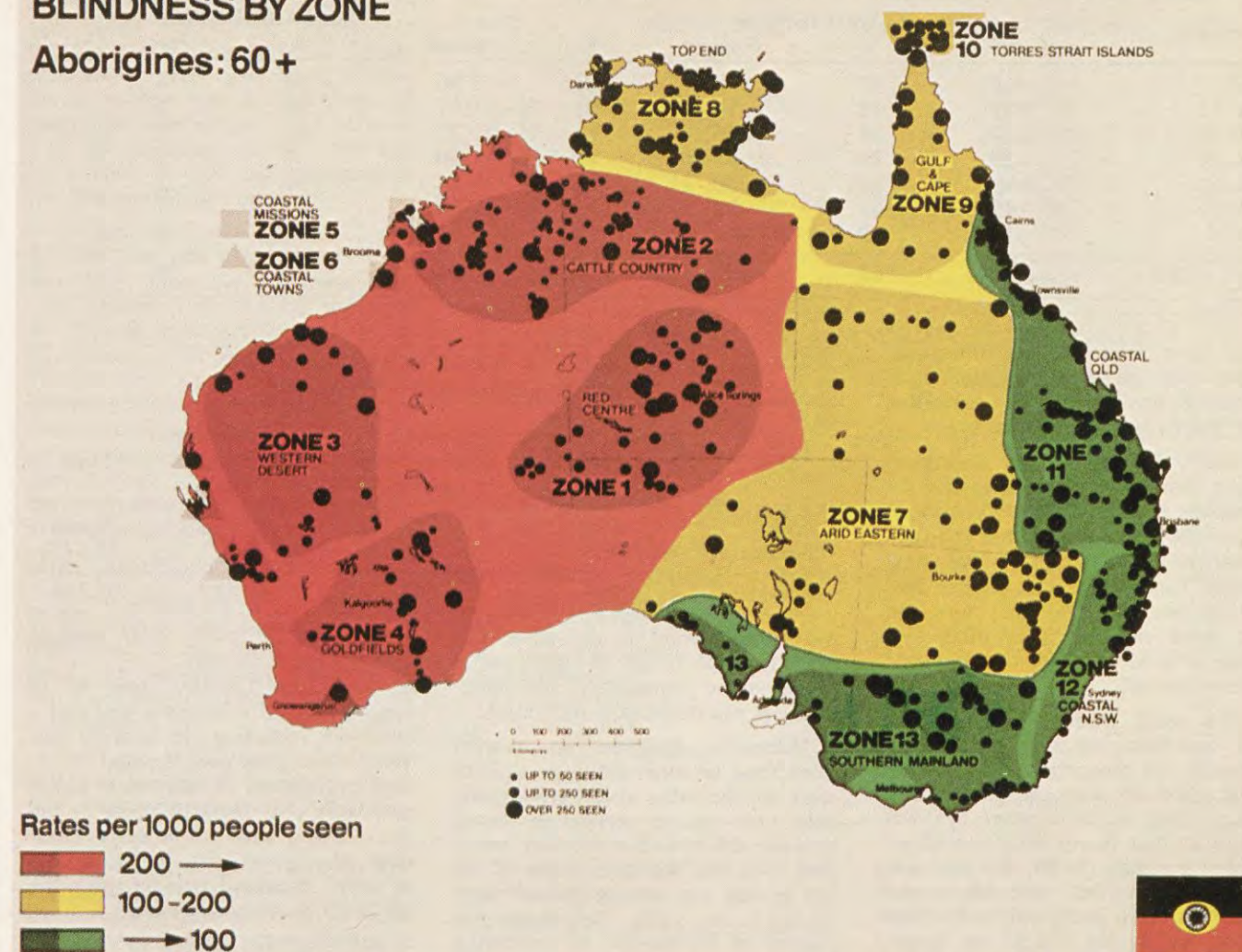


Figure V8

PREVALENCE OF MONOCULAR BLINDNESS RATE PER 1000 Aborigines and Non-Aborigines

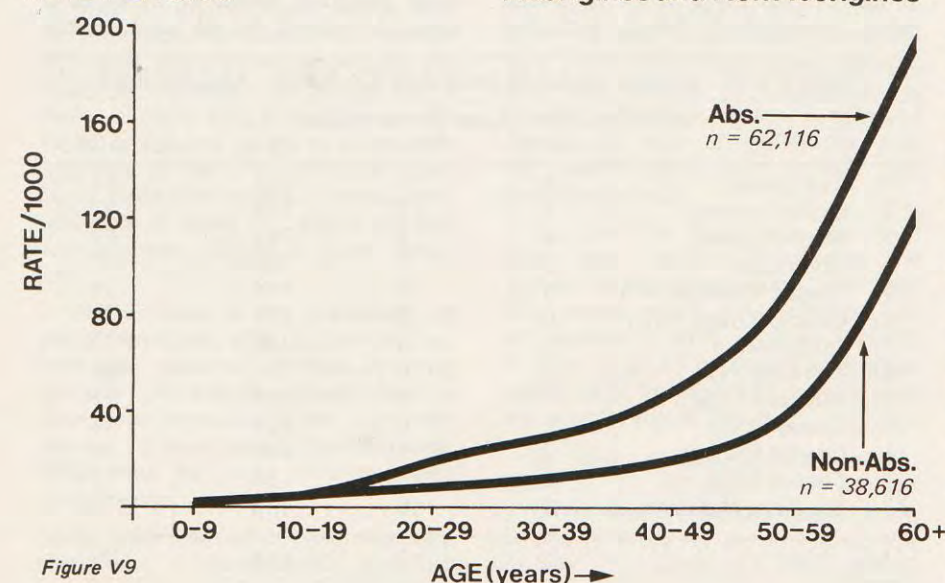


Figure V9

with nine per thousand non-Aborigines; in the 30–39 age group, 31 per thousand Aborigines were monocularly blind, compared with 11 per thousand non-Aborigines; in the 40–49 age group, the rates were 49 and 21 per thousand respectively; in the 50–59 age group, 94 per thousand Aborigines had a blind eye compared with 43 per thousand non-Aborigines. In the 60+ group, almost one in every five Aborigines was monocularly blind, while one in every eight non-Aborigines was.

Those who were monocularly blind had either good vision or poor vision in their other eye. Table V12 shows the pattern of distribution of vision in the other eye of persons classed as monocularly blind.

There was a strong tendency for monocular blindness in Aborigines under the age of 50 to be associated

TABLE V12: VISION IN OTHER EYE OF PERSONS MONOCULARLY BLIND

AGE	ABORIGINES				NON-ABORIGINES			
	Good	%	Poor	%	Good	%	Poor	%
0-9	45	92	4	8	36	86	6	14
10-19	112	90	12	10	101	93	8	7
20-29	120	88	16	12	22	100	0	0
30-39	128	89	16	11	20	91	2	9
40-49	166	86	26	14	24	92	2	8
50-59	169	66	86	34	30	81	7	19
60+	321	42	446	58	61	55	49	45
ALL AGES	1,061	64	606	36	294	80	74	20

with good vision in the other eye. After that age, however, monocular blindness was increasingly associated with poor vision in the other eye.

Nearly 89 per cent of Aborigines under the age of 50 with monocular blindness had satisfactory vision overall, which is to say that their good eye permitted them to carry out most human functions. Only 66 per cent of persons aged 50-59, however, had good vision in their other eye, while only 42 per cent of those aged 60 or more did.

The same tendency existed with the non-Aboriginal monocular blind, although the proportion of the monocular blind in older age groups with poor vision in their other eye was less than that found with Aborigines. Under the age of 50, 92 per cent of non-Aborigines with monocular blindness had good vision in their other eye; in the 50-59 age group, the proportion was 81 per cent and among persons aged 60 or more only 55 per cent had good vision in their other eye.

Monocular blindness rates were considerably higher in men than in women. Table V13 shows the difference between monocular blindness in Aboriginal men and women.

For males, the overall monocular blindness rate was 31 per thousand, while 23 in every thousand Aboriginal women were blind in one eye. This difference was significant ($p = 0.001$).

Most of the extra monocular blindness was found among those with good vision in the other eye. Of Aboriginal males of all ages, 21 in every thousand were blind in one eye with good vision in the other, compared with 14 in every thousand Aboriginal women.

Although more males than females had monocular blindness associated

TABLE V13: MONOCULAR BLINDNESS: ABORIGINAL MEN AND WOMEN

SEX	Number with good vision in other eye	Number with poor vision in other eye	Number not monocularly blind	Total
Males	608	308	28,728	29,644
Females	453	298	31,721	32,472
TOTAL	1,061	606	60,449	62,116

with poor vision in the other eye (with rates of 10 per thousand and 9 per thousand respectively) the difference was not statistically significant.

Monocular blindness rates varied from zone to zone, although, as with some of the other vision groups, the only very strong correlation found between the overall monocular blindness rates and the rates in any of the age groups was among persons aged 60 or more. Table V14 shows the pattern of distribution of monocular blindness, zone by zone.

The highest rate of monocular blindness was found in Zone 3, with almost one in every 20 persons seen being monocularly blind, including

almost one in every four persons over the age of 60 seen.

In the Cattle Country zone, 47 in every thousand Aborigines seen had a blind eye, including 215 in every thousand Aborigines over the age of 59. High prevalences of monocular blindness were also found in Zone 1, the Red Centre, with 37 in every thousand Aborigines seen, including 227 of every thousand persons over the age of 60, monocularly blind.

Although the persons in Zones 1, 2 and 3 comprised only 25 per cent of the total Aboriginal sample seen by the program, the cases of monocular blindness found in these three zones comprised 40 per cent of the

TABLE V14: MONOCULAR BLINDNESS BY ZONE: ABORIGINES

ZONE	AGE GROUPS (Rates per thousand)			ALL AGES
	0-9	10-19	60+	
1: Red Centre	3	5	227	37
2: Cattle Country	3	13	215	47
3: Western Desert	4	2	247	49
4: Goldfields	2	7	150	25
5: Coastal Missions (WA)	4	3	144	29
6: Coastal Towns (WA)	0	8	171	25
7: Arid Eastern	3	6	180	22
8: Top End (NT)	1	10	174	28
9: Gulf and Cape	1	7	238	28
10: Torres Strait	1	6	124	18
11: Coastal Qld.	2	7	148	17
12: Coastal NSW	3	3	154	13
13: Southern Mainland	2	10	145	13
ALL ZONES	2	7	193	27

total number of cases seen.

In Zones 4, 5, 6, 7, 8 and 9, the monocular blindness rate for all ages ranged from 29 per thousand in the Coastal Missions zone to 22 per thousand in the Arid Eastern zone. Similarly, the rate among those 60 years and over ranged from between 238 per thousand in the Gulf and Cape zone to 144 per thousand in the Coastal Missions zone.

In each of Zones 10, 11, 12 and 13, less than one person in every 50 seen had monocular blindness, with rates ranging from 13 per thousand in Coastal NSW and Southern Mainland zones to 18 per thousand in the Torres Strait zone. The monocular blindness rate for persons 60+ in these four zones ranged from 124 per thousand in the Torres Strait zone (about half of that found in the peak zone) to 154 per thousand in the Coastal NSW zone.

Visually Handicapped

Those found by the program to be blind or to have poor vision were considered to be visually handicapped. Such persons were those whose visual acuity in their better eye was no better than 6/18.

As Table V15 shows, there were 350 non-Aborigines found to fit in this group, compared with 2,361 Aborigines.

In both groups, the rates for visual handicaps increased in each age group, except among 30 to 39 year-old non-Aborigines, where there was a fall (significant only to a 0.1 level) from the rate in 20-29 year old non-Aborigines.

With Aborigines there was a very steep increase, especially from age 30-39 with the number of persons visually handicapped increasing by a factor of more than three from age 40-49 to 50-59 and 50-59 to 60+. More than four in every 10 Aborigines aged 60 or more were visually handicapped, with one in every 27, taking all ages into account, having a visual handicap.

The increase in the prevalence of visual handicaps with successive decades also occurred, though at a lesser rate, in non-Aborigines. One in every six non-Aborigines over the age of 59 was visually handicapped, while nine in every thousand seen overall were.

As with the other vision groups, there was a considerable variation

TABLE V15: VISUALLY HANDICAPPED ABORIGINES AND NON-ABORIGINES

AGE	ABORIGINES Number	Rate	NON-ABORIGINES Number	Rate
0-9	39/22,778	2	39/16,034	2
10-19	93/17,554	5	59/15,185	4
20-29	52/ 6,593	8	20/ 2,400	8
30-39	68/ 4,590	15	8/ 1,977	4
40-49	141/ 3,913	36	14/ 1,249	11
50-59	318/ 2,716	117	32/ 867	37
60+	1,650/ 3,972	415	178/ 904	197
ALL AGES	2,361/62,116	38	350/38,616	9

TABLE V16: VISUALLY HANDICAPPED ABORIGINES: ZONE BY ZONE

ZONE	Rate 0-9	Rate 10-19	Rate 60+	Rate All ages
1: Red Centre	1	3	445	48
2: Cattle Country	1	1	501	73
3: Western Desert	1	2	464	72
4: Goldfields	2	2	477	40
5: Coastal Missions (WA)	6	6	500	56
6: Coastal Towns (WA)	4	11	513	49
7: Arid Eastern	2	4	323	25
8: Top End (NT)	0	2	405	31
9: Gulf and Cape	2	3	381	35
10: Torres Strait	3	18	386	43
11: Coastal Qld.	3	7	288	25
12: Coastal NSW	1	5	297	22
13: Southern Mainland	1	8	256	20
ALL ZONES	2	5	415	38

in the visual handicapped rates between the zones.

Table V16 shows the pattern seen.

Looking firstly at overall rates, it can be seen that in Zones 2 and 3, the Cattle Country and Western Desert zones, more than one person in every 14 seen was visually handicapped. Then follow four zones: Zone 1, the Red Centre; 4, Goldfields; 5, Coastal Missions; and 6, Coastal Towns, in each of which the visually handicapped rate overall was around one in 20.

In the Top End zone, the Gulf and Cape Country zone, and the Torres Strait Island zone, the visually handicapped rate averages 34 per thousand, with a range from 31 in Zone 8 to 43 in Zone 10. In these zones, one in every 30 people seen was visually handicapped.

In the remaining four zones, Zones 7, 11, 12 and 13, an average of 24 in every thousand people seen, or one in every 41 persons seen, was visually handicapped. The overall

rate in these three zones was less than a third of the rate found in Zones 2 and 3.

For all zones the rate of visual handicaps in the elderly, rather than that for children and younger adults, decides the rate for the zone.

There was, however, a correlation between the rate for all ages and the 60+ rate (Spearman's $R = .87$: $p = 0.01$).

In three zones, Zones 2, 5 and 6, half or more of the Aboriginal population over the age of 60 were visually handicapped. Rates almost as high were found in Zones 4, 3 and 1, with a range of 513 in every 1,000 Aborigines over the age of 60 with visual handicaps in the Coastal Towns zone, to 445 in every thousand in Zone 1, the Red Centre zone.

In Zones 8, 9 and 10, comprising all the zones in the Gulf of Carpentaria area, the visual handicap rate among the elderly ranged from 381 per thousand in the Gulf and Cape zone to 405 per thousand in the Top End zone.