THE TREND OF LEPROSY IN CORDOVA AND TALISAY CEBU PROVINCE, PHILIPPINES

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In a previous paper (1) the usefulness of historical records of households for determining the trend of lepromatous leprosy in two Philippine municipalities was demonstrated. For the life experience prior to the year 1915, the average annual attack rate was 1.0 per 1,000; whereas, for the experience between 1915 and the time when the records were obtained the rate was only 0.7 per 1,000. Historical information regarding cases of nonlepromatous leprosy was not considered so reliable. In the present report there is presented, and evaluated from the point of view of trend of the disease, information for the same municipalities which was secured by repeated physical examinations of the inhabitants and from records of current incidence. For the lepromatous type, comparison is made with incidence as computed from the historical records.

SOURCES OF DATA

As a joint project of the Leonard Wood Memorial and the Department of Health of the Philippines, field studies of leprosy have been carried on continuously since 1933, except for an interruption of about five years caused by World War II. These studies were commenced in 1933 with an intensive survey of Cordova (3), one of the two municipalities of Mactan Island which lies off the east coast of Cebu Island, separated from the city of Cebu by a narrow channel. In 1936-37 the studies were extended to Talisay (6), a "mainland" municipality, situated about 8 miles south of the city of Cebu. The principal features of each survey were: (*a*) a detailed sociologic and economic census; (*b*) physical examination of the inhabitants, and (*c*) epidemiologic investigation of all leprosy cases.

Following completion of the initial studies, clinics were maintained in the two municipalities to the end of 1941 for supervision of unsegregated patients and continued investigation of cases. Inhabitants were encouraged to come to the clinics for advice regarding all skin conditions, and in this way many new leprosy cases were discovered. In 1941 a resurvey of Cordova was made (4) along the same lines as the first study. The Japanese occupation forced postponement of a scheduled resurvey of Talisay, and early in 1942 all field activities had to be discontinued. Work was carried on intermittently in 1945 and 1946 and continuously since October 1947. A third survey of Cordova was made in 1948, and a complete resurvey of Talisay in 1950-51. The intervals between midpoints of surveys were as follows: Cordova, from the first in 1933 to the second in 1941, a little less than 8 years, and

from the first to the third in 1948, 15 years; Talisay, from the first in 1936-37 to the second in 1950-51, 14 years.

The postwar resurveys were conducted in exactly the same manner as that of Cordova in 1941. A new household census was made of each community, the new record of each continuing household was checked against the original, and all save a small proportion of the enumerated inhabitants were examined physically. Particular attention was given to reconciliation of the original and resurvey populations of each area, and in Cordova the dates of birth, death and marriage were verified from church or municipal registries. This was not possible for Talisay, because of loss or destruction of the registries.

The prevalence of leprosy in Cordova and in Talisay was approximately the same at the time of the initial surveys and analysis of the data collected showed that the two communities had had very similar incidence rates in the past. The resurvey records for each municipality likewise indicated that the trend of the disease was more or less the same. The findings for the two communities have, therefore, been combined throughout this report, as was done in the original incidence studies (2), except where otherwise stated and in the statistics of Tables 5 and 9.

POPULATION CHANGES

(*a*) *General population.*—In the 1933 survey of Cordova 6,063 living persons were enumerated, and in that of 1936-37 of Talisay, 10,672 persons. Thus, the combined population was 16,735. In the latest surveys the corresponding figures were: Cordova, 1948, 7,222; Talisay, 1950-51, 13,698; total, 20,920. The factors indicated in Table 1 accounted for the total net increase of 4,185 persons.

TABLE 1.— *Net increase in population, Cordova and Talisay combined, during the intervals between the initial and final surveys.*[a]

Population, initial surveys:			16,735
New births	10,372		
Immigrants	3,199	13,571	
Deaths	5,218		
Emigrants	4,168	9,386	
Net increase			4,185
Population, resurveys:			20,920

a Initial surveys, Cordova, 1933; Talisay, 1936-37. Resurveys, Cordova, 1948; Talisay, 1950-51.

(*b*) *Persons with leprosy.*—In an amended report (7) of the first survey of Cordova, the number of living persons with leprosy of all forms was given as 115, a prevalence of 19.0 per 1,000 of the enumerated population. After an interval of 15 years, 147 cases were discovered among the 7,222 persons enumerated, a prevalence of 20.4 per 1,000. In Talisay (6),

208 cases were found in the first survey, a prevalence rate of 19.5 per 1,000. After 14 years, 241 cases were found among the 13,698 persons enumerated, a prevalence rate of 17.6 per 1,000. The factors which gave rise to a net increase of 65 cases of leprosy in the combined population of the two communities are shown in Table 2.

TABLE 2.—*Changes in leprosy prevalence, Cordova and Talisay combined, during the intervals between the initial and final surveys, by type.*[a]

Lepromatous		
Number present, initial surveys	194	
Number imported in immigrants	4	
New cases	68	
Transformed from nonlepromatous	6	272
Deaths	148	
Emigrations	11	159
Number present, resurveys		113
Decrease, lepromatous		81
Nonlepromatous		
Number present, initial surveys	129	
Number imported, in immigrants	16	
New cases	207	352
Deaths	39	
Emigrations	32	
Transformed to lepromatous	6	77
Number present, resurveys		275
Increase, nonlepromatous		146
Net increase, total leprosy		65

a Initial surveys, Cordova, 1933; Talisay, 1936-37. Resurveys, Cordova, 1948; Talisay, 1950-51.

PREVALENCE RATES, INITIAL AND FINAL SURVEYS

Changes in the prevalence of disease are subject to misinterpretation. They may be caused by variation in incidence, or in duration, or in both incidence and duration. Nevertheless, the prevalence rate is of practical importance, representing as it does the magnitude of the problem on the date for which it is determined; and, if it can be shown that duration has remained unchanged, prevalence rates for two successive periods indicate the trend of the disease during the interval.

Of 16,735 living residents enumerated in the first surveys, 16,555 or 98.9 per cent were examined. A total of 180, or 1.1 per cent, were not

examined for various reasons. Of these, 37 had died and 41 had moved to other areas during the course of the surveys, 61 were temporarily absent, and 41 did not attend the clinic and were absent when their homes were visited by the examiners. Among these 180 persons there were 5 who were suspected to have leprosy.

Of 20,920 living residents enumerated in the latest surveys, 98.8 per cent were examined. A total of 251, or 1.2 per cent, were not examined. Of these, 31 had died and 58 had moved to other areas, 94 were temporarily absent, and 68 did not attend the clinic and were absent when their homes were visited. Among these 251 persons there was 1 suspected of having leprosy.

The prevalence rates for total leprosy and for each type are given for initial and latest surveys in Table 3. The total prevalence figures show no significant change. The rate was 19.3 per 1,000 on the first examination and 18.5 on re-examination 14 (or 15) years later. A drop in the rate for males, from 25.9 to 21.2, was associated with an increase in that for females, from 12.9 to 16.1. Examining the figures more closely, it is seen that the reduction occurred only in the lepromatous type, from 11.6 per 1,000 to 5.4. The nonlepromatous cases, on the other hand, increased from 7.7 per 1,000 to 13.1.

TABLE 3.—*Population, cases of leprosy, and prevalence rates per 1,000 of enumerated population, by sex and type of leprosy. Differences observed after 15 years, Cordova, and 14 years, Talisay.*[a]

Type of case	Initial survey[b]						Resurvey[c]					
	Males (8,218)		Females (8,517)		Total (16,735)		Males (10,149)		Females (10,771)		Total (20,920)	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Lepromatous[d]	145	17.6	49	5.7	194	11.6	79	7.8	34	3.2	113	5.4
Nonlepromatous	68	8.3	61	7.2	129	7.7	136	13.4	139	12.9	275	13.1
Total leprosy	213	25.9	110	12.9	323	19.3	215	21.2	173	16.1	388	18.5

a Rates are adjusted for age, using the combined enumerated populations of initial and final surveys as a standard.

b The population includes 180 unexamined persons.

c The population includes 251 unexamined persons.

d All bacteriologically positive patients, clinically lepromatous, at leprosaria, paroled, or never segregated. A few transitional (borderline) cases are included.

It is of interest also to note changes of prevalence at various ages, and a comparison of the findings of the initial and latest surveys is given in Table 4. The figures show some increases in lepromatous leprosy for ages under 15 years, but the numbers are small. From 15 to 39 years of age a striking reduction in prevalence took place. A large part of the lepromatous leprosy formerly present at these ages disappeared (5) and was not replaced. For ages over 40 years the rates for the two surveys are not significantly different.

The prevalence rates for nonlepromatous (tuberculoid and indeterminate) leprosy, on the other hand, show increases at every age group except from 50-59 years, but most strikingly in childhood. In children of 5-9

TABLE 4.—*Prevalence of leprosy (per 1,000) by age and type of case. Differences observed after 15 years, Cordova, and 14 years, Talisay.*

Age group (years)	Initial survey					Resurvey				
	Population	Lepromatous		Nonlepromatous		Population	Lepromatous		Nonlepromatous	
		Cases	Rate	Cases	Rate		Cases	Rate	Cases	Rate
0-4	2,629	—	—	1	0.4	3,516	1	0.3	4	1.1
5-9	2,414	3	1.2	1	0.4	2,983	4	1.3	50	16.8
10-14	1,992	2	1.0	22	11.0	2,518	6	2.4	52	20.7
15-19	1,790	25	14.0	22	12.3	2,109	9	4.3	31	14.7
20-29	2,856	81	28.4	39	13.7	3,425	30	8.8	53	15.5
30-39	1,746	51	29.2	11	6.3	2,549	31	12.2	39	15.3
40-49	1,439	17	11.8	11	7.6	1,609	21	13.1	15	9.3
50-59	873	9	10.3	12	13.7	1,122	6	5.3	14	12.5
60+	996	6	6.0	10	10.0	1,089	5	4.6	17	15.6
Total[a]	16,735	194	11.6	129	7.7	20,920	113	5.4	275	13.1

a Total rates are adjusted to the age distribution of the combined population in both surveys.

years only 1 case was found in the earlier examinations, *as against 50 in the resurveys.* In the initial surveys a total of only 24 cases were discovered in children under 15 years of age, a rate of 4.0 per 1,000. In the resurveys 106 cases were found, or 11.7 per 1,000. The increase occurred in both males and females, and in each community. In Cordova, the increase in prevalence rate for nonlepromatous leprosy, for ages under 15 years, was 8.4 per 1,000, and in Talisay, 8.3.

TABLE 5.—*Prevalence rates for lepromatous and nonlepromatous leprosy in the three surveys of Cordova, per 1,000 enumerated population.*[a]

Type	Prevalence rates		
	1933	1941	1948
Lepromatous	10.6	8.0	6.4
Nonlepromatous	8.4	10.0	14.0
All forms	19.0	18.0	20.4

a Rates are adjusted for age, using the combined enumerated populations of the initial and final surveys as a standard.

For Cordova, where three surveys were made, prevalence rates show a fall in lepromatous leprosy between 1933 and 1941 and one of similar proportion between 1941 and 1948. The other forms of leprosy increased slightly during the first interval, but much more during the second. These rates are shown in Table 5.

It is evident that some factor related to the war or postwar period was responsible for the great increase in nonlepromatous leprosy. Although the rates for the prewar and postwar periods for Talisay have not been separated, a large proportion of the nonlepromatous cases in that municipality have also occurred in children born during and since the war.

INCIDENCE OF LEPROSY BETWEEN SURVEYS (OBSERVATION PERIOD)

To measure the incidence of leprosy during the intervals between the initial and final surveys, a modified life table method has been used. This procedure was employed and described in detail in a previous report (2).

The modified life table permits the division of the life of any individual into years during which he was present in the community or household, and those during which he was absent. It also permits division into years prior to and subsequent to household exposure. In calculating rates, persons are included in the denominator only for those periods of their lives during which they are known to be present, and they are removed as of the date of death or departure, if lost for those reasons before the end of the study. The population is expressed in person-years; i.e., each year of life of an individual is regarded as a unit. The sum of the person-years of life recorded for the whole community or group constitutes the denominator, and only persons developing leprosy while resident in the area or household are counted in the numerator. The results are expressed as attack rates per 1,000 person-years; i.e., the average number of cases per 1,000 persons observed for 1 year. It should be noted that these attack rates are an average statement of what is known to have occurred over the entire period of this study, i.e., 15 years in Cordova and 14 years in Talisay.

The interval life-experience of persons at risk of contracting leprosy totaled 262,844.5 person years. This includes part or all of the lives of 29,963 persons. This experience is tabulated in Appendix A by sex and age groups for persons exposed in the household and for persons not known to have been subjected to such exposure. The 275 persons who developed leprosy are similarly classified in Appendix B, the ages given being those at the estimated dates of onset.

Incidence in the total population.—The average annual attack rates for lepromatous and nonlepromatous leprosy are given by sex and age groups in Table 6. The rate for lepromatous leprosy for all ages was more than three times as high for males as for females—0.39 per 1,000 person-years as compared to 0.11. For nonlepromatous leprosy there was no significant sex difference, the rates being 0.82 for males and 0.67 for females.[1]

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[1] The total rates of Table 6 and subsequent tables are standardized for age. The standardized rate for each class is the product of the actual attack rate for all ages and a standardizing factor which is the ratio of the crude attack rate for all forms of leprosy (1.20) in the historical period (2) to an index attack rate for the class. The index attack rate is the sum of the cases expected in each age group at the age-specific rates prevailing in the total population in the historical period multiplied by 1,000 and divided by the population of the class.

The age of onset is always difficult to determine, and the error is usually in the direction of later rather than earlier age. For lepromatous

TABLE 6.—*Average annual attack rates for lepromatous and nonlepromatous leprosy, by sex and age groups, Cordova, 1933 to 1948, and Talisay, 1936-37 to 1950-1951.*

Age group (years)	Cases of leprosy per 1,000 person-years of life experience					
	Lepromatous		Nonlepromatous		Total leprosy	
	Male	Female	Male	Female	Male	Female
0-4	0.14	0.09	0.27	0.38	0.41	0.47
5-9	0.16	0.17	1.93	1.38	2.09	1.55
10-14	0.83	0.25	1.97	1.86	2.80	2.11
15-19	0.81	0.21	0.88	0.14	1.69	0.35
20-29	0.62	0.09	0.76	0.61	1.38	0.70
30-39	0.21	0.12	0.35	0.37	0.55	0.50
40-49	0.31	—	0.20	0.29	0.51	0.29
50+	0.23	—	0.23	0.46	0.46	0.46
Total[a]	0.39	0.11	0.82	0.67	1.21	0.79

a Regarding the standardizing of the total rates for age, see text, Footnote 1.

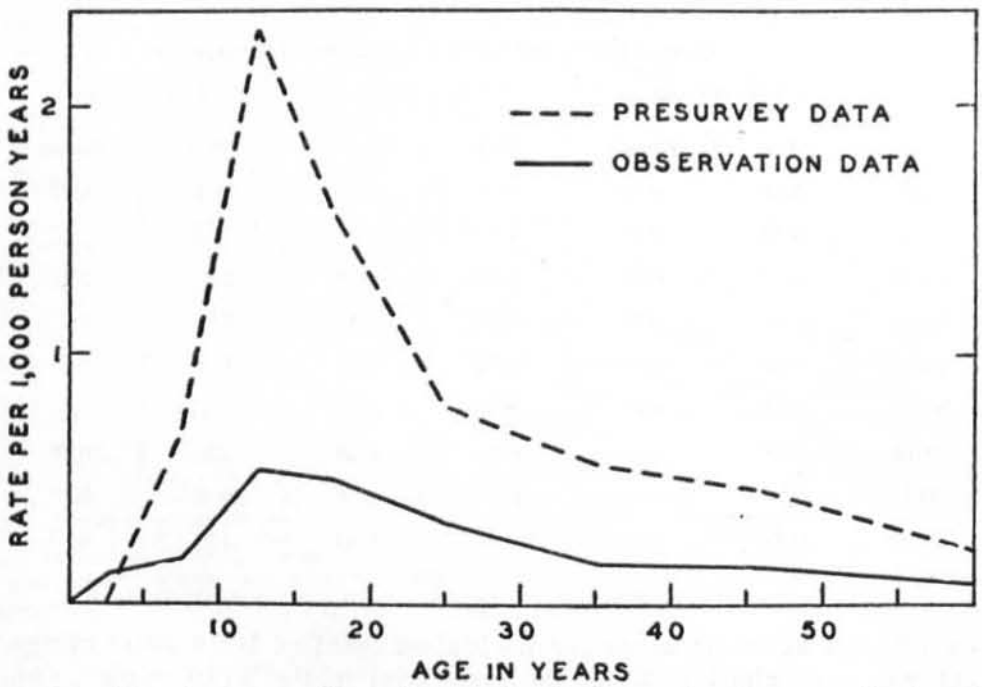
leprosy, the attack rate reached its highest point at 10-14 years of age, but was maintained at about the same level in the 15-19 years group. This was true for both males and females. In the retrospective attack rates computed from the records obtained in the initial surveys, the peak was clearly in the 10-14 years age group, with a sharp decline in the next quinquennial period (Text-fig. 1). It appears that a slight shift upwards has occurred in the modal age.

For nonlepromatous leprosy the peak was at 10-14 years in each sex, but the rates were not appreciably higher than those for children of 5-9 years. This peak reflects the discovery of large numbers of early macular cases in young children.

New cases in children under 5 years of age.—Among children of 0-4 years, 19 new cases occurred in the interval between the surveys, 5 being classified clinically as lepromatous and 14 as nonlepromatous. All 5 of the lepromatous cases occurred in children exposed in the household to prior cases of the lepromatous type. Of the nonlepromatous 3 were in children exposed to the lepromatous type in the household, and 1 in a child exposed to a nonlepromatous case. This leaves 10 children whose contact with prior cases was probably outside their immediate families. The clinical histories of these 19 cases are given below.

1. V. A. (Fam. 1084, Cordova), male, born Nov. 8, 1944. Family history positive; father lepromatous. Lesions first noticed when child was less than 3 years old.

July 6, 1948: On right thigh, four ill-defined macules with faintly erythematous margins, 3 to 6 cm. in diameter. Tests for sensory impairment unsatisfactory because of age of child. Smears from lesions positive. Lepromin reaction negative. *July 19, 1950*: Extensive ill-defined, slightly erythematous and infiltrated area covering most



TEXT-FIG. 1. Age-specific incidence rates for lepromatous leprosy, prior to and subsequent to initial surveys, Cordova and Talisay combined.

of outer half of right thigh, from hip to knee. Smears positive. *Feb. 3, 1951*: Admitted to the Eversley Childs Sanitarium, with infiltration of ears and alae nasi, and multiple small infiltrated patches on trunk and extremities; lesions heavily positive.

2. M. R. (Fam. 746, Cordova), male, born May 16, 1943. Family history positive; father lepromatous, mother with a single tuberculoid macule. Stated onset 1947, age 4 years. *May 5, 1948*: An extremely faint and ill-defined macule 5 by 8 cm., on right leg. *Jan. 22, 1949*: Macule still faint and ill-defined, now 5 by 10 cm. New lesions on buttocks, 9 or 10 fawn-colored, 0.5-2 cm. macules, rather ill-defined, suspiciously infiltrated. Smears from 4 sites all positive. Lepromin negative. *July 19, 1950*: Marked increase in number and size of lesions on buttocks; many new, similar lesions on trunk. Smears from 7 sites all positive. *Biopsy*, specimen May 13, 1949, from small lesion on buttocks: Slight to moderate infiltrative lesion, in part undifferentiated but with features of tuberculoid differentation; no appearance of a lepromatous lesion. Bacilli present in some numbers.

3. C. L. (Fam. 2343, Talisay), female, born 1945. Family history positive; father lepromatous. First lesion noticed in 1948, age 3 years. *Dec. 1, 1950*: A single fawn-colored, 3 cm. macule on upper right buttock; surface shiny, tense-looking; border fairly well-defined, not granular; anesthetic to light touch and pain. *May 18, 1951*: About 15 small fawn-colored macules, 0.5-2 cm., on trunk and extremities, apparently without infiltration. Original macule much increased in size. Smears

from 6 sites negative. *Feb. 20, 1952*: Numerous fawn-colored macules on trunk and extremities, some fairly distinct, others ill-defined. Slight but definite infiltration, palpable to touch, in the larger lesions. Smears from 5 sites all positive. Lepromin negative. *Biopsy*, specimen May 17, 1952, from lesion on upper right buttock: Lesion of undifferentiated character, with some features of the tuberculoid type and others of the lepromatous. Bacilli found in some numbers.

4. C. S. (Fam. 936, Talisay), male, born 1942. Family history positive; both parents lepromatous Culion patients. Child born at Culion, evacuated to Cebu during the Japanese occupation. Disease noticed in 1945, age 3 years. *Nov. 16, 1949*: Admitted Eversley Childs Sanitarium; L3N1, with generalized infiltration and macular lesions; smears heavily positive.

5. J. S. (Family 936, Talisay), female, born 1940. Family history positive; sister of No. 4. Also born at Culion and evacuated to Cebu during Japanese occupation. Stated onset 1943, age 3 years. *Nov. 16, 1949*: Admitted Eversley Childs Sanitarium; L3N1, with extensive infiltration, ill-defined macules, ulnar and peroneal anesthesia; smears heavily positive.

6. L. A. (Fam. 394-B, Cordova), female, born Dec. 13, 1939. Family history negative. Lesion noticed in 1944, child barely 4 years old. *Jan. 28, 1948*: A sharply circumscribed, annular lesion, 4 by 3 cm., on inner right forearm. Erythematous, raised margin 3 to 4 mm. wide, thickly lined with pinhead papules; center hypopigmented, slightly atrophic, dotted with few scattered papules. Completely anesthetic. Smears negative. Lepromin 1+ (5 mm.). *Biopsy*, specimen May 6, 1949, from the lower margin of the macule: Slight, superficial tuberculoid lesion. No bacilli found.

7. V. C. (Fam. 934-B, Cordova), female, born Aug. 28, 1942. Family history negative. Macule noticed in 1946. *Aug. 31, 1948*: Solitary erythemato-hypochromic macule 3 by 2 cm. on right hip, with faintly erythematous, very slightly infiltrated, nongranular margin; anesthetic, insensitive even to fairly deep pinprick. Smears negative. Lepromin ± (3 mm.). *Biopsy*, specimen April 30, 1949, from outer portion of macule: Tuberculoid, relatively marked; active superficially, large sarcoid-like aggregates deeper. Bacilli not found.

8. D. I. (Fam. 915, Cordova), male born Oct. 9, 1943. Family history positive; household exposure to uncle, whose case was clinically nonlepromatous with extensive macular lesions. *Mar. 1, 1948*: Two superficial, rather ill-defined erythemato-hypochromic macules on upper extremities, each about 2 cm.; one faintly palpable, possibly infiltrated. Tests for sensory impairment unsatisfactory because of age. Smears negative. Lepromin ± (4 mm.).

9. C. M. (Fam. 307, Cordova), female, born Nov. 3, 1942. Family history negative. Stated onset 1946, age 3 years. *July 15, 1948*: Seven small, distinct hypochromic macules, 1 to 2 cm., on buttocks and extremities. Lesions superficial, markedly hypopigmented, with well-defined nongranular borders, not infiltrated. Smears negative. Lepromin negative. Examinations in 1949 and 1950 showed increase in number and size of macules, but smears still negative. *Biopsy*, specimen May 7, 1949, from lesion on left buttock: Tuberculoid, rather slight. Bacilli found, rare.

10. V. P. (Fam. 121, Cordova), female, born 1942. Family history negative. Stated onset 1946, age 4 years. *April 13, 1948*: A single, 2 cm. macule on left forearm; hypochromic, distinct and well-defined, with a few small papules dotting border. Center completely insensitive to light touch and pinprick. *May 5, 1949*: Macule still very distinct, 3 by 2 cm. Finely granular border shows many tongue-like projections and indentations. Some return of pigmentation at center. Completely anesthetic. Smears negative. Lepromin ± (4 mm.). *Biopsy*, specimen May 14, 1949, from upper border of macule: Slight infiltration, histologically undifferentiated. Bacilli found, rare.

11. A. B. (Fam. 2470, Talisay), male, born May 2, 1946. Family history negative. Onset 1950, age 4 years. *June 6, 1951*: Minimal but very distinct hypochromic macule

on left buttock, only 1.2 by 0.9 cm. in size, but center is insensitive to pinprick. *June 21, 1952*: Solitary macule on buttock still distinct, 1.3 cm., border finely granular; two minute satellites near upper pole. A new 1 cm. macule on left forearm, superficial, edge rather ill-defined. Smears negative. Lepromin 1+ (5 mm.).

12. A. B. (Fam. 2466, Talisay), male, born Jan. 25, 1946. Family history negative. Stated onset 1950, age 4 years. *Sept. 9, 1951*: Fairly distinct erythemato-hypochromic macule, 3.5 by 2 cm., on right buttock. Slightly erythematous margin palpably infiltrated, not granular. Center completely anesthetic, insensitive to deep pinprick. *Mar. 25, 1952*: Some clinical resolution; very little erythema or infiltration, but lesion still completely anesthetic; size unchanged. Smears negative. Lepromin negative. *Biopsy*, specimen March 15, 1952: Condition residual; some fibrosis, no evidence of activity, and nothing indicative of leprosy. No bacilli found.

13. C. C. (Fam. 614-B, Talisay), female, born Feb. 20, 1946. Family history negative. Stated onset 1950, age 4 years. *May 5, 1952*: Distinct, erythemato-hypochromic, thickly circinate 5 cm. lesion on left thigh. Slight atrophic central portion completely ringed by a thickly granular, sharp-edged margin at least 0.5 cm. wide. Completely anesthetic. Smears negative. Lepromin 1+ (5 mm.). *Biopsy*, specimen June 5, 1952: Tuberculoid, of moderate degree, active. Probable bacillary forms, rare.

14. L. C. (Fam. 422-B, Talisay), female, born May 4, 1945. Family history positive; brother lepromatous. First lesion noticed when child was 3 years old. *June 29, 1951*: Twenty or more macules, 0.5 to 4 cm., on trunk and extremities. Macules erythemato-hypochromic; some with fairly distinct borders, others less well-defined. Lesions not infiltrated or granular. *Mar. 27, 1952*: Marked increase in number, size and extent of macular lesions. Larger ones show definite insensitivity to pinprick. Smears from 8 sites negative. Lepromin negative. *Biopsy*, specimen March 27, 1952, of a macule on the right thigh, posterior: Slight, undifferentiated round-cell infiltration; possibly a tuberculoid tendency. No bacilli found.

15. R. C. (Fam. 422-B, Talisay), male, born Mar. 13, 1943. Family history positive; brother lepromatous; also, No. 14 is a younger sister. Stated onset 1947, age 4 years. *June 29, 1951*: Three small but very distinct hypochromic, finely granular macules on left buttock, average 1.5 cm.; sharp, irregular borders lined with small papules; centers slightly atrophic, clearing. Appearance characteristic of minimal minor tuberculoid lesions. *Mar. 27, 1952*: The three lesions still distinct, sharply circumscribed and finely granular. Some increase in size. Smears negative. Lepromin 1+ (5 mm.). *Biopsy*, specimen March 27, 1952: Tuberculoid, slight, active, with a small subepidermal mass doubtless corresponding to a morphological papule. No bacilli found.

16. D. L. (Fam. 509, Talisay), male, born Dec. 4, 1945. Family history negative. Stated onset 1948, age 3 years. *June 15, 1951*: Fawn-colored oval macule, 3.5 by 2.5 cm., on front of right thigh. Faintly erythematous margin, slightly palpable. Definite impairment of touch, pain and temperature senses. *Mar. 25, 1952*: Macule more distinct, size increased to 4.5 by 4 cm. Margin slightly erythematous and infiltrated, sharply defined, with hint of fine granulation. Completely anesthetic. Smears negative. Lepromin ± (4 mm.). *Biopsy*, specimen March 25, 1952, from upper border of the macule: Histologically slight undifferentiated, round-cell infiltration. Tuberculoid tendency? No definite bacilli seen, but a few suggestive forms.

17. T. L. (Fam. 316, Talisay), female, born 1946. Family history negative. Stated onset 1949, age 3 years. *June 14, 1951*: Fairly distinct hypochromic macule, 1.7 by 1.3 cm., with finely granular margin, on left upper arm. *Mar. 28, 1952*: Macule now 2 by 1.6 cm.; border distinct, lined with fine papules; a small satellite close to lower pole. Sensory impairment complete; deep pinpricks are painless. Smears negative. Lepromin 2+ (9 mm.). *Biopsy*, specimen March 28, 1952, from the upper border of macule: Subtuberculoid, very slight, superficial. No definite bacilli found, but several suggestive bodies.

18. M. N. (Fam. 2660, Talisay), male, born Oct. 24, 1945. Family history negative. Stated onset 1950, age 4 years. *June 6, 1951*: Four thick, erythematous plaques, 2 to 5 cm., on extremities; irregularly shaped, sharp-edged, with rough pebbled surfaces. All anesthetic. Markedly thickened left peroneal nerve. The present condition is reactional, of recent origin. Smears from 6 sites negative. *May 2, 1952*: The four plaques have become circinate lesions with large atrophic centers, granular margins. All anesthetic. Smears negative. Lepromin 1+ (7 mm.).

19. S. R. (Fam. 1189, Talisay), female, born 1938. Family history positive; father lepromatous. Lesion first noticed when child was 4 years old. *Dec. 19, 1950*: On left posterior axillary region, a distinct, 5 cm. circinate lesion. Central clear zone surrounded by a thick, erythematous, granular margin 1 to 1.5 cm. wide, thickly studded with small papules. Center completely anesthetic. Smears negative.

New cases in older adults.—It is of interest also that 13 cases, 3 lepromatous and 10 nonlepromatous, were recognized for the first time in persons 50 years of age or older. With one exception these were in persons examined and considered free from leprosy during the initial surveys. One of the lepromatous and 3 of the other cases were in persons known to have been exposed to lepromatous leprosy in the household. No cases occurred in persons exposed to nonlepromatous leprosy. The clinical histories of these 13 cases follow:

1. A. A. (Fam. 964-A, Cordova), male, born May 10, 1880. Family history apparently negative. Stated onset 1938, age 58 years. *Aug. 8, 1933*: Findings negative; only a few impetigo scars. *Oct. 14, 1941*: Extensive, slightly raised, erythematous area of infiltration covering right elbow and adjacent arm and forearm; anesthetic. Smears heavily positive. *Feb. 14, 1948*: Marked infiltration, face and ears; slight to moderate infiltration almost generalized, on trunk and extremities. No contractures, atrophies, or trophic lesions. All smears heavily positive. Lepromin negative.

2. C. S. (Fam. 574-A, Cordova), male, born Sept. 14, 1889. Family history negative; several antecedent lepromatous cases in other relatives. Stated onset 1943, age 54 years. *Oct. 12, 1933*: Negative. *June 18, 1941*: No suspicious lesion. *May 14, 1945*: Admitted Eversley Childs Sanitarium; L2N1, with infiltration of face, ears, extremities; circinate lesions on arms and forearms. Smears from 6 sites all positive. *April 19, 1948*: Paroled.

3. B. A. (Fam. 936, Talisay), male, born 1878. Family history positive; lepromatous cases, antecedent by many years in wife, 3 sons and 2 daughters. Wife and 5 children all segregated, sent to Culion between 1927 and 1931. Stated onset 1939, age 61 years. Not examined (temporarily nonresident) during 1936 survey. *Feb. 4, 1942*: Admitted Eversley Childs Sanitarium; L2N2, with moderate infiltration of ears, face, trunk and extremities; ulnar and peroneal anesthesia; no contractures, no atrophies or absorption. Smears heavily positive.

4. L. B. (Fam. 817, Cordova), female, born 1885. Family history apparently negative. Stated onset 1936, age 51 years. *Sept. 12, 1933*: No suspicious lesion. *June 28, 1941*: On left hip, a small but distinct annular lesion, 1.2 cm.; margin completely lined with small pinkish papules; center hypochromic, slightly atrophic, anesthetic to touch and pain. On right leg, a large, 9 cm. scar (said to have been a macule which the patient cauterized with acid one year ago); center of this scar completely anesthetic. Right saphenous nerve irregularly thickened, lumpy, easily palpated. Smears negative. *Mar. 11, 1948*: Macule on left hip still distinct after 7 years, now 4 by 2 cm.; margin slightly erythematous and granular, center clear and slightly atrophic; completely anesthetic. Anesthetic scar on right leg unchanged. Smears negative. Lepromin 3+ (10 mm.).

5. V. B. (Fam. 1044, Cordova), male, born July 28, 1885. Family history negative. Stated onset 1947, age 62 years. In *1933 survey*: Negative. *June 26, 1941*: Negative. *Mar. 15, 1948*: On left thigh a superficial, rather faint macule, 2.5 cm.; not striking but characterized by very fine granulation along margin. Completely anesthetic. Smears negative. Lepromin 3+, with ulceration.

6. B. C. (Fam. 903, Cordova), female, born June 18, 1884. Family history apparently negative. Stated onset 1939, age 55 years. *Aug. 31, 1933*: Negative except for a few pigmented scars, and slight papular dermatitis. *July 5, 1941*: Small but distinct annular lesion on right arm, 1.7 cm.; center slightly atrophic; margin lined with thick, fresh-looking, pinkish papules as large as heads of match sticks; a few isolated papules close to outer edge. Center of lesion completely anesthetic. Smears negative. *Feb. 7, 1948*: Lesion still distinct and circinate, now 4.5 by 2.5 cm. Residual central portion ringed by a thick, raised margin of prominent pinkish papules. Completely anesthetic. Smears negative. Lepromin 3+, with ulceration. *Biopsy*, specimen May 1949 from upper border: Tuberculoid, marked. No bacilli found.

7. B. D. (Fam. 1026, Cordova), male, born Feb. 27, 1893. Family history negative. Stated onset 1947, age 54 years. In *1933 survey*: Negative. *June 26, 1941*: Negative. *Mar. 19, 1948*: A solitary, 3 cm. macule on anterior left leg; center clear, almost normal in appearance, with hair growth intact; narrow, slightly erythematous, finely granular, well-defined margin. Dissociated anesthesia: Macule sensitive to light touch, insensitive even to deep pinprick. Smears negative. Lepromin 2+ (7 mm.). *In 1953* this lesion had increased in size, the margin still erythematous and granular.

8. R. C. (Fam. 533, Talisay), female, born 1870. Positive history of household exposure: Lepromatous cases in 2 stepchildren—son and daughter of husband by a former marriage—with disease dating back to 1927. Stated onset 1938, age 68 years. *June 24, 1936*: Negative. *Aug. 8, 1951*: A large, irregular, granular lesion, 14 by 10 cm., covering right elbow. Characteristic tuberculoid appearance: Large central area of resolution surrounded by a marginal hypochromic zone 1 to 3 cm. wide, with discontinuously granular margin. Several isolated small groups of papules close to outer edge of main lesion. Definite impairment of touch, pain and temperature senses over a large portion of central area. Smears negative. Lepromin 3+ (10 mm.).

9. M. C. (Fam. 1068, Talisay), female, born 1886. Family history positive; two lepromatous cases in stepson (onset 1928) and own son (onset 1944). Stated onset 1949, age 63 years. *Sept. 1, 1936*: No suspicious lesion. *Nov. 28, 1950*: Two minimal but fairly distinct lesions, one on left thigh (2 cm.), other on right arm (1 cm.). Both annular, with finely papulate, pinkish margins. Definite sensory impairment despite small size; both insensitive to pinprick. *May 31, 1952*: Slight increase in size, to 3.5 by 2 cm. and 1.5 cm., respectively. Margins less distinctly granular, no longer erythematous; centers now dry and scar-like; anesthesia still evident. Smears negative. Lepromin 3+ (10 mm.). *Biopsy*, specimen May 31, 1952, from lesion on left thigh: Tuberculoid, slight, but with sarcoid tendency; an active zone leaves behind a slightly atrophic-scarred condition. No bacilli found.

10. C. D. (Fam. 1486-B, Talisay), female, born 1887. Family history negative. Stated onset 1945, age 58 years. *Sept. 27, 1937*: Negative. *Nov. 24, 1950*: On upper extremities, four large macules, 7 to 10 cm. diameter. General appearance: Rather faint, with large residual centers, faintly erythematous along margins; edges rather ill-defined, smooth in contour, with suspicion of infiltration. Definite anesthesia to touch and pain. *May 22, 1951*: All macules somewhat more active than at last examination, with faintly erythematous, slightly infiltrated marginal zones about 0.5 cm. wide. Smears negative.

11. J. E. (Fam. 820, Talisay), female, born 1877. Family history positive; one daughter (onset 1916) died in 1936 with multiple lesions, probably tuberculoid; a second daughter (onset 1937), advanced lepromatous. Stated onset 1943, age 66 years. *Oct. 23, 1936*: Negative. *Jan. 24, 1951*: Large single lesion covering right elbow and

adjacent areas. Macule consists of a completely residual central portion, incompletely surrounded by a raised, markedly hypochromic, distinctly granular margin 0.5-1 cm. wide. Smears negative.

12. E. L. (Fam. 745, Talisay), female, born 1886. Family history: A married brother, living elsewhere, developed leprosy in 1917, was segregated in 1920, and died at Culion. Stated onset 1944, age 58 years. *Oct. 3, 1936*: Negative. *Feb. 9, 1951*: A solitary hypochromic macule, 3 by 3.5 cm., on left upper arm; fairly distinct, with discontinuously papulate margin; definitely anesthetic to light touch, pain and temperature. Smears negative.

13. M. T. (Fam. 3101, Talisay), male, born 1892. Family history negative. Stated onset 1946, age 54 years. Not examined (nonresident) during 1936 survey. *Oct. 9, 1951*: Large nonmacular area of anesthesia extending from elbow to wrist on posterior and medial surfaces of right forearm. Within this area, a few scattered groups of small papules incompletely delineate a smaller lesion 3.5 cm. in diameter. Ulnar not thickened. *Sept. 22, 1952*: Sensory impairment of right forearm still evident. The granular lesion inside this area is now more distinct, with raised, slightly erythematous, papulate margins; completely anesthetic. Smears negative. Lepromin 3+ (10 mm.).

Incidence in leprous households.—The household associates of persons suffering from leprosy offer a measurable universe in which exposure of persons of both sexes and various ages is much more uniform than in the general population. The attack rates which were observed in this group during the intervals under consideration confirm the findings of the retrospective studies for both communities (2), and of the study of the observation period 1933-41 for Cordova (4). These attack rates—standardized for age differences—for lepromatous, nonlepromatous and total leprosy, are given for males and females of all ages, according to the type of the primary case, in Table 7. Rates for persons in these com-

TABLE 7.—*Average annual attack rates for persons exposed and not exposed in the household, by sex and type of leprosy, Cordova, 1933-48, and Talisay, 1936-37 to 1950-51.*[a]

Type to which exposed	Type occurring: rates per 1,000 person-years						
	Lepromatous		Nonlepromatous		Total		
	Male	Female	Male	Female	Male	Female	Total
Lepromatous	2.61	0.88	3.73	1.76	6.33	2.65	4.38
Nonlepromatous	0.16	0.15	1.29	0.47	1.45	0.62	1.03
Not exposed	0.25	0.06	0.60	0.60	0.85	0.66	0.75
Total[b]	0.39	0.11	0.82	0.67	1.21	0.79	0.99

a Rates are standardized for differences in age composition, as described in Footnote 1 of the text.

b Two cases of tuberculoid type occurred in 752 person-years of life experience exposed to cases of unknown type. These are included in computing rates for the total populations.

munities who are not known to have been exposed in the household are give for comparison.

Examining first the attack rates for total leprosy as shown in this table, it is seen that for persons exposed to the lepromatous type the attack rate for both sexes (4.38) was more than four times that for the total population (0.99), and about six times that for nonexposed persons (0.75). It is of importance also that the higher risk for persons exposed in the household to lepromatous leprosy extended to both types of the disease.

Another method frequently used to illustrate the risk for persons exposed in the househod to lepromatous leprosy is to state the percentage of total patients of any series which can be traced to such contact. Strictly speaking, this statement is of value only when the proportion of the total population which would give such a history is known. In the present series, 27.5 per cent of all cases of leprosy were in persons who had lived in household association with lepromatous leprosy, while only 6.2 per cent of the total life experience of both communities belonged to individuals who had lived in such association.

A fact which may be of significance is that persons exposed in the household to the lepromatous type contributed a much larger proportion of total lepromatous cases than they did of total nonlepromatous cases. The attack rate for lepromatous leprosy, for both sexes (not shown in Table 7), for persons thus exposed (1.69), was more than ten times that for nonexposed persons (0.15). On the other hand, the attack rate for nonlepromatous leprosy, for both sexes, for persons exposed to the lepromatous type (2.69), was only about four and a half times that for nonexposed persons (0.60). An approximate method of expressing this relationship is that 29 (or 42.6%) of all 68 lepromatous cases occurred in persons exposed to lepromatous leprosy in the household, while only 46 (or 22.4%) of the total 205 nonlepromatous cases occurred in persons thus exposed.

Exposure in the household to nonlepromatous leprosy did not result in attack rates for total leprosy or for either type which are significantly different from those which occurred in unexposed persons or in the total population. Slight differences between the rates for these groups (Table 7) are probably fortuitous. Thus it appears that, in the experience here described, exposure in the household to nonlepromatous leprosy was not followed by a measurable increase in risk of contracting leprosy.

For lepromatous leprosy, the usual greater risk of males than of females is evident among household associates to more or less the same extent as in the unexposed population. For nonlepromatous forms there is also evidence of a higher risk for males among household associates, but not in the unexposed population.

Attack rates have been computed for males and females by age groups for household associates, but these figures are not included here. The

highest rates in both males and females and for both lepromatous and nonlepromatous leprosy occurred at 10-14 years of age, with a sharp fall at 15-19 years.

INCIDENCE OF LEPROMATOUS LEPROSY, HISTORICAL AND OBSERVATIONAL

During the initial surveys of the two communities the data collected permitted the estimation of attack rates for lepromatous leprosy from the establishment of the households to the dates of the surveys. These historical or retrospective attack rates are considered to be highly accurate. They are much less accurate for the nonlepromatous forms, and the discussion which follows will therefore be restricted to the lepromatous type.

In Table 8 there are presented for comparison the attack rates for lepromatous leprosy by age groups for the total population of Cordova and Talisay for the historical or presurvey period, and for the intervals between the first and final surveys. The average annual attack rates for lepromatous leprosy during the observation period were strikingly lower for every age group above 5 years of age than the rates calculated from the historical data. For all ages, the standardized attack rate for the recent period was only 0.25 per 1,000 person-years, as compared to 0.78 for the earlier period.

The average number of person-years for each person included in the

TABLE 8.—*Average annual attack rates for lepromatous leprosy, Cordova and Talisay combined, by age groups, for presurvey and observation periods.*[a]

Age group (years)	Presurvey period			Observation period		
	Person-years	Lepromatous cases	Attack rates	Person-years	Lepromatous cases	Attack rates
0-4	72,208	0	0.00	43.204	5	0.12
5-9	52.013	36	0.69	36,227	6	0.17
10-14	39,433	91	2.31	31.808	17	0.53
15-19	31,225	50	1.60	27,806	14	0.50
20-29	56.099	45	0.80	43,968	15	0.34
30-39	41,103	23	0.56	30,488	5	0.16
40-49	24,932	12	0.48	20,239	3	0.15
50+	18,003	4	0.22	28,352	3	0.11
Total[a]	335,016	261	0.78	262,092[b]	68	0.25

a Rates for all ages are standardized for differences in age composition, as explained in Footnote 1 of the text.

b Life experience totaling 752 person-years of persons exposed in household to cases of unknown type is omitted for convenience of computation and checking. Inclusion would not appreciably change the rate. See Appendix B.

historical study was 14.5 for Cordova and 15.9 for Talisay. Counting back from 1933 and from 1936-37, respectively, the average annual incidence in the historical period may be said to apply to about the year 1920 for both communities. For the intervals between the surveys the average number of person-years was approximately 9 for each community. The average annual incidence for the intervals between surveys, therefore, may be taken roughly as applying to the year 1940. If these dates are even approximately correct, the incidence of lepromatous leprosy has fallen in these communities by more than two-thirds in two decades, or an average decline of more than 3 per cent annually.

In an earlier publication (1), as has been mentioned, the historical data were divided in order to derive attack rates for lepromatous leprosy for years prior to 1915, and for the period from 1915 to the time of the initial surveys. In Table 9 these attack rates are compared with those of the observation period. The evidence indicates that the fall in lepromatous leprosy has been progressive since before 1915. In Cordova the decline continued during World War II and the years immediately following, despite the fact that during the war many patients left Culion and Eversley Childs Sanitarium and returned to their homes.

TABLE 9.—*Attack rates for lepromatous leprosy, males and females of all ages, according to chronological periods, Cordova and Talisay.*[a]

Municipality	Chronological period	Cases of lepromatous leprosy per 1,000 person-years		
		Males	Females	Total
Cordova & Talisay	Prior to 1915	1.37	0.72	1.04
Cordova & Talisay	1915 to first survey	1.01	0.38	0.69
Cordova	1933 to 1941	0.72	0.22	0.46
Cordova	1941 to 1948	0.46	0.00	0.22
Talisay	1936-37 to 1950-51	0.26	0.11	0.19

a Rates are standardized for differences in age composition, as explained in Footnote 1 of the text. Standardized rates for periods prior to the initial surveys differ slightly from those previously published (1), because a different method of standardization has been used.

DECLINE IN LEPROMATOUS LEPROSY IN RELATION TO HOUSEHOLD EXPOSURE

To determine whether or not households in which lepromatous leprosy was present shared proportionately in the decline of that type of the disease, attack rates for persons exposed to lepromatous leprosy in the household, and for those not exposed, as estimated for the historical period (2) were compared with rates prevailing during the intervals between initial and final surveys. These rates are given in Table 10. Judging from the ratios shown there, the decline in attack rates for lepro-

matous leprosy although striking in both groups, was perhaps less marked among persons exposed to lepromatous leprosy than among persons not known to have been exposed in the household. For the former, the average annual attack rate was 58.5 per cent lower for the intervals between the surveys than for the historical period; for the latter the reduction was 71.7 per cent. If the reason for the decline of lepromatous leprosy in these communities were solely a diminishing opportunity for person-to-person contact, a wider difference would be expected between persons exposed in the household and other persons with respect to the extent of the reduction. Actually the factor or factors responsible for the decline operated almost as well within the infected households as in the general population.

TABLE 10.—*Attack rates for lepromatous leprosy in persons with household exposure to lepromatous leprosy and in those not exposed, Cordova and Talisay, combined, for presurvey and observation periods.*[a]

Group	Rate per 1,000 person-years		Ratio A/B
	A. Presurvey	B. Observation	
With household exposure	4.07	1.69	2.4:1
Without household exposure	0.53	0.15	3.5:1

a Rates are standardized for differences in age composition.

A previous study (1) of this point also failed to show that household associates had a less favorable position than other persons during a period in which lepromatous leprosy declined. From historical records collected during the initial surveys, attack rates for lepromatous leprosy were computed for Cordova and Talisay inhabitants who were born between 1896 and 1910 and for those who were born between 1911 and 1925. The experience of the first group was terminated in 1920, and that of the second in 1935. For each group, separation was made between those exposed to lepromatous leprosy in the household and those not known to have been exposed. The comparison demonstrated that the attack rates were considerably lower for the later period than for the earlier one, but that the reduction had affected those exposed in the household somewhat more than the rest of the population.

DISCUSSION, SUMMARY AND CONCLUSIONS

A study has been made of the trend of leprosy in the municipalities of Cordova and Talisay, Cebu Province, Philippines. The data are considered to be highly accurate, having been collected by means of three surveys of Cordova and two of Talisay, during each of which a complete census of the inhabitants was made and practically all were examined, and by investigation of all cases occurring in the intervals between surveys.

The intervals between midpoints of the surveys were: Cordova, from the first in 1933 to the second in 1941, a little over 8 years, and from the first to the third in 1948, 15 years; Talisay, from the first in 1936-37 to the second in 1950-51, 14 years.

Prevalence: Taking both municipalities together, the prevalence rate for total leprosy remained almost unchanged, 19.3 per 1,000 population on the first examinations and 18.5 on the final examinations 14 (or 15) years later. Lepromatous leprosy, however, decreased from 11.6 per 1,000 to 5.4; nonlepromatous forms, on the other hand, increased from 7.7 per 1,000 to 13.1. The decrease in the former and the increase in the latter occurred in both communities. For Cordova, where three surveys were made, the prevalence rates per 1,000 for lepromatous leprosy were: 1933, 10.6; 1941, 8.0, and 1948, 6.4; and for nonlepromatous; 1933, 8.4; 1941, 10.0, and 1948, 14.0. For Talisay, the rates for lepromatous leprosy were: 1936-37, 12.2, and 1950-51, 4.9; and for nonlepromatous 1936-37, 7.3, and 1950-51, 12.7.

The decrease in prevalence of the lepromatous type affected both sexes: for both communities, the rate for males in the initial surveys was 17.6 per 1,000, and, in the final, 7.8; the corresponding rates for females were 5.7 and 3.2. Likewise, the increase in nonlepromatous leprosy was observed in both sexes: in the initial surveys the rate for males was 8.3, and in the final, 13.4; for females, the increase was 7.2 to 12.9. For lepromatous leprosy, the most striking reduction occurred at ages from 15-39 years. For nonlepromatous leprosy, the increase was most marked in childhood.

Incidence: Cases of leprosy in these municipalities were investigated on discovery except for the interruption caused by the war. Average annual incidence rates have been calculated for the intervals between the surveys, for both communities combined and for each separately. For both communities, the average annual incidence of lepromatous leprosy was 0.39 per 1,000 for males, 0.11 for females, and 0.25 for the total; for nonlepromatous it was 0.82 for males, 0.67 for females, and 0.75 for the total population.

For lepromatous leprosy, the attack rate reached its highest point at 10-14 years of age but was maintained at about the same level in the 15-19 years group. In the retrospective attack rates computed from the records collected in the initial surveys the peak was clearly at 10-14 years with a sharp decline thereafter. For nonlepromatous leprosy the peak was at 10-14 years but the rate was not appreciably higher than that for children of 5-9 years.

Attack rates observed in household associates confirm the findings of the retrospective studies for both communities (2) and of the study of the observational period 1933-41 for Cordova (4).

The average annual attack rate for persons exposed to lepromatous leprosy was more than four times that for the total population, and about six times that for nonexposed persons. Exposure in the household to non-

lepromatous leprosy was not followed by a measurable increase in risk of contracting leprosy.

For lepromatous leprosy, the trend for both communities is indicated by a comparison of rates computed from the historical data collected at time of the initial surveys with those for the intervals between initial and final surveys. For the nonlepromatous forms the rates for the historical period are not considered to be sufficiently reliable for valid comparison. For the historical period, the life experience of the inhabitants was split into two parts, namely, from establishment of the household to the year 1915, and from 1915 to the time of the initial surveys and examinations. For the lepromatous type, the average annual attack rates were: earlier historical period, 1.04 per 1,000; later historical period, 0.69; and, as noted above, for the intervals between surveys, 0.25. Supplemental information is available for Cordova. For the interval between the first and second surveys, 1933 to 1941, the average annual attack rate was 0.46, and for the interval between the second and third, 1941 to 1948 it was 0.22.

There is no doubt, therefore, that the incidence of lepromatous leprosy has been declining for a considerable period. For both communities, a rough estimate has been made that between 1920 and 1940 the attack rate for the lepromatous type declined at an average rate of about 3 per cent annually. The data for Cordova show that the decline continued through the period of World War II and the years immediately following.

The decline in the incidence of lepromatous leprosy occurred both in persons exposed to the lepromatous type in the household and in those not known to have been exposed, although it was somewhat less marked in the former group. In a previous study (1) of this point, based solely upon the historical data, the decrease was found to be somewhat greater in households in which lepromatous leprosy had been present. In such households the ratio of cases to population remains more or less constant at different periods, and the opportunity for effective exposure would be expected likewise to remain more or less the same; while in the population at large the risk would diminish proportionately with the fall in numbers of infectious cases. Further study of this important question is desirable but, as far as available evidence goes, it appears that some cause other than lessening of opportunity for person-to-person contact was the principal factor contributing to the decline of lepromatous leprosy in these communities.

The fact that there was a compensatory increase in nonlepromatous leprosy suggests a transition towards less severe forms of the disease; that is, that although the number of infections may have been as frequent as before, the resultant disease was nonlepromatous rather than lepromatous in a remarkably high proportion of cases. If the factor of exposure remained the same, increase in resistance of the population, or lowered pathogenicity of *M. leprae*, or both, have to be invoked to explain such a

transition. Caution is necessary because the increase in nonlepromatous cases appears to have been a recent development, related to the war and the years immediately following, and may have been a temporary phenomenon.

Changes in type and severity have occurred in certain acute infectious diseases such as diphtheria and scarlet fever. In these the infection can be maintained in a population for long periods, in which recognized cases may be few, by means of carriers or mild clinical attacks. In leprosy, however, as far as is known at present, the disease is maintained chiefly by the lepromatous type and a change to nonlepromatous forms would lead to its eradication. If the findings here reported have any such significance they are of great practical and theoretical importance. Confirmation can be obtained by continued observation of Cordova and Talisay and by extension of the area of study to other endemic foci in the Philippines.

ABSTRACTO

Se estudió la tendencia de la lepra en dos provincias de Cebú, Filipinas. Informes anteriores han sido rendidos relativos a la prevalencia de la lepra en Cordova y Talisay, luego de haber examinado casi la totalidad de la población en aguellas areas. Estos estudios fueron efectuados en 1933 y 1941 en Cordova, y en 1936-37 en Talisay.

El área de Cordova fué re-examinada en 1948 y Talisay en 1950-51. Al combinar los resultados de ambas áreas se obtiene una prevalencia de 19.3 por mil, contando todas las formas de lepra, durante el primer ensayo y de 18.5 en el segundo exámen 14 años más tarde. La lepra lepromatosa, sinembargo, disminuyó de 11.6 por mil a 5.4; las formas no-lepromatosas, al contrario aumentaron de 7.7 por mil, a 13.1. Este cambio ocurrió en ambas comunidades y en ambos sexos. En la lepra no-lepromatosa el aumentó fué mas notable en los niños.

Se calcularon valores de incidencia anual. Estos fueron, para le lepra lepromatosa, de 0.39 por mil en varones, y de 0.11 en hembras, con un total de 0.25 por mil. En la lepra no-lepromatosa, los valores fueron de 0.82 en varones, 0.67 en hembras y total de 0.75 casos por mil. Ambas formas de lepra tuvieron una infectividad máxima en el grupo de 10-14 años de edad.

El uso del métodod e tabulación de estadísticas vitales arrojó datos de los cuales se estimó que entre los años 1920 y 1940 la lepra lepromatosa disminujó a razón de 3% anualmente. Los datos no fueron suficientes para realizar un cálulo similar en la lepra no-lepromatosa.

La disminución en la lepra lepromatosa fué menos pronunciada en aquellas personas que habían sido expuestas en el hogar que en aquellas, en las cuales no hubo tal exposición. El aumento en las formas no-lepromatosas puede sugerir que ha habido una transición hacia las formas menos severas de la enfermedad. Si esto es cierto, y puesto que la enfermedad es mantenida por la forma lepromatosa, éste cambio, si persiste, puede causar la eradicación gradual de la enfermedad. Son necesarios mas estudios para estáblecer definitivamente lo anteriormente expuesto.

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REFERENCES

1. DOULL, J. A., GUINTO, R. S., BANCROFT, H. and RODRIGUEZ, J. N. Historical inquiry as a method of estimating the trend of leprosy. Internat. J. Leprosy **15** (1947) 369-377.
2. DOULL, J. A., GUINTO, R. S., RODRIGUEZ, J. N. and BANCROFT, H. The incidence of leprosy in Cordova and Talisay, Cebu, P. I. Internat. J. Leprosy **10** (1942) 107-131.
3. DOULL, J. A., RODRIGUEZ, J. N., GUINTO, R. S. and PLANTILLA, F. C., A field study of leprosy in Cebu. Internat. J. Leprosy **4** (1936) 141-170.
4. GUINTO, R. S., DOULL, J. A., BANCROFT, H. and RODRIGUEZ, J. N. A field study of leprosy in Cordova, Philippines. Resurvey in 1941 after eight years. Internat. J. Leprosy **19** (1951) 117-135.
5. GUINTO, R. S., DOULL, J. A., DE GUIA, L. and RODRIGUEZ, J. N. Mortality of persons with leprosy prior to sulfone therapy, Cordova and Talisay, Cebu, Philippines. Internat. J. Leprosy **23** (1954) 273-284.
6. GUINTO, R. S. AND RODRIGUEZ, J. N. A field study of leprosy in Talisay, Cebu, Philippines. Internat. J. Leprosy **9** (1941) 149-166.
7. RODRIGUEZ, J. N. and GUINTO, R. S. A field study of leprosy. II. Re-examination of cases of leprosy at Cordova, Cebu Province, Philippine Islands. Internat. J. Leprosy **6** (1938) 285-302.

APPENDIX A

Person-years of life experience, by sex and age groups, for persons with household exposure to lepromatous and to nonlepromatous leprosy, and for those without known household exposure, for the periods between initial and final surveys, Cordova and Talisay combined.

Age group (years)	Exposed to lepromatous leprosy		Exposed to nonlepromatous leprosy		Not exposed to leprosy		Total population	
	Males	Females	Males	Females	Males	Females	Males	Females
0-4	669.5	477.0	1,013.0	766.0	20,340.0	19,938.0	22,022.5	21,181.0
5-9	697.0	660.5	864.5	734.0	16,608.5	16,663.0	18,170.0	18,057.5
10-14	740.5	787.0	657.0	718.5	14,306.0	14,599.5	15,703.5	16,105.0
15-19	744.5	878.0	619.5	650.5	12,221.5	12,692.0	13,585.5	14,220.5
20-29	1,545.5	1,632.0	1,138.0	1,146.0	18,405.5	20,101.5	21,089.0	22,879.5
30-39	1,099.0	1,432.5	662.0	915.0	12,677.0	13,703.0	14,438.0	16,050.5
40-49	795.5	981.0	386.0	392.5	8,617.0	9,066.5	9,798.5	10,440.0
50+	1,442.0	1,784.5	664.0	642.0	11,040.5	12,778.5	13,146.5	15,205.0
Total	7,733.5	8,632.5	6,004.0	5,964.5	114,216.0	119,542.0	127,953.5[a]	134,139.0[a]

a Exclusive of the life experience of persons, totaling 752 person-years, exposed in the household to cases of unknown type. Two cases of tuberculoid type occurred in these persons.

Appendix B

Cases of leprosy in males and females, by type and age at onset, occurring among those exposed and not exposed in the household, classified by type of primary case, for the periods between initial and final surveys, Cordova and Talisay combined.

Age group and form of leprosy	Exposed to lepromatous leprosy		Exposed to nonlepromatous leprosy		Not exposed to leprosy		Total	
	Males	Females	Males	Females	Males	Females	Males	Females
0– 4								
Lepromatous	3	2	—	—	—	—	3	2
Nonlepromatous	1	2	1	—	4	6	6	8
5– 9								
Lepromatous	2	2	—	—	1	1	3	3
Nonlepromatous	7	4	3	—	25	21	35	25
10–14								
Lepromatous	6	3	1	—	6	1	13	4
Nonlepromatous	10	5	2	2	19	23	31	30
15–19								
Lepromatous	3	—	—	1	8	2	11	3
Nonlepromatous	7	1	—	—	5	1	12	2
20–29								
Lepromatous	5	—	—	—	8	2	13	2
Nonlepromatous	4	—	2	—	10	14	16	14
30–39								
Lepromatous	1	1	—	—	2	1	3	2
Nonlepromatous	1	1	—	1	4	4	5	6
40–49								
Lepromatous	—	—	—	—	3	—	3	—
Nonlepromatous	—	—	—	—	2	3	2	3
50+								
Lepromatous	1	—	—	—	2	—	3	—
Nonlepromatous	—	3	—	—	3	4	3	7
Total								
Lepromatous	21	8	1	1	30	7	52[a]	16[a]
Nonlepromatous	30	16	8	3	72	76	110[b]	95[b]

a Six lepromatous cases transformed during the intervals from nonlepromatous cases present at time of initial surveys are not included.

b Excluding two cases of the tuberculoid type occurring in persons exposed to leprosy of unknown type in the household.