

LEPROSY IN PANAMA

FIRST THIRTY YEARS OF SEGREGATION¹EZRA HURWITZ AND HAMILTON H. ANDERSON²

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Previous to 1904, Panama was infested with such indigenous diseases as malaria, yellow fever, dysentery, typhoid fever, small-pox, helminthiasis and cutaneous infections. We have no accurate records of the incidence of leprosy during that period but certainly the disease must have been present, since the isthmus was either a home of or a thoroughfare for the peoples of the Caribbean area where leprosy presumably had been introduced from Africa in the early 16th century. Other diseases of greater numerical importance occupied the attention of the sanitary and medical workers of the Canal Zone during the early days of construction, and since then the disease has not been considered a major public health hazard.

In the past 30 years there have been segregated on the isthmus 320 leprosy patients in an estimated population of 450,000 or 0.71 per 1000 as compared with 718 such patients isolated over a 34-year period in the United States of America, or roughly 0.007 per 1000 (1). In other words, Panama has had a leprosy index about 100 times that of the United States over a three decade period, counting segregated cases only.

An inquiry regarding previous residence of the Panaman group

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reveals that only three of the 320 patients were born in the Canal Zone, while 50 had at one time lived in this area. The Republic of Panama was the birthplace of 124 and the residence of 242; the cities of Panamá and Colon, and the provinces of Bocas del Toro, Los Santos, Panama and Darien contributed the most cases. The islands and the countries of the Caribbean area were the birthplace of 160; 84 from Jamaica and Barbados, 14 from Colombia and 12 from Santa Lucia.

Population groups on the isthmus are very mixed, 50 per cent consisting of negroes and mestizos in the Canal Zone, 78 per cent in Panama City, and 85 per cent in Colon (2). These people are largely West Indian by birth or extraction and were brought or came into the area during the construction days of the Canal. Over-crowding and malnutrition is common among them, especially in Panama City and Colon, but much less so in the Canal Zone. The population of Panama City in 1933 was estimated at 79,000; of Colon at 30,000 and of the Canal Zone 42,851, a total of 151,851 for the Canal Zone and the two terminal Panaman cities (3). Approximately 27 per cent of the Canal Zone population are American (white) employees and their families living in the sanitated area of the Zone, 39 per cent are negro employees and their families living in the sanitated areas, and 22 per cent are soldiers (white) living here except when on maneuvers, 5 per cent are employees (mostly negroes) living in the unsanitated areas, and 7 per cent are "Zone Settlers" and their families (mostly negroes) who farm in the unsanitated areas. Of the 3,058 white employees in 1928, only 450 were females, although most of the white male employees are married, as well as the army and navy officers, and have their wives and families with them in the Zone (2). Of the 108 patients now isolated at Palo Seco Colony two are white Panamans, two are Chinese, 51 are mestizos and 53 are black.

Physical conditions on the isthmus are fairly constant throughout the year. The mean monthly temperature ranges from 79° to 81°, the lowest temperature recorded being 59°. Eight or nine months of the year are rainy, the mean annual fall being 70 inches on the Pacific side and 130 inches on the Caribbean littoral.

Evaporation is slow, despite winds, and during the wet season the humidity ranges from 86 to 88.5 per cent.

HISTORY OF THE COLONY AT PALO SECO

In January, 1905 temporary shelter for leprous patients was provided near Miraflores, in the Canal Zone, to provide domiciliary care for these people. Actually two patients had been isolated in 1904 and only one appears to have been segregated during 1905. In 1906 three more entered the shelter and in 1907 the present quarters at Palo Seco were occupied and 7 new patients arrived. The present colony is located on the west side of the canal about 3 miles from Balboa on the Pacific shore. Since 1904, 320 have been isolated of whom 233 are males and 87 females. The colony is maintained by the Canal Zone at a cost of about \$1.15 per patient per day. The Republic of Panama reimburses the Canal Zone Government for Panaman patients at the rate of seventy-five cents per day. During the past 10 years the average colony population was slightly in excess of 100, and about 85 of these were Panaman cases. The settlement is under the complete jurisdiction of the Health Department of the Panama Canal. Chart 1 shows the yearly admissions to the colony. It is unfortunate indeed that only 33 patients were isolated early, that is, as children.

The older buildings are one story frame structures and were the only ones in use to 1927, when two new modern buildings were erected. They are of concrete and wood, and are each two stories high. One is for a dispensary, infirmary, offices and store-room, the other contains the kitchen, mess-hall (with seating capacity for 120), laundry, cistern, and refrigerating machinery. Electricity, water and food supplies are brought in from Balboa, with which the colony is now connected by road and ferry. The settlement is neither policed nor enclosed.

Previous to 1921 a lay superintendent was in charge but since then a physician, at first part-time to 1928, and now resident since that year, has administered the colony. Seventeen non-leprous "silver" employees (i.e., black) aid the administrator, in addition to those patients who are able and desire to work. Dr. Philip

Horwitz was assigned, part-time, to the colony from 1921 to 1928, and since then Dr. Ezra Hurwitz has been medical superintendent. The 17 "silver" employees were examined completely and not one of them showed either clinical or laboratory evidence of leprosy. These non-infected employees have worked for many years as foremen, laborers, cooks, waiters, attendants, and laundresses.

YEARLY ADMISSIONS - PALO SECO COLONY

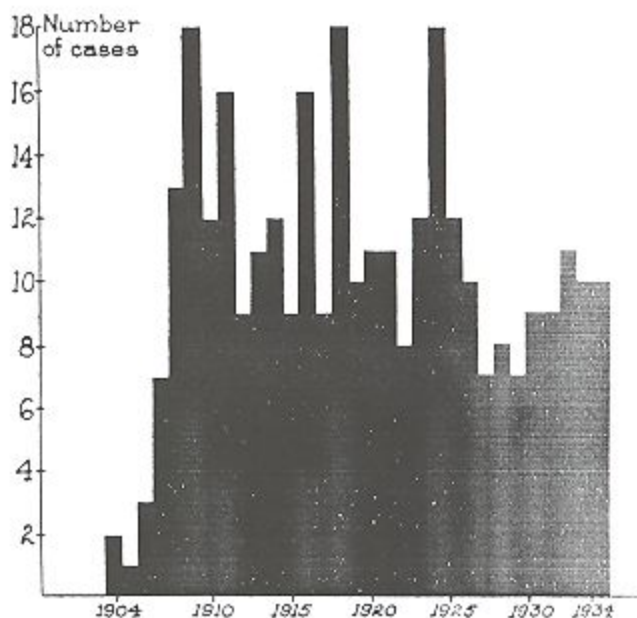


CHART 1

As far as possible the more infectious patients are housed separately but because of limited facilities this is not completely feasible. Marriage is permitted when age and physical fitness permit and with the understanding that the off-spring are to be isolated from their parents at birth. Vasectomy has been suggested to some patients. As far as possible patients in the colony are encouraged to lead normal lives. Over half of those who are able-bodied are employed in the colony and do much gardening,

carpentry, masonry, painting, grass-cutting and other general work, for which they are paid. Some actually have made enough to support families on the outside to a considerable extent.

The present superintendent of the colony has made a definite effort to promote the hygienic, dietetic, and social standards of the patients. In spite of set habits and tastes, a well-planned and general diet is given. Sample menus now include cereal, cheese or eggs, butter, bread, and coffee each morning; salad or soup, meat, potatoes, rice, vegetable (fresh), butter, and milk at noon; and meat, rice, potatoes, vegetable, butter, bread, and tea or coffee for the evening meal. Fresh fruit is not usually served daily but is available everywhere about the settlement and on the small farms of the patients. Vegetable and animal (especially pork) fats are favored by the Panamans at Palo Seco. This possibly accounts, in part, for the increased blood lipids which are referred to later.

Socially much of interest occurs in the colony to keep the patients happy. In fact, 15 arrested cases now resident prefer to continue their stay at Palo Seco instead of returning to their previous, oftentimes forlorn and uninteresting, environments. Talking motion pictures (2 or 3 times weekly), frequent band practice, the daily broadcast of the short-wave radio, phonographs, pool, amateur boat-building, fishing, swimming, and other amusement facilities make the colony a rather desirable haven for the so-called "out-cast." Clothing, tobacco, toilet articles, etc., may be purchased at the colony storeroom by the patient on his monthly allowance, and those who work are able to buy many of the nicer things that are desirable. A credit system now exists whereby each patient is given \$1.50 per month allowance for the purchase of necessities. This method tends to decrease gambling and allows an ample budget for the individual's extra needs, and is an assurance that the money will not be spent recklessly. Profits from the salesroom were used for purchasing the projector for the talking motion pictures. Three cinema agencies in Panama each furnish the colony with one show weekly, without charge. Such arrangements give great satisfaction and pleasure to this isolated group, though they tend to make the arrested patients less self-reliant and unwilling to leave the colony.

COURSE OF LEPROSY IN PANAMA

A leprosy board, consisting of Dr. D. P. Curry, Assistant Chief Health Officer, Dr. Lewis B. Bates, Chief of the Board of Health Laboratory, and the current chief of the medical clinic at Gorgas

TABLE 1

*Data on 35 of 44 patients paroled at Palo Seco Leper Colony from 1904 to 1934**

	RE-ADMITTED TO COLONY	NOT RE-ADMITTED TO COLONY
Number of patients.....	12	23
Average age in years on entry.....	28.7	30.2
Average duration of leprosy in years.....	3.4	3.6
Number of patients with complications.....	12	13
Wassermann positive (on entry).....	4	3
Luetic history.....	2	2
Treatment: duration of hospitalization (average in years).....	8	7.5
Chaulmoogra esters (average amount in cubic centimeters intravenously or intramuscularly).....	2,315	1,536
Mercurochrome, in addition to chaulmoogra (average amount in grams intravenously).....	1.51 (8 patients)	0.15 (2 patients)
Neosarsphenamine (average amount in grams intravenously).....	41.0 (2 luetics)	12.0 (2 luetics)
Bismocymol (average amount in cubic centimeters intramuscularly).....	64 (2 luetics)	
Cod liver oil (in cubic centimeters intravenously in one patient also given chaulmoogra).....		246
No drug therapy.....	1	1
Ultimate fate (after discharge).....		21 not known
Number of deaths.....	4	2
Present status of leprosy.....	4 quiescent 2 improving 2 advancing	

* Seventeen resident Panamans, 18 born elsewhere; 12 are females and 23 are males.

Hospital (an officer of the Medical Corps, U. S. Army, detailed for this position), govern the placing of patients at Palo Seco and also determine the status of patients to be released. Generally cases are first given a complete medical examination in

the isolation ward at Gorgas Hospital and subjected to clinico-pathologic study, including search for acid-fast organisms, before being sent to the colony. Surgical or other treatment of extra-leprous complications is carried out before isolation whenever necessary. The special board for the examination of leprous cases and suspects conducts a physical examination of the alleged

TABLE 2

Present status of 108 patients at Palo Seco Leper Colony, Panama

TYPE OF CASE*	NUMBER SEEN	SEX		AGE GROUPS			CHANGE IN STATUS SINCE ENTRY†			
		Male	Female	0 to 15	15 to 30	30 and up	Advancing	Improving	Quiescent	Arrested‡
C ₁	2	1	1	0	2	0	1	1	0	0
C ₁ N ₁	29	20	9	0	14	15	5 (all pos.)	18 (7 pos.)	2	4
C ₁₋₂ N ₁₋₂	38	31	7	1	12	25	10 (all pos.)	15 (8 pos.)	12	1
C ₂ N ₁₋₃	22	17	5	0	6	16	17 (16 pos.)	1 (pos.)	4 (all pos.)	0
N ₁	7	3	4	0	4	3	0	0	1	6
N ₂	10	7	3	0	0	10	3 (1 pos.)	0	3	4
Total...	108	79	29	1	36	71	36 (31 pos.)	35 (16 pos.)	22 (4 pos.)	15

* Leonard Wood Memorial classification.

† Bacteriologic examination of nasal scraping or skin biopsy; material is negative for *M. leprae* unless otherwise noted.

‡ Clinically and bacteriologically negative for 2 years or more.

leprous lesions, with bacteriological studies, and the bacteriologic and clinical diagnosis is made by this board. Likewise, patients successfully treated and found bacteriologically negative and arrested clinically over a twelve-month period, even after attempted activation with potassium iodide, are reexamined by this board for parole. The patient is urged to return, if released, each six months for re-check but often this is not possible due to

lack of sufficient personnel to enforce this rule since many depart immediately for distant or little known parts of the isthmus. It is also unfortunate that all family or household contacts of positive "open" cases cannot be examined. No out-patient service for care of "closed" cases is provided. It would be highly desirable to have a more satisfactory follow-up system. Table 1 summarizes the data on 35 of the 44 patients paroled from 1904 to

TABLE 3

More frequent causes of death in lepers (1904-1934*) and in non-lepers (from Reports of Board of Health Laboratory, 1904-1929)†

DISEASE	NUMBER OF LEPERS	RATES PER 1000	
		Lepers	Non-lepers
Tuberculosis.....	39	273	140
Chronic nephritis.....	23	161	50.5
Organic heart disease.....	12	84	43
Septicemia.....	8	56	
Leprosy.....	6	42‡	15.7§
Pneumonia.....	4	28	130
Cancer.....	4	28	27
Affections produced by external causes...	3	21	75
Syphilis.....	3	21	32.6
Combined types of dysentery.....	3	21	29
Malaria (and hemoglobinuric fever).....	2	14	45

* 140 patients, all but 21 were examined postmortemly.

† 8,901 patients examined at necropsy.

‡ Noted only when no other "contributory cause" given.

§ Leprosy always indicated as "cause of death" in accordance with the preference of the *International Manual of Joint Causes of Death*, third edition, 1927.

1934. Unfortunately the ultimate fate of 21 of these is not known.

Of the total patients hospitalized over the 30-year period (1904-1933) 142 have died, 18 absconded, and 18 were repatriated. Thirty-eight were released from 1919 to 1929 during the period of most intensive therapy, and from 1930 to 1933 only four patients have been discharged although there are now 15 arrested cases residing in the colony. Table 2 indicates the present status of the patients now at Palo Seco. In the arrested group, 6 have no deformities, 5 are slightly disfigured, and 4 are maimed.

The more frequent causes of death are given in table 3; leper and non-leper groups are both listed for comparison. As noted in other countries, tuberculosis and nephritis occur more frequently in lepers than in the general population. The more common complications now present in the patients at the colony are shown in table 4. On entering Palo Seco, 74 had secondary anemia, 45 had had malaria, 15 nephritis, and 24 exhibited casts and/or albumin in the urine, which have since cleared in all but three patients. Intestinal worms were seen in 25 on entry and

TABLE 4

More frequent complications or intercurrent diseases now present in 108 Palo Seco patients (including serologic reactions)*

Eye involvement†.....	26
Secondary anemia.....	18
Nephritis.....	18
Amputation‡.....	9
Tuberculosis.....	4
Hypertension and heart disease.....	4
Pyuria.....	3
Psychopathic.....	2
Glycosuria.....	2
Malaria (acute).....	2
Wassermann (or Kahn) positive§.....	31

* Other than intestinal parasites (see text).

† Sclerosis of cornea, pterygia, panophthalmitis, iritis and cataract most frequent.

‡ Because of extensive leprosy tissue damage.

§ The 77 other patients had negative serologic reactions.

these were given specific therapy, while 6 others had had dysentery. Gonorrhoea was admitted by 13 and luetic symptoms were noted in 6.

The average age of onset of leprosy is 31 years according to the patients' statements, the leper entering the colony 3.7 years later. Six years was the average hospital stay of the 140 lepers that died at Palo Seco, the average span of leprosy years being 8.4. Of the 108 patients now segregated the known period of leprosy is 9.84 years, and this group will have a considerably increased life span if complicating diseases are controlled and their general

nutrition and hygienic status continue to improve. Hopkins and Denney report 14.2 years as the average duration of the disease in the United States of America (1). Compared with the life span of the indigenous non-leprous population of these two areas the Panamanian results are not unfavorable. The average death age of lepers in Panama is 40 years.

PRESENT METHODS OF ANTILEPROSY THERAPY

In the fall of 1934 two of us (J. Van D. A. and H. H. A.) were invited to visit the colony and introduce a new modification of chaulmoogra therapy as part of a chemotherapeutic study of antileprosy drugs (4). Before attempting these therapeutic trials we made a clinico-pathologic study of the patients and 50 not recently nor extensively treated were selected by one of us (E. H.) as suitable. Nasal smears were positive for *M. leprae* in 40 and skin biopsy material contained the mycobacterium in 4 others. The Icterus index for the group averaged 5.4 and none was abnormally high. Phenolsulphonphthalein excretion averaged 61.5 per cent before treatment in the 20 patients given "chaulphosphate" intravenously over four months and 70 per cent in two hours after this period. The thirty other patients averaged 51.5 per cent dye excretion during 2 hours. Twenty of these were given saline intravenously, as a control group, while 10 others received merthiolate intravenously. Those patients having total dye excretion below 50 per cent were placed in the control group.

Denney, Hopkins, and Wooley (4) reported mercuricureol improved 16 of 44 lepers given the drug intravenously once weekly for a year. We were desirous to compare this mercury-fluorescein type of drug with another mercurial, namely, "merthiolate" (sodium ethyl mercuri-thiosalicylate) which contains no dye and which is most effective *in vitro* against *M. leprae*. One of us (E. H.) had confirmed, in part, the observations of Denney et al. in a group of Panamanian lepers. Ten other patients were selected with normal kidney function and over a two months time they each received intravenously from 0.55 to 0.7 gram of the drug, given in 1 per cent aqueous solution. No improvement in the leprous status was noted and the drug was discontinued because

five individuals complained of uncomfortable abdominal "pressure," back pain and stomatitis, and albuminuria was observed. If mercurochrome proves of value in leprosy it is not the mercury but rather the fluorescein portion which is active, according to our results.

"Chaulphosphate," a relatively non-toxic (one-fifth to one-tenth as lethal for animals as "alepol"), non-sclerosing type of water-soluble chaulmoograte (Na-dichaulmoogryl- β -glycerophosphate) which does not cause the immediate hemolysis of blood cells, was designed for intravenous use in antileprosy therapy (6). It was felt that since leprosy is a systemic disease, not always confined to peripheral nerve or cutaneous tissues, it might best be treated systemically. The experiences of Emerson, Leake and Anderson (7) in rat leprosy therapy confirmed this view. The solubilizing portion of this chaulmoograte is a glycerophosphate which was found, both in the laboratory and clinically, to have definite tonic effects, an important factor in any chronic therapy.

Table 5 summarizes our experience over a four month's period with "chaulphosphate" administered to 20 patients in 0.5 to 1.0 gram amounts dissolved in sterile physiologic saline solution. Treatments are given twice or thrice weekly. Certain lots of the drug gave no reactions at all while others caused severe immediate (i.e., within two hours) febrile response, sometimes preceded by chills. The oral temperature in some cases reached 40°C. and nausea and vomiting were occasionally noted. In every instance these untoward effects were transient, the temperature approaching normal within eight hours, and not always recurring after subsequent injections of other lots of the same drug. We felt that the reactions were not due to water since the group given saline intravenously did not exhibit any similar effects. The same glass-ware and rubber tubing were used in sterilizing (by passing through Seitz Filters) both saline and "chaulphosphate" (3 percent in saline) solutions. The most likely cause was the presence of carbonates and phosphates, particularly, in the crude drug preparation used. Phosphates are known to produce such reactions when given intravenously to dogs (8). No patient desired to discontinue therapy because of these side effects. At

TABLE 5

Follow-up data on twenty leprosy patients given "Chauliophosphate" intermittently over four months trial period

PATIENT	ORGANS INVOLVED			DURA TIONS	COMPLICATIONS	NO. OF DOSES	NO. PER CAP. DOSES	LEPROSY RESPONSE AND DRUG EFFECTS	WEIGHT CHANGE
	SEX	AGE	TYPE OF LESION						
5	34	M.	50.0	C.N.	Advancing	20	20	Nodules apparently softening and shrinking, feels stronger; severe drug reactions	+1.36
6	30	M.	66.0	C.N.	(Tubercloid) advancing	16	29	Trophic ulcer on foot healing, otherwise no change except feels stronger; moderate drug reactions	-2.28
8	66	M.	67.0	C.N.	?, improving	4.5	25	Apparent shrinkage of nodules and shriveling of skin over macules, lesions smaller, softer; mild drug reactions	-3.18
11	48	M.	80.0	C.N.	Advancing	5	29	Mucles appear paler and smaller, physically stronger; mild drug reactions	+2.28
16	35	M.	61.0	C.N.	Advancing	16	26	No apparent change, moderate drug reactions	+2.28
21	26	M.	52.5	C.N.	Improving	2.5	26	Local reactions one month after onset of therapy, mild, except of lesions of face rapidly clearing, severe drug reactions	-1.36
23	50	F.	70.1	C.N.	Improving	16	25	No apparent change, rather severe drug reactions	+1.0
33	31	M.	48.0	C.N.	Advancing	16	28	No apparent change, moderate drug reactions	None

36	31	M.	66.9	C ₂ N ₁	Improving	8	Wassermann positive, arsphenamine 16.2 grams, bismodel 65 cc. None	12.6	29	Lesions softening, physically stronger; mild drug reactions	None
43	18	F.	50.0	C ₁ N ₁	Advancing	1.5		18.3	27	Macules apparently clearing; moderately severe drug reactions	-1.0
44	20	F.	53.0	C ₁ N ₁	Improving	3	<i>Banophilus coli</i> and <i>Escherichia histolytica</i>	12.75	28	Lepra reaction severe, albumin in urine, edema of ankles, but nodules on face and ears are absorbing	-10.0
48	38	F.	54.5	C ₁ N ₁	Advancing	7.5	Wassermann positive, negative since anti-luetic therapy	15.75	20	Macules receding, improved, severe reactions	+1.36
50	34	M.	60.9	C ₁ N ₁	Advancing	8	Kahn positive, no anti-luetic therapy	23.25	29	Nodules are softer and smaller, subjectively improved also; moderate reactions	+2.72
54	49	M.	69.0	C ₂ N ₁	Advancing	1.5	None	19.2	29	Nodules are softer and "shrunken"; moderate drug reactions	-5.44
72	24	F.	46.3	C ₂ N ₁	?, improving	7	None	18.45	29	Undoubted improvement with clearing of macules and absorption of nodules new hair over denuded areas, stronger generally	+1.0
90	33	M.	47.7	C ₂ N ₁	?, improving	6	None	19.35	29	Lesions resolving, symptomatically improved; moderate reactions	+1.0
92	25	M.	50.1	C ₂ N ₁	Advancing	13	None	17.25	25	Lesions extending; moderate drug reactions	None
95	20	M.	56.8	C ₁ N ₁	Advancing	12	None	19.95	29	No apparent change, feels well; mild drug reactions	+2.72
99	40	M.	71.3	C ₂ N ₂	Advancing	1	None	19.0	28	No apparent change, feels well; mild drug reactions	+5.44
108	26	F.	45.4	C ₂ N ₁	Advancing	26	Secondary anemia	15.0	27	Nodules apparently softer, otherwise no change; moderate drug reactions	+1.0

Summary: 5, no change; 1, aggravated; 14, improved objectively or subjectively.

* Given in 3 per cent saline solution passed through Seitz filters.

-, weight loss over 4 months period; +, weight gain over 4 months period.

present newly prepared lots of the drug are being tried in an effort to determine the most satisfactory way to avoid these chemical difficulties. One of us (E. H.) felt the results of this preliminary clinical trial were sufficiently encouraging to warrant continuing the experiment since none of the twenty saline treated controls exhibited any clinical evidence of improvement.

No other therapy was given during these therapeutic trials except that 15 patients in the colony harboring uncinaria and ascaris were treated with hexylresorcinol and 14 others with strongyloidiasis also were treated successfully with gentian violet orally. Three patients with *Balantidium coli* and four harboring *Endameba histolytica* were given carbarsone by mouth.

OTHER STUDIES AT PALO SECO

Since the mechanism of action of unsaturated fatty acids (including chaulmoogra and its derivatives) is still unknown we felt that perhaps a study of the iodine values and total lipids of the blood of lepers given various amounts of chaulmoogra might be interesting. Hansen (9) has shown that the iodine value of the blood of infants suffering from eczema is abnormally low and that by giving large amounts of linseed oil orally an increased degree of unsaturation of the blood fatty acids occurs which parallels clinical improvement. De Vera (10) has noted that in a series of oils of diminishing saturation, the greater the saturation the greater the therapeutic action. Walker and Sweeney (11) demonstrated that unsaturation is partly responsible for the *in vitro* activity of non-chaulmoogryl oils. Paras (12) studied the blood plasma lipoids of lepers and felt that "the leprosy bacilli attempt to protect themselves from the destructive action of the defense mechanism of the body by utilizing part of the plasma lipoids."

We examined the blood of 53 "cutineural" (i.e., mixed) cases of leprosy and found the average iodine value for the group to be 58.5 ± 15.9 and the total lipids 0.805 ± 0.161 gram per 100 cc. Early "cutineural" leprosy and cases improving under chaulmoogra therapy exhibit lower unsaturation of the fatty acids and higher total lipids than do the blood of those cases that are more extensively treated and are quiescent or advancing. The three

highest numbers, 108.0, 120.4, and 129.3 occurred in treated patients rapidly becoming worse. In table 6 this data is outlined.

It appears probable that unsaturated fats are depleted in early leprosy and are either more rapidly destroyed or hydrogenated to saturated lipids. The latter circumstance seems most likely since the total lipids are increased in early cases, and may actually exceed the normal level in chaulmoogra-treated lepers. The de-

TABLE 6

*Average iodine values and total lipids of the blood sera of 53 patients under treatment for "cutaneous" (mixed) leprosy at Palo Seco Leper Colony, Panama**

	EARLY PRE- DOMINANTLY CUTANEOUS LEPROSY†	ALL STAGES IMPROVING‡	ADVANCED STATIONARY	ALL STAGES ADVANCING
Number of patients.....	18	13	11	11
Average age, years.....	30.1	30.4	31.9	33.1
Average weight, kgm.....	57.2	59.9	56.2	58.7
Average grams per 100 cc. hemoglobin.....	12.15	11.85	11.02	12.67
Average duration of disease, years.....	4.1	5.3	9.4	9.8
Average amount of Chaul- moogra esters given in kilograms.....	1.44	1.57	2.25	2.74
Average iodine value.....	50.1±13.6	54.5±18.1	66.9±14.1	77.8±19.8
Average total lipids, grams per 100 cc.....	0.995±0.129	0.813±0.194	0.720±0.200	0.572±0.148

* Normal values: Iodine value of total fatty acids, 88; total lipids, 0.589 gram per 100 cc. (Boyd, E. M.: J. Biol. Chem., 101:323, 1933).

Average values for 53 leprosy patients: Iodine value, 58.5 ± 15.97; total lipids, 0.805 ± 0.161 gram per 100 cc.

† Three untreated patients included.

‡ One patient with lepra fever, iodine value 31.2, total lipids 1.016 grams.

rangement of lipid metabolism in this stage is more pronounced than in cases that are advanced or advancing. In other words the older lepers lipid response approaches normal in spite of extensive tissue invasion by the acid-fast organisms, and in the presence of intensive chaulmoogra therapy.

SUMMARY

Since 1904, 320 leprosy patients have been segregated in Panama, half of whom were born in the islands or in other coun-

tries of the Caribbean. Only three lepers gave the Canal Zone as their birthplace. All but four now resident at Palo Seco are mestizos or blacks. The average patient-per-day cost for domiciliary and medical care is \$1.15 for an approximate yearly population of 100 during the past ten years. Only 33 children have been admitted to the colony during the 30-year period. More than half of the patients are engaged in gainful occupation, which tends to improve the general morale of the group. Fifteen arrested cases, now resident in the colony, prefer to remain because of their recently improved hygienic, dietetic, social and medical status. None of 17 originally uninfected individuals employed at the colony, for as long as 20 years, in some instances, show any evidence by laboratory or clinical tests of having acquired leprosy.

A leprosy board of three members reviews all new patients, after a complete examination in the isolation ward at Gorgas Hospital, Ancon, and also passes on arrested cases ready for parole. Forty-four patients have been paroled, 142 have died, 18 absconded, 18 were repatriated, and 12 were re-admitted to the colony since 1904. Tuberculosis and nephritis are the most common causes of death. The more frequent complications are secondary anemia, malaria, nephritis, and intestinal parasites. Serologic blood reactions were positive in 31 of the 108 patients now segregated. The average age of onset of the disease is 31 years according to patients' statements, the leper entering the colony 3.7 years later. The leprosy years numbered 8.4, 6 of which were spent in the colony (based on the average of 140 patients now dead). The present group of 108 have averaged 9.84 leprosy years to date.

In the past chaulmoogra esters were given intravenously and intramuscularly and mercurochrome was used for a short period intravenously. At present the esters are being continued intramuscularly in those patients who present themselves for treatment, and this group is being compared with another now receiving "chaulphosphate" by vein. Merthiolate was found to be unsatisfactory for clinical use by intravenous injection. Saline treated controls failed to show the improvement noted in the "chaulphosphate" treated group over a comparable period. Intestinal parasites found in lepers were treated specifically.

Other studies now proceeding at Palo Seco include an investigation of the level of unsaturated fatty acids and total lipids in the blood of patients at various stages of the disease who have received various amounts of chaulmoogra (unsaturated) fatty acids. Early "cutaneous" leprosy (that is, mixed leprosy, the most common type at Palo Seco) and cases improving under chaulmoogra therapy exhibit lower unsaturation and higher total lipids in the blood than do patients who are quiescent or advancing.

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