

Endemism of Coccidioidomycosis in the Paraguayan Chaco

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SUMMARY

Skin testing of 541 men with coccidioidin was carried out in an investigation of endemism of coccidioidomycosis in the Paraguayan Chaco. In two areas where the climate is hot, dry and windy, positive reactions developed in a considerable number of the employees of an oil company who were of various racial origins, as well as among native Indians. In a third area, where rain is more plentiful and vegetation lush, only 2 per cent of 250 Indians tested had positive reaction to coccidioidin.

THE geographical distribution of coccidioidomycosis is related principally to hot, dry, windy and dusty areas where little rain is encountered.^{1, 6, 7, 9} Identification of clinical cases in a given area arouses suspicion of endemicity; and if positive reaction to skin tests with coccidioidin, the validity of which has been generally recognized in the United States for such investigation,^{1, 2, 8, 9} develops in a substantial number of residents tested, then the suspicion is confirmed.

Two clinical cases have been identified within the personnel of the Union Oil Paraguay,⁴ a company which has worked in the Paraguayan Chaco for some four years. These two cases were encountered in persons living in the central zone of the Paraguayan Chaco (Zone B, Figure 1), where the climate is typical of endemic areas. The discovery of the two cases led to a survey with a view to establishing an index of probable coccidioidal infection within the personnel of the company.*

With a view to covering the three characteristic zones of the Chaco (Figure 1), the survey included a group of Guazurangué Indians, typical inhabitants of the north and northwestern zone of the Chaco (Zone C, Figure 1), also a group of Lengua Indians, who inhabit the southeastern part of the Chaco (Zone A, Figure 1).

TOPOGRAPHIC AND CLIMATIC CHARACTERISTICS OF THE PARAGUAYAN CHACO

The "Chaco Boreal" or "Gran Chaco Paraguayo," generally speaking, is a vast, flat area except for a

*A staff doctor for the company, the author was in an excellent position to carry on such an investigation. Fortunately he had been corresponding with Dr. Charles E. Smith of the Stanford University School of Medicine and the Commission on Acute Respiratory Diseases of the Army Epidemiological Board, and Dr. Smith made the survey possible by sending the necessary coccidioidin and by faithfully answering even the smallest question.

few small hills in the northern part, the most prominent of which, Cerro Leon, is some 35 kilometers long, 20 kilometers wide and 600 meters high. The climate is hot and arid, with temperatures reaching 45° C. (112° F.) or more. The wind, predominantly from the north, blows constantly and with considerable force the major part of the year. Rains begin in October, predominate in December and January, and gradually diminish in the following months, becoming rare after the month of May.

From the point of view of topographical and physical characteristics, the Chaco may be divided into three well defined zones; the southeastern (A), the central (B), and the northwestern (C) (see Figure 1).

Zone A. This zone is of generally lower terrain, susceptible to flooding in the rainy seasons and in the periods of overflow of the Pilcomayo and Paraguay rivers. The flora consist principally of extensive palm groves and tall grass, with a scattering of quebracho and other varieties of large trees. A large part of this zone is owned and inhabited by cattle ranchers, and the fertile soil is irrigated by numerous small streams and lagoons formed by the local rains which are, generally speaking, more prevalent in this area (55 to 65 inches per year). Numerous tribes of Indians inhabit this zone, among them the Lenguas who are found throughout the section from Puerto Casado to the Monte Lindo River.

Zone B. The soil of this zone, although sandy in places, is essentially a clay. In general the zone is heavily wooded and has an erratic growth of spiny underbrush and cactus, but there is no grass to prevent the easily pulverized clay powder from being blown by the strong north winds. This is particularly true of all sections where dirt roads exist or the brush has been cleared—in other words, all the areas which are populated.

This zone is very arid and windy. Annual rainfall is from 19 to 27 inches, and arroyos, rivers, and other watercourses are completely lacking. The rain that collects in small depressions or aguadas located throughout the area is the only drinking water.

Among the fauna of the area are numerous varieties of burrowing rodents as well as many sylvan animals such as deer, wildcats, pumas, pigs, and tapirs. Vinchucas (*Triatomas infestans*) are abundant, as are mosquitoes, flies and ticks.

The two principal centers of population are Mariscal Estigarribia, military headquarters of the Paraguayan Chaco, and the Mennonite colonies, 100 kilometers to the south.

Zone C. This zone is a desert, with the wind-blown sands accumulating to form dunes. The an-

nual precipitation is far below that of Zone B, and water holes are practically non-existent. Vegetation consists of a few scrubby bushes and scattered cacti. Temperatures are consistently high and a strong north wind blows almost constantly, carrying with it a powdery sand that penetrates every opening or crack.

The Guazurangué Indians are the only typical and ancestral inhabitants of this part of the Chaco. In addition there is the personnel of a small military garrison located at Irendague or General E. Garay.

It was in zones B and C that the principal exploration program of the company was carried on; and for a period of more than three years these zones were the habitat of the personnel subjected to skin tests with coccidioidin.

THE COCCIDIOIDIN SKIN TEST

The coccidioidin used in the tests was prepared at the Stanford University School of Medicine for the Army Epidemiological Board. As is known, the coccidioidin has a very high degree of specificity, and it has been definitely demonstrated that there is no cross-reaction of coccidioidin in the tuberculous. However, there is recent evidence of cross-reaction with histoplasmin.¹⁰

The material was diluted 1:100, and 0.1 to 0.3 cc. of this dilution was injected intradermally. Results were read 24 and 48 hours after injection. Induration over 0.5 cm. in diameter at either time was considered a positive reaction. The size of reaction indicated by symbols is the generally adopted one:

- ± Induration with diameter under 5 mm. or redness without induration.
- + Induration with diameter of 5 to 9 mm.
- ++ Induration with diameter of 10 to 19 mm.
- +++ Induration with diameter of 20 mm. or over.
- ++++ Necrosis.

A positive reaction, according to Smith,⁸ may be interpreted as is a positive tuberculin reaction; that is, it signifies past or present infection and does not prove active infection. Sensitivity to coccidioidin, once acquired, may endure for years even in persons dwelling long outside the area in which they became infected.

INITIAL RESULTS OF SKIN TESTS

The initial skin tests were made in the month of March 1949, upon a group of 291 adult men, of whom 209 were employees of the company and 82 were Guazurangué Indians. The entire group may be considered almost exclusively as related to zones B and C of the Chaco. The results are shown in Tables 1 and 2. The duration of residence in the area by company employees who had positive reaction ranged from ten months to 17 years.

TABLE 1.—Detail of Results of Initial Tests (Zones B and C)

Nationality	Number of Men	Positive*		Negative Reactions	
		No.	%	No.	%
Paraguayan	186	29	15.5	157	84.5
American	10	5	50	5	50
Guazurangué Indians	82	36	43.9	46	56.1
Other nationalities	13	1	8	12	92
Total.....	291	71	24.3	220	75.7

*Reaction was not considered positive unless the indurated area was at least 6×5 mm.

TABLE 2.—Degree of Reaction

Degree of Reaction	Number
++++	1
+++	6
++	26
+	38
Total.....	71

COMMENT

In both of the previously mentioned clinical cases of coccidioidomycosis, x-ray films of the chest were typical and erythema nodosum was present. Both patients had strong reaction to coccidioidin. In a review of filed data on patients which was conducted after the skin testing, it was found that three men who had strong positive reactions (two of them with +++ and one with +++) had been ill within the period 1947-1949, showing symptoms of acute infections of the respiratory system. Two had had dry pleurisy which had persisted for from one to two weeks. The diagnosis at the time of illness was influenza and pneumonia, but in light of their later strong reactions to the skin test, they now may be presumed to have had primary coccidioidomycosis.

The majority of the North Americans tested had been in the Chaco for more than two years and some of them had previously worked in areas considered endemic in the United States, which might account for the high percentage of positive reactors within that particular group.

In the group of Paraguayans tested were some who had lived in the same area for many years before being employed by the company.

The Guazurangué Indians tested had lived in the north and northwestern part (Zone C) of the Chaco all of their lives.

There were no positive reactions in men who had spent less than ten months in the Chaco, although 45 of the 291 men tested had been in the Chaco for ten months or less. Hence it would appear that all those with positive reaction (with the possible exception of the North Americans who had been previously exposed) had acquired the sensitivity after a residence of some duration in the Chaco.

RESULTS IN ZONE A

After the tests in Zones B and C of the Chaco had been completed, further investigation was carried on by the same method in Zone A. As previously

pointed out, this area is completely different from Zones B and C. In Zone A the skin tests were administered to 250 Lengua and Sanapana Indians who have been domesticated and are employed by the local ranchers. All had lived in the area five years or more. Results of the tests are shown in Tables 3 and 4.

COMMENT

The tests were conducted in the same manner as those in Zones B and C and the results were interpreted on the same basis. The coccidioidin used was from the same lot. It was diluted immediately prior to making the tests. The results contrast sharply

TABLE 3.—Detail of Results of Secondary Tests (Zone A)
250 Indians Subjected to Test

Tribe	Number Tested	Positive Reactions		Negative Reactions	
		No.	%	No.	%
Lengua	240	5	2	235	2
Sanapana	10	0	0	10	100
Total.....	250	5	2	245	98

TABLE 4.—Degree of Reaction

Degree of Reaction	Number
++++	0
+++	0
++	2
+	3
Total.....	5

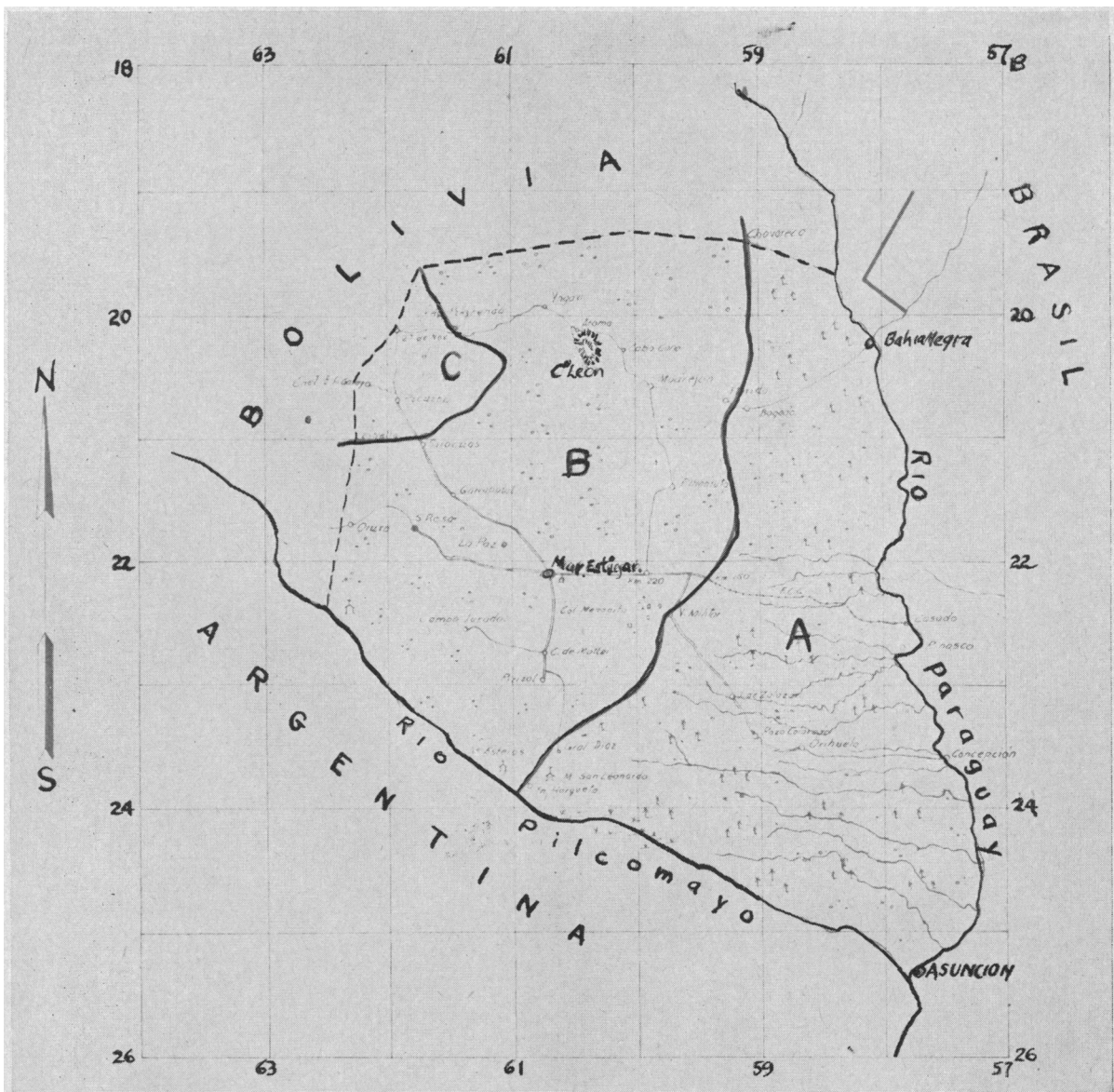


Figure 1

with those noted in the tests in Zones B and C, not only with regard to company employees but also to the Guazurangu Indians of the northwestern area. It is therefore evident that there is a well defined area (Zones B and C) where the index of coccidioidal infection is remarkably high, and it is interesting to note that the characteristics of the soil, climate and vegetation in Zones B and C are similar to those encountered in previously known endemic areas. Concomitantly, it is not surprising that Gines,³ who recently conducted a similar survey in Asuncion, noted virtually no positive reactions in that sector.

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REFERENCES

1. Baker, E. E., Mrak, E. M., and Smith, C. E.: The morphology, taxonomy and distribution of *Coccidioides immitis*, Rixford and Gilchrist, 1896, *Farlowia*, 1:199-244, July 1943.
2. Butt, E. M., and Hoffman, A. M.: Healed or arrested pulmonary coccidioidomycosis: Correlation of coccidioidin skin test with autopsy findings, *American Journal Pathology*, 21:485-505, May 1945.
3. Gines, A. R., Gould, E., and Talavera, M. S. M.: de Intradermorreaccion con coccidioidina (Contribucion al estudio de la coccidioidomycosis en el Paraguay). Not published.
4. Gomez, R. F.: Coccidioidomycosis primaria, A proposito de dos casos clinicos originados en el Chaco Paraguayo, Presented before the Paraguayan Society of Medicine and Surgery, Oct. 14, 1949. Not published.
5. Kunstaster, R. F., and Pendergrass, R. C.: Primary coccidioidomycosis. A possible pediatric problem, *J.A.M.A.*, 127:624, March 17, 1945.
6. Randolph, H., and McMartin, H. L.: Coccidioidomycosis in Phoenix, Ariz., *Diseases of the Chest*, 13:471-478, Sept.-Oct. 1947.
7. Smith, C. E.: Recent progress in pulmonary mycotic infections, *California Medicine*, 67:1-7, Sept. 1947.
8. Smith, C. E., Whiting, E. C., Baker, E. E., Rosenberger, H. G., Beard, R. R., and Saito, M. T.: The use of coccidioidin, *Am. Rev. of Tub.*, 57:330-360, April 1948.
9. Smith, C. E., Beard, R. R., Rosenberger, H. G., and Whiting, E. C.: Effect of season and dust control on coccidioidomycosis, *J.A.M.A.*, 132:833, Dec. 1946.
10. Smith, C. E., Saito, M. T., Beard, R. R., Rosenberger, H. G., and Whiting, E. C.: Histoplasmin sensitivity and coccidioidal infection, *Amer. Journ. Public Health*, 36:722-736, June 1949.