on Rivière Gauche, arrondissement of Jacmel, Republic of Haiti.

THE UPPER MIOCENE CAIMITO FORMATION

The lithological and faunal characters of the beds at Caimito, on Rio Cana, in the valley of Rio Yaque del Norte, Dominican Republic, were described by the writer[6] in 1917. The beds were found by the Maury Expedition, and the horizon was seen to be very intriguing, and an Upper Miocene age was suspected.

Later, from researches of the Vaughan Expedition, the Cerro de Sal formation, on the southern side of the Dominican Republic, in the Province of Barabona, near Las Salinas and Angostura, was described by Messrs. Condit and Ross[7] and referred to the Upper Miocene.

In 1929, I definitely referred the Caimito beds to the Upper Miocene,[8] and now propose for this horizon the name Caimito Formation.

CORRELATION OF UPPER MIOCENE ANTILLEAN HORIZONS

The following correlation of the Upper Miocene beds of the West Indies is now suggested. Those of Trinidad Island were discussed in detail by the writer in 1925.[9]

Upper Miocene: Younger or Caimitoan stage, Dominican Republic, north side, Caimito formation; south side, Cerro de Sal formation, apparently slightly younger than the Caimito. Trinidad, west central part of the island, Gomez Estate beds and Freeport to Todd's road outcrops. Tobago Island, Botanic Station beds. *Upper Miocene: Older or Springvalean stage,* Trinidad, Savanetta and Springvale beds near Couva, in the western part of the island; Pointe Noir beds on the eastern side of the island.

Climate of the Caimitoan Stage: Gypsum in the form of encrustations, plates and crystals is present in the Caimito formation. It is also abundant in the Cerro de Sal formation where it is followed by salt, which runs about 90 per cent. sodium chloride. This indicates aridity and excessive evaporation towards the close of the Upper Miocene. Conditions recall the gypsiferous strata of the Catahoula formation, regarded by the writer as equivalent to the Tampa formation of the Lower Miocene. The Cerro de Sal horizon is probably somewhat younger than the Caimito because the degree of evaporation exceeded that required for the precipitation of gypsum, and the beds of nearly pure salt were deposited.

Salt marsh and shallow lagoonary habitats are indicated for the faunas of the Caimitoan stage, concomitant with a rising coast-line and withdrawal of the sea off shore.

CARLOTTA J. MAURY

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REPORTS

INVESTIGATIONS IN PANAMA DURING THE SUMMER OF 1930[1]

INTRODUCTION

AT the suggestion and on the invitation of Dr. Herbert C. Clark, director of the Gorgas Memorial Laboratory, Panama City, the writer undertook the investigation which is presented in this report. Facilities were extended so that Dr. William H. Martinez, a Tulane Medical School graduate, accompanied the writer, and later Mr. Alberto Prieto, a Tulane Medical School student resident in Panama, was enlisted as a technical assistant. In addition, non-professional personnel were secured locally in Panama City. The entire facilities of the Gorgas Memorial Laboratory and the connections which it enjoys in the Republic of Panama and the Canal Zone were placed at the writer's disposal for the work in view.

OBJECTS OF THE STUDY

The investigations were undertaken with the following objects in view.

(1) To study representative samplings of the population of Panama, in order to determine by present refined methods of examination the incidence of *Endamoeba histolytica,* both in its active and carrier states, and to discover, if possible, the public health importance of this infection in Panama at the present time.

(2) To study concurrently the incidence and significance of the following infections: giardiiasis, ascariasis, hookworm infection, trichocephaliasis and strongyloidiasis.

(3) To obtain autopsy confirmation of as many of these cases as was possible.

(4) To treat selected cases of *Endamoeba histo-*

[6] C. J. Maury, *Bull. American Paleontology,* No. 30, pp. 25–26, 1917.

[7] "Geol. Reconnaissance Dominican Republic," pp. 214–215, 1921.

[8] SCIENCE, p. 609, December, 1929.

[9] *Bull. American Paleontology,* No. 42, 1925.

[1] Contribution from the Gorgas Memorial Laboratory, Panama, and from the Department of Tropical Medicine, Tulane University.

lytica with di-hydranol; to treat hookworm infection, where it seemed advisable, with tetrachlorethylene, and to treat cases of strongyloides infection with gentian violet.

(5) To determine whether *Endamoeba histolytica* is a natural infection in New World monkeys in the wild state or whether their infection, if present, is acquired from contamination with human habitations.

MATERIAL STUDIED

During the three months which were available for this investigation the following series of cases were examined.

(1) The Hospital Santo Tomas of the Republic of Panama: medical wards, 635; surgical wards, 166; maternity wards, 445; total, 1,246.

(2) Canal Zone Administrative Office employees and families (white population only), 143. Gorgas Hospital patients and staff (white population only), 153. (This group represents individuals enjoying the best sanitated condition of the Canal Zone).

(3) Four Chagres River villages, 542.

(4) Tiura River villages (Darien Province), 105.

These made a grand total of 2,089 cases. Of this number three or more fecal examinations were obtained on 1,340 individuals; two examinations on 326 individuals, and one examination only on 423. The total number of fecal examinations was in excess of 6,000, making an average examination quotient of approximately three per individual.

BRIEF RÉSUMÉ OF THE FINDINGS

(1) *Endamoeba histolytica.* (a) In the Santo Tomas Hospital, which represents the average cross section of the Panamanian population, the incidence of *Endamoeba histolytica* ranged from 12 to 18 per cent., the former being on medical wards and the latter on maternity services. (b) Canal Zone white administrative force employees, 2.81 per cent. (c) Gorgas Hospital patients and staff, 8.55 per cent. (d) Chagres River villages, 34 per cent. (e) Tiura River villages, 30 per cent. on one examination (children, 1 to 15 years, 38 per cent.; adults, 15 years or older, 18 per cent.). This last figure is based on one examination only, so that on a basis of three to six examinations the figure for children would range above 75 per cent. (f) Monkeys obtained in the wild state above the town of Boco de Cupe on the Tiura River, Darien Province, provided the following results: marmosets, negative for endamoebae; white-face monkeys, negative for endamoebae; black howling monkey, large numbers of active *E. histolytica, E. coli,* and *Endolimax nana.* In addition, autopsy examination of one red spider monkey, which had been in the animal house of the Gorgas Memorial Laboratory for several months, revealed a condition similar to that found in the black howling monkey. Likewise, a baby black howling monkey, which had been in the laboratory for less than one month, showed, on examination of passed feces, numerous cysts of *Endomaeba histolytica.*

Through the cordial cooperation of Dr. L. C. Prieto, of the maternity service of Santo Tomas Hospital, a considerable series of cases positive for *Endamoeba histolytica* received di-hydranol treatment. In every case the drug was effective in clearing up active or obscure symptoms involving the large bowel, and follow-up examinations showed that the dysentery amoebae had disappeared from the stools. A special paper will communicate these findings in detail.

Autopsies were obtained on five cases which had been previously diagnosed as harboring *Endamoeba histolytica.* Of this series two showed extensive deep chronic amoebic ulceration of the cecum, colon and rectum. The other three, which were carrier cases, showed no lesions which were detectable either by gross examination or by microscopic findings.

(2) *Giardia lamblia.* This infection ranged from 4½ to 9 per cent. in the Panamanian populations examined. It was more common in children than in adults.

(3) *Ascaris lumbricoides.* This worm was relatively common in the native populations, particularly in the country districts, but was fairly light as respects the number of worms in each case. As a filth infestation it was found to be more common in children than in adults.

(4) *Necator americanus.* This worm was also found to have a wide distribution but to be of relatively little clinical importance in the populations studied. It was not common among children under eleven years of age. Treatment with tetrachlorethylene on the maternity services of the Santo Tomas Hospital indicated the value of this drug in the treatment of such cases where toxic complications are to be avoided.

(5) *Trichocephalus trichiurus.* The infection with this worm ranged from seven tenths of one per cent. among the Canal Zone employees to 21 per cent. incidence in the Santo Tomas Hospital and river-town populations. Most of these cases consisted of light infestations only, but from 15 to 20 per cent. constituted conditions of clinical significance. One case in particular, which was observed in the maternity service of the Santo Tomas Hospital, called for special consideration. This woman was almost *in extremis* at the time when observation was first begun. Her stools were watery in consistency and teemed with Strongyloides larvae. Treatment with gentian violet *per os* was instituted and improvement noted

after ten days, with larvae reduced to a minimum. By the end of three weeks her condition was markedly improved and the stools were formed. In less than five weeks she had left the hospital, having gained several pounds and with evidence pointing toward complete recovery.

Thirty-two heavy strains of Strongyloides were cultured and examined daily over a period covering approximately two and a half months. Five of these were duplicate strains from the same individuals. Of the total number, twenty-three strains showed direct development only, four showed indirect development only and five consisted of combined types. Clinical importance is attached to those direct strains which metamorphose into the filariform larvae without a previous feeding period. Larvae of this filariform type are frequently passed in stools of individuals showing clinical symptoms. Evidence is accumulating to indicate that this is the type which is responsible for hyperinfection of individuals.

RARE PARASITES ENCOUNTERED

Balantidium coli. This ciliate protozoon was encountered in four cases during the investigations. These cases gave a history of probable contamination from porcine sources. Red spider monkeys in the animal house also had this same infestation.

Hepaticola hepatica. This infection is common in rats and mice in various parts of the world but there is only one human case on record, from autopsy of a British soldier in India. Nine cases of this rare human infestation were diagnosed from the Chagres River Basin.

Gongylonema pulchrum. One case of this rare human infestation was diagnosed on the basis of eggs from the Chagres River Basin.

EXAMINATION OF ANIMALS IN THE JUNGLE OF DARIEN PROVINCE

Altogether 45 animals were examined during the trip up the Tiura River in Darien Province. The majority of these were monkeys. Filarial infections were found in two types, the marmoset and the white faced monkeys. In the poncho (*Hydrochoerus hydrochoerus*) amphistomate flukes were obtained from the abdominal cavity. This is possibly the same fluke which was recovered by Dr. Clark from the wild hog in the Coto region of Panama in February, 1929. Other helminth and protozoa parasites were obtained from the agoutis, the ponchos and the monkeys.

CONCLUSIONS

The material obtained from these investigations has indicated to the writer that the area studied offers extremely valuable opportunities for helminthological and protozoological work. The data obtained will serve as the basis for several important papers which will be published in the near future.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ADJUSTABLE DROP-CONTROL FOR BURETTES

FOR some time past, the writer has been performing micro-titrations to determine free and total acidities on one half to one cc of gastric juice. To insure an accuracy of better than one per cent., the burette employed was graduated so that one could estimate volumes to 0.002 cc. Since end-points were determined by comparison with colorimetric standards of definite pH, it was necessary to use drops of this order of magnitude in approaching the end-point. In order to obtain such drops, the burette tip was replaced by a Leuer adapter and a hypodermic needle (chromium plated or non-rusting steel) of such size as to give a freely falling drop of no more than 0.01 cc. Then, by opening the stopcock very slightly a small fraction of a drop was released, which could be taken off quantitatively with a stirring rod. However, the time and energy consumed by this procedure were so great as to cause an appreciable reduction in the efficiency of the worker engaged in these titrations. Therefore, a mechanical drop-control became imperative.

Such a device has been described by Müller[1] for use in potentiometric titrations where drops of uniform size are required. On attempting to employ his contrivance, two difficulties were encountered. Occasionally, the stopcock opened accidentally, due to a falling of the heavier end of the drop-control handle attached to the stopcock plug. Also, since it was necessary to add fractions of a freely falling drop, it was important that the rate of drop formation be readily controllable—which was not true in this case. Consequently, the requisite changes in the principle of Müller's device were made, and as the resulting instrument has proved very satisfactory for more than a year, it is described herewith.

It consists of two parts as indicated in the figure. The stationary part (EGJH), which carries the stop

[1] Erich Müller, "Elektrometrische (Potentiometrische) Massanalyse," 4th ed., 1926, p. 67.