THE ROUTE FROM SUAKIN TO BERBER.

THIS route, estimated by General Gordon during his rapid passage over it in 1874 as about 288 miles in length, and found by Major Prout in his careful reconnoissance in 1875 to be about 255 to 260 miles, is one presenting great and peculiar difficulties to the march over it of a large body of troops; especially between the months of March and November, when the heat is excessive, and when those troops may be required to deal, during the march, with hostile forces.

Starting at sea-level at Suakin, it ends at an altitude of about 1,240 feet on the Nile, at Berber, after having attained at one point an altitude of nearly 3,000 feet.

In its entire length it is practically, *for a large force*, a barren, treeless, waterless desert, but quite different for a small detachment of a few hundred men with their necessary animals. For a large force (say, 5,000 to 10,000 men) the water used by men and horses must in some manner be transported with them or in advance of them.

The wells and water-holes on the whole line may be quickly named and described, as follows: at about 2 miles from Suakin are the wells which furnish water to the town; and here a good supply for a large force may be had. The next water is at El Hundouk, about 9 miles out. These wells furnish partly sweet and partly brackish water, sufficient for about 250 men and 500 animals. At about 17 miles out are the wells of O-Taon, with capacity for, say, 250 men and their horses. In the valley of Sinkat, at about 23 miles, 200 men with 500 animals can usually be supplied by shallow water-holes, which are called the wells of Hambouk; and it is probable, that, by using care, this result might be doubled. Sinkat, nearly 1,000 feet above sea-level, was, in former times of peace and good government, used as a summer residence by the richer merchants of Suakin.

At about 40 miles from Suakin, the wells of Kissibil can furnish good water for a small party, say, a general officer with his staff and escort; and thence on, no water is found until Wady Haratree is reached, at about 64 miles out. Here 600 men and as many animals can drink. Eleven miles farther on, an equally good supply is found at the wells of Salalaat.

The next supply worth mentioning is the well of Abd-el-Hab, where perhaps two battalions might be supplied. This excellent well is 97½ miles from Suakin. At El Ariab, about 118 miles from Suakin, there are three large wells, well constructed, and furnishing good water, in quantity large enough for two or three battalions, with a fair proportion of animals, — a strategic point which should be held by a permanent garrison if the road is to be used.

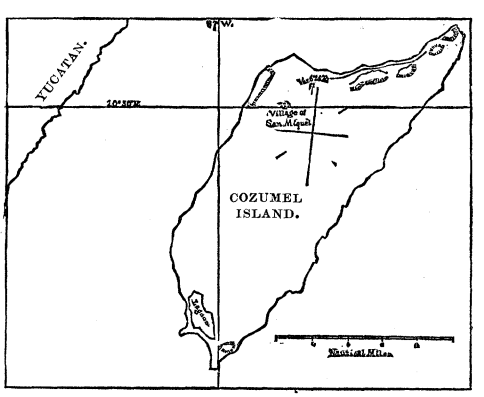
From El Ariab to O-Baek, a distance of nearly 60 miles, no water is found; and even at O-Baek the supply is very disappointing to thirsty marchers, since it is hardly sufficient for a battalion with its animals, and is often brackish. Thence on, the route is in blank desert until within six miles of Berber.

Thus it is seen that on the eastern half of the route there is scant supply of water for the advanced guard of a strong division, while on the western half there is practically no water until within six miles of Berber. Throughout the line, cannon and wagons can be drawn with little difficulty; but the eastern half passes frequently through narrow and tortuous defiles, which an active and intelligent enemy would render extremely dangerous to a marching force.

C. P. STONE.

THE ISLAND OF COZUMEL.

DURING the night of Jan. 22 last, the U.S. fish-commission steamer Albatross was anchored off the northern end of the island of Cozumel, on the east coast of Yucatan, and on the 23d steamed along the western side of the island to an anchorage off the village of



San Miguel, four miles from its north-west end. The naturalists went ashore next day in two divisions, — a shore party and a seining party, the latter aided by men from the ship. Both were remarkably successful, the birds collected

(the only material yet examined) comprising thirteen new species and two new sub-species.

On the 24th the photographer, Mr. N. B. Miller, was sent in the steam-launch to visit the plantation of Mr. J. B. Anduze, in the southern part of the island, some twelve miles away. Mr. Miller's report, which is forwarded with Capt. Tanner's (noticed in No. 113) describes the shores as generally low, with a notable exception occurring at the mouth of a creek, five miles from San Miguel, where the shores are bold enough to allow vessels of

INDIAN VILLAGE ON THE ISLAND OF COZUMEL.

eighty tons to lie alongside to load. His party was landed through the surf on the backs of Indians, and rode to Mr. Anduze's plantation upon ponies, through a dense forest closed in by interlacing vines so as to shut out the sun, and agreeably remarkable for the absence of buzzing insects. The plantation was about a mile and a half square, enclosed by a high stone wall. It abounded in bananas, plantains, pine-apples, corn, ginger, oranges, and lemons, but seemed to be carelessly or inefficiently cultivated. The main house was stone, with a thatched roof, surrounded by five large sheds arranged in a square.

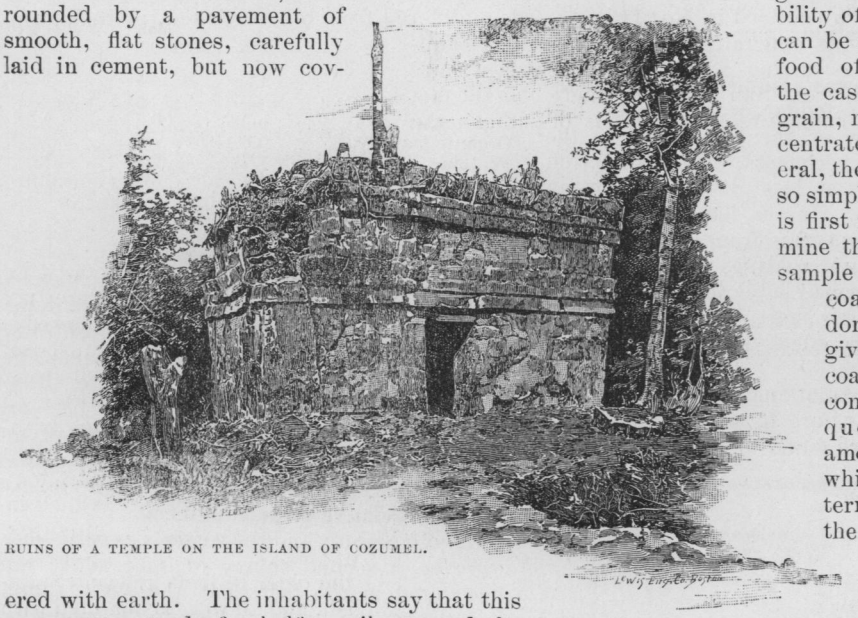
Near by was a small Indian village of some fifty huts, but only thirty families. The huts were of the ordinary single-room type, with hammocks triced up against the roof in the daytime; the floor of cement, raised about a foot from the ground, and kept scrupulously clean. The natives were bright mulatto in complexion, with long, straight, coarse black hair; neater and more intelligent than those of the village of San Miguel. The men were short, not over five feet four inches in height, and wore scanty black beards: the women were neatly dressed in loose white gowns. This village differed from others visited, in its unusual cleanliness, and in the fact that the cattle were not allowed to run loose, but were penned up within high stone-walled enclosures. Some of the older Indians knew no Spanish, and all were acquainted with the native dialect.

The small Roman-Catholic church of the village had fallen into ruin because of a curious circumstance. Some remarkable spiritualistic manifestations had taken place there several years ago, and as a consequence the whole village had become a community of spiritualists. It would be interesting to know whether this remarkable conversion was the result of missionary effort, if there be any such among spiritualists, or arose from indigenous 'manifestations.'

On the edge of the village are the ruins of a large structure, supposed to have been a temple, which both Indians and whites declare to date beyond the Spanish conquest. Nothing definite could be learned, beyond the legend that Cortes had landed there and destroyed the building before going to the mainland. The ruins could be traced over about half an acre, now covered by large trees. Only a central tower, or part of it, is now standing. Into this there is but one entrance, opening into a narrow, vaulted room. Markings were noticed on the plaster covering the walls, and stone hooks cemented to the same. Within a radius of half a mile are the ruins of many stone arches,

as to which the Indians declare that the island was once the cemetery for the neighboring mainland, and therefore will not allow the mounds to be explored.

Subsequently, near the village of San Miguel, Mr. Miller examined and photographed the ruins of an old church, surrounded by a pavement of smooth, flat stones, carefully laid in cement, but now cov-



RUINS OF A TEMPLE ON THE ISLAND OF COZUMEL.

ered with earth. The inhabitants say that this pavement extends for half a mile around the church, and that a broad, paved way once led from the church to the water, a mile away.

ERRORS IN DIGESTION EXPERIMENTS.

Henneberg and Stohmann, in their *Beiträge zur rationellen fütterung der wiederkäuer*, published in 1860, reported practically the first determinations of the digestibility of the proximate constituents of cattle-foods. Since that time, a large number of similar determinations upon various fodders, and with the several species of domestic animals, have been made, chiefly, if not entirely, by the German experiment-stations. In these determinations the method employed by Henneberg and Stohmann, and which is here given in outline, has been universally followed.

The food of the animal is weighed, suitable account being taken of any portion left uneaten, and a sample of the food is subjected to chemical analysis. The solid excrement of the animal, which consists for the most part of the undigested portions of the food, is also carefully collected, weighed, and analyzed. From these data, it is a simple matter to compute how much dry matter or how much of any particular ingredient of the food the animal received, and what part of this failed to be digested.

This method of experiment evidently will give directly the digestibility of any fodder which can be made the exclusive food of the animal. In the case of material like grain, meal, and the concentrated fodders in general, the matter is not quite so simple. In this case it is first necessary to determine the digestibility of a sample of hay, or other coarse fodder. This done, the animal is given a mixture of this coarse fodder and the concentrated fodder in question, and the amount of this mixture which is digested is determined. Then, on the assumption that the same proportion of the coarse fodder was digested in the second trial as in the first, we calculate how much of the concentrated fodder must have been digested in order to yield the results observed upon the mixture.

Certain sources of error have been ignored in the general statement given above. Thus the excretion is always more or less irregular from day to day; and the excreted matter contains, in addition to undigested food, more or less intestinal mucus, and remnants of digestive juices, which, though small in amount relatively, are not entirely to be neglected. Then it has recently been shown that some portions of the food fail to appear in the excreta, because they suffer a fermentation in the alimentary canal, rather than because they are digested in any proper sense. This is particularly the case with cellulose (see *Science*, No. 100, p. 11). Finally, the methods of analysis in use for fodder and excrement are not in all respects capable of giving sharply defined results.

Another class of errors, the small unavoidable errors of weighing and chemical analysis, usually less considered, may grow to very considerable dimensions when multiplied many