GEOLOGY OF BRITISH HONDURAS

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ABSTRACT

British Honduras consists of a central peneplain of folded Upper Carboniferous marine beds, with granitic intrusions, surrounded by unfolded limestone of about Oligocene age. Deposits between these two periods are unknown. The main movements are associated with Permo-Carboniferous and Miocene diastrophism. The trends of the Paleozoic rocks conform to those of Honduras and Guatemala. Youthful NE.–SW. features parallel to western Cuban trends are common. Large faults descending into 2,000-fathom water outline the east coast.

British Honduras (area, 8,210 square miles) is the only British possession on the mainland of Central America, and until recently was perhaps even less known than the adjoining republics. The geological survey was commenced in 1921, but as minerals in workable quantities were not located, it was abandoned at the end of 1926. The only previous geological investigations of the colony were G. H. Wilson's[1] geological traverses of rivers in 1886, and Dr. Carl Sapper's[2] traverses in the dry seasons of 1891, 1894, and 1896.

For the present purpose the Caribbean region may be defined as the area bounded on the northwest by the Isthmus of Tehuantepec, on the northeast by the Bahama Banks, and on the south by the Orinoco River.

The European idea of the Antillian Continent is that advanced by Suess.[3] The clearest statement of the case, however, is that by Dr. J. D. Falconer[4] in the *Scottish Geographical Magazine* (1902). Briefly, Suess's idea was that the Andes, on reaching Columbia, turn eastward along the north coast of South America through

[1] G. H. Wilson, "Notes on River Surveys, 1886," *Local Publication, British Honduras*.

[2] C. Sapper, "Über Gebirgsbau und Boden des nördlichen Mittelamerika," *Petermanns Mitt.*, Ergänz. 127 (1899); "Südlichen Mittelamerika," *ibid.*, 32 (1905); "Geology of Chiapas, Tabasco and Yucatan," *Jour. of Geol.*, Vol. IV (1896), p. 938.

[3] E. Suess, *The Face of the Earth*, English translation by H. B. C. Sollas, 1909.

[4] G. D. Falconer, "Evolution of the Antilles," *Scottish Geog. Mag.*, Vol. XVIII (1902) p. 37.

Trinidad, then turn sharply northward through some of the Leeward Islands, then sharply again westward through Jamaica and Honduras, and thence northward up the Pacific Coast. Suess originally divided the Antilles into an Inner zone (most of the Lesser Antilles), an Intermediate Zone (Caribbean Andes and Greater Antilles), and an Outer Zone (Florida and the Banks). He afterward considerably modified this idea. Exponents of this Antillean Continent theory omit to state clearly when it was formed and when it commenced to break up.

The Americans put forward quite different ideas. Bailey Willis,[1] in his paleographic maps of North America assumes that there have been Gulf of Mexico and Caribbean "deeps" ever since early Paleozoic times. Schuchert[2] suggests the existence, during Permian to Jurassic times, of the land mass of "Columbia," embracing the Greater Antilles, Guatemala, and Honduras, with an extension into the Pacific. T. W. Vaughan[3] has divided the region between the two Americas into twelve zones, but does not suggest that they all formed a continental mass. The author's own ideas of the problem favor the American views.

In the Caribbean region rocks definitely older than Carboniferous are unknown. Sapper's[4] maps show "Archean schists"; Sidney Powers[5] and myself agree that the granitic intrusions and the great earth movements at the end of the Carboniferous period could account for the metamorphism. The Lower Mesozoic is represented only by patches of limestone in western Cuba and fresh-water deposits in Honduras and Mexico. The Cretaceous is very widely distributed and exists throughout almost the whole of the Carribbean region, though often masked.

[1] B. Willis, "Index to Stratigraphy of North America," *U.S. Geol. Survey Prof. Paper 71* (1912).

[2] C. Schuchert, "North American Geosynclines" (presidential address), *Bull. Geol. Soc. Amer.*, Vol. 24 (1923), p. 158.

[3] T. W. Vaughan, "Geologic History of Central America and West Indies," *Bull. Geol. Soc. America*, Vol. XXIX (1918), p. 615.

[4] C. Sapper, "Über Gebirgsbau und Boden des nördlichen Mittelamerika," *Petermanns Mitt.*, Ergänz. 127 (1899); "Südlichen Mittelamerika," *ibid.*, 32 (1905); "Geology of Chiapas, Tabasco and Yucatan," *Jour. of Geol.*, Vol. IV (1896), p. 938.

[5] S. Powers, "Notes on the Geology of Eastern Guatemala," *Jour. of Geol.*, Vol. XXVI (1918), p. 507.

The diastrophism at the close of the Cretaceous appears to have been pronounced, except in Central America. Vaughan claims extensive submergence of Central America and West Indies in later Eocene and Oligocene times, with maximum submergence in mid-Oligocene. The Miocene was a period of great earth movements, and these are apparently still active. British Honduras is now outside the severe earthquake zone. The mountainous portion of British Honduras appears to have risen as a block and shows no folding since the intrusion of the granites. It has not been involved in the building of the present Central American mountain system, being situated on the lower side of its main arc. Very briefly, British Honduras may be described as a central peneplain of Upper Carboniferous rocks surrounded by Tertiary limestones.

TOPOGRAPHY

The portion of the Colony north of Lat. 17° 10′ is a limestone region of low relief. It contains the main watercourses, but at present is of little geological interest. The Belize and Sibun rivers collect the drainage from the Maya Mountains. The New River and Rio Hondo are base-level streams rising in the limestone lagoons.

The mountain area, known as the Maya Mountains, is a well-vegetated peneplain of about 3,000 feet altitude. The divide between the eastward and westward drainage is about 25 miles from the coast and about 16 miles beyond the western edge of the coastal plain.

The general east and west strike of the Paleozoic rocks has determined the easterly and westerly flowing streams. Although those trending eastward are little better than mountain torrents, they have not captured any important westerly drainage. All the colony's drainage enters the Caribbean except perhaps some small streams in the southwest corner of the Maya Mountains that disappear into limestones and perhaps form portions of the headwaters of the Rio Usumacinta.

The southern end of the colony contains badly fractured, thin-bedded mudstones and hills of massive limestone. The Sarstoon River forms the south boundary of the colony, and beyond it rise the limestone ranges of Santa Cruz.

The western boundary of British Honduras runs approximately north and south along Long. 89° 10′ W., but the southern or moun-

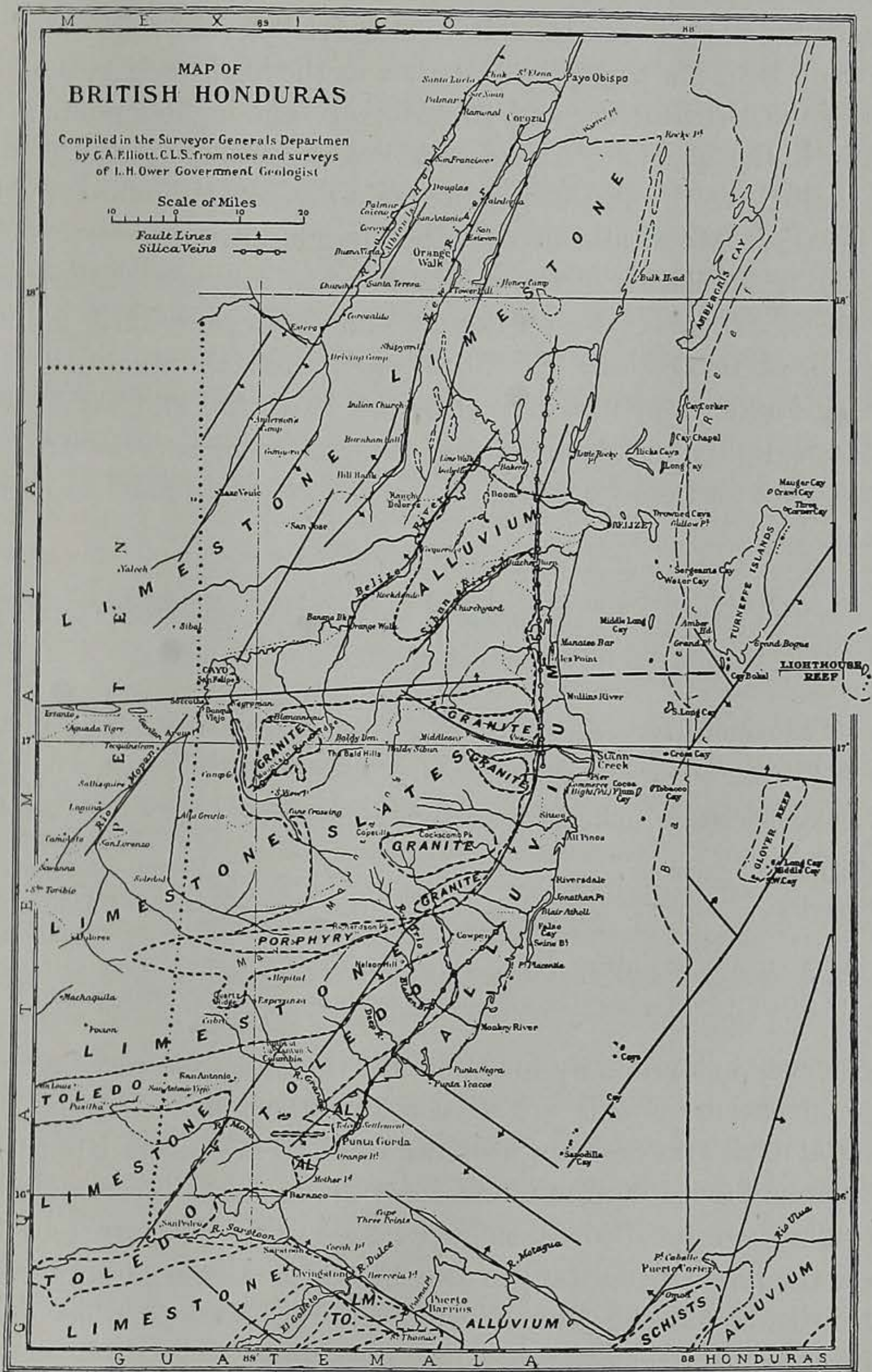

FIG. 1

tainous portion is still unopened. There is a coastal plain in few places exceeding 8 miles in width between the mountains and the sea. The levels of the Stann Creek railway indicate that the inland edge of the plain is 100 feet above sea-level. A trial railway survey run from Belize to Cayo gives 200 feet as the bank level at the junction of the Belize River and Rio Mopan. The highest point in the colony is the quartzite Cockscomb Peak, 3,800 feet, standing isolated a little to the seaward of the main divide. A number of ridges of the Maya Mountains exceed 3,000 feet in altitude.

The triangulation of the colony has just commenced, but when the geological survey began there was no map sufficiently accurate even for sketch geology. The local topographical draughtsman has compiled an entirely new map of British Honduras and has included the topography obtained during the geological survey. This has enabled contours to be sketched and a geological model to be constructed.

GEOLOGY

For the purpose of the present survey the geological formations of British Honduras have been classified as follows:

	Square Miles	
Coastal alluvium	1,100	Post Pliocene
Toledo beds	650	Miocene
Rio Dulce limestones and chalky marls	5,070	Oligocene / Miocene
Acid igneous intrusions	370	Permo-Carboniferous
Slate series	1,020	Upper Carboniferous
Total area of mainland	8,210*	

* Of this, 36 per cent is below the 500-ft. contour and 57 per cent above 1,000 ft. in altitude.

The survey being mainly for minerals, the Paleozoic rocks received most attention. Fossils are very scarce. The blue crinoidal limestone at Rio Trio and south of the Bald Hills contain Upper Carboniferous fossils. Foraminifera from the massive limestone of low altitudes were in 1896 considered Eocene (?). Vaughan now considers the fossils from the Rio Dulce gorge as Lower Miocene.[1] The Toledo beds and the New River chalky marls have in several localities yielded Miocene fossils.

[1] J. W. Vaughan, "Anguilla Formation," *Bull. Geol. Soc. America*, Vol. XXXV (1924), p. 733.

DEPOSITS STILL FORMING

The development of extensive coral reefs off British Honduras is due to the presence of platforms favorable for coral growth, facing currents bringing a good food supply. There is a barrier reef and three outlying banks. Fringing reefs are absent, and there are no traces of reefs inland. Vaughan estimates the growth of Atlantic coral to be from one foot in 14 years to one foot in 50 years. He states that he is unaware of Miocene or Pliocene coral reefs in the Antilles, and considers that coral reefs have played an insignificant part in building up the islands and banks of that region. Agassiz makes a somewhat similar statement and adds that the Campeche Bank coral is underlain by marine limestone, while along the Honduras-Mosquito coast and north of South America, corals appear upon extensive banks or shoals of proper depth. The opinions of these authorities coincide with the author's observations.

THE BARRIER REEF

The edge of this reef runs parallel with the shore line at a distance of from 15 to 22 miles. There are few channels through it that are navigable, the principal deep one being at English Cay, 15 miles southeast of Belize, where there are depths up to 150 feet. The sides are evidently limestone, as attempts to drive piles for lighting buoys had to be abandoned. Between the southern end of the barrier reef (Sapodilla Cays) and Guatemala there is a stretch of deep water giving access to Belize. Soft limestone and coral can be seen on the bottom in the water north of Belize, as the area between the reef and the shore is very shallow. On the seaward side there is a steep drop off the reef into deep water, 600 feet being recorded off English Cay and 1,200 feet of Sapodilla Cays. Numerous small cays and sand banks are exposed along the course of the reef. The water inside the barrier reef deepens gradually southward and there are many small cays, banks, and submerged pinnacles. Shells contribute largely to their formation, but on the outer cays coral predominates.

The rock 20 feet below Belize on which the pile foundations of the post-office, bridge, and customs wharf rest, may be a silt-covered coral reef.

DEEP SEA REEFS

The dimensions of the British Honduras deep-sea reefs are:

	Square Miles
Glovers Reef (22×6 miles)	130
Lighthouse Reef (30×6 miles)	180
Turneffe Reef (37×13 miles)	480

Off these reefs there is a sharp drop into over 1,000 feet of water. They lie with their long axis representing the continuation of the trend lines of a large portion of the barrier reef, which itself runs parallel with both the shore and the edge of the hills.

The reefs are mainly just below sea-level, but there are patches of dry sand formed by storm beaches. At Turneffe these sandbanks are numerous and are fringed with mangrove. In 1920 an oil seepage was reported from Long Cay on Lighthouse Reef, but it has not reappeared since.

ALLUVIAL DEPOSITS

These consist almost entirely of the deposits of the old coastal plain, ferruginous sandy clay predominating. Alluvial deposits are best developed between Deep River and Belize, but no idea can be formed as to their thickness or the nature of the underlying rocks. North of the Belize River the drainage is all from limestone, so little alluvium is deposited. In the hilly area the valleys are too steep and narrow to retain much detritus, but in a few localities when crossing granite they open out into fertile basins. From Punta Gorda to Swasey Stream there is a line of young siliceous veins and mounds having the usual 215° trend.

FLINTS

About nine miles inland from the mouth of the Sibun River flints appear on the alluvium and run northward. From Baker's Pine Ridge to Northern River, flints up to 2 feet in diameter are numerous. Beyond this, in the northeast corner of the colony, flints are frequent and quartzose veins traverse the limestone. The whole of the sand of the pine belts appear to have originated from siliceous springs, those that were submarine apparently also provided silica for the flints. Sapper reports that flints extend into Yucatan to the west of Rio Hindo. Round the township of Cayo flints are numerous in a chalky marl which overlies the limestone at an altitude of about 600 feet. On the edge of the Little Mountain Pine Ridge, a few miles to the southeast, are young deposits of quartz grit. The siliceous springs that produced this grit may have also provided silica for these Cayo flints and sand for the Mountain Pine Ridge. In only two places were flints noticed in the solid limestone, and both are near quartz veins that may be contemporaneous with the limestone.

From Monkey River to Sarstoon River there are a number of warm springs, but only at the north end in Sennis Creek is siliceous material still being deposited.

CHALKY MARLS

These are confined to the north of Lat. 17°, and are best developed at Cayo, where NE.–SW. faulting has elevated them 600 feet above sea-level. Orange Walk and Corozal townships on the New River are also built on this marl, which has not yet been observed interbedded with the limestone.

THE TOLEDO SERIES (MIOCENE)

Between the Maya Mountains of British Honduras and the mountains of Guatemala are a series of thin-bedded strata to which the name Toledo beds has been applied, as in British Honduras they are confined to that district. Their weathering, with the heavy rainfall, produces the most fertile soil in the colony. Interbedded with these thin-bedded shales and mudstones are laminated limestones and blue calcareous Miocene sandstones. Diatomite occurs in Golden Stream and Temash River. Generally speaking, the farther from the sea, the fewer the calcareous bands, the less disturbed the strata, and the more unconsolidated the formation. The Toledo beds probably rest conformably on the Rio Dulce Limestone, but no section has yet been seen showing them actually in contact with undoubtedly older rocks. Near the coast the beds are badly crushed and the folding is very irregular.

Exposures of Toledo beds are numerous beneath the alluvium in both Golden Stream and Deep River, where they are either level-bedded or have a small southerly dip. In both streams they cease suddenly against the massive limestone where warm water flows in from small tributaries. In Golden Stream the last exposure seen is level-bedded, but in Deep River the maximum dip, viz., 20°, with strike at 160°, is recorded close to the limestone. In the lower reaches of all the southerly streams no rock is exposed. On Monkey River no rock is seen below the junction of Bladen and Swasey branches, but Toledo beds appear at intervals up to Trio Junction. Up Rio Trio no rock is seen until close to the hills, when a small outcrop of Toledo occurs, followed by a thin strip of massive limestone lying against the slates and porphyries. A small outcrop some miles below Cowpen forms the northern limit of exposed Toledo. Alluvium extends from here to the slate at the first fall of Swasey Stream.

To the south the Toledo beds are downfaulted against the Lower Miocene limestone hills of Santa Cruz, Guatemala, and to the east they disappear beneath the sea. To the northwest the limestone rises beyond them, but the Toledo beds enter Guatemala and may even extend to the southwest corner of Peten.

At a couple of miles south of Pocton, where the pine belt ends, there are beds of sand amongst the limestone. At Santa Toriba, farther north along the main trail to Peten, mudstone and pink and green sandstone are interbedded with the limestone. The dips measured averaged 20°, with the 220° strike so frequent amongst the newer formations.

RIO DULCE LIMESTONE

There is no limestone definitely older than that of the Rio Dulce gorge at Livingstone from which this formation derives its name. Fossils collected by Sidney Powers in 1917 from the walls of this gorge were mainly corals and oysters which T. W. Vaughan refers to the Emperado limestone of the Panama Canal Zone. Spines and fragments of echinoids on weathered rock surfaces from Fuerto San Filipe (Lake Isobal) are classed as Lower Miocene.

With the exception of the Paleozoic rocks of British Honduras, the whole of the peninsula of Yucatan contains Tertiary limestone. Sapper states that the greater part of northern Chiapas is Cretaceous limestone and dolomite, but as he maps the formations of the Rio Dulce gorge as possibly of that age, much of his Cretaceous limestone may be younger, expecially as he admits that nearly all his fossils were derived from the southern part of the Cretaceous belt. Sapper also states that in Chiapas and southern Tabasco limestone is an unimportant member. The eastern extension of these Chiapas Tertiaries is represented in British Honduras almost entirely by limestone. This British Honduras limestone is mainly foraminiferal and weathers easily. It is white to cream in color, frequently recrystallized, and dissolves almost entirely in dilute hydrochloric acid. In no place does it attain an altitude of over 2,500 feet.

The massive limestone in the mountains is in most places horizontal and rests directly on the granite and the upturned edges of the Upper Carboniferous. At Cane Crossing, where the Belize River commences to fork, the limestone is 1,000 feet thick. As it is absent to the north, thin to the south, and does not extend far to the east, it is evident that the floor on which it accumulated was uneven.

The relation of the Rio Dulce limestone to the Toledo beds is obscure, the best evidence being at the Rio Jolocte on the frontier, where the Toledo beds are seen dipping away from the uplifted limestone. At Cattle Landing, Punta Gorda, the Toledo shales overlie a massive limestone which is mapped Rio Dulce, like the prominent conical hills rising out of the adjacent coastal plain.

THE INTRUSIVE ROCKS

There are six main outcrops of acid igneous rocks:

		Square Miles
Granite (290 sq. mils)	Mountain Pine Ridge	80
	Middlesex	56
	Silk Grass Creek	27
	Waha Leaf Creek	27
	Cockscomb	100 (approx.)
Porphyry	Rio Bladen	80

The boundary of the Cockscomb granitic area was not located during the survey, and there is evidently some granite to the east of the Bald Hills, for the Sibun River gravels below these contain granitic material. All the igneous rocks appear to be from the same granodiorite magma. Some are interbedded, but the majority were intruded into the Upper Carboniferous sedimentary beds soon after their deposition.

As a small quantity of tin was located, the Middlesex area was mapped in some detail and petrological examinations were made by Dr. A. Brammall at the Royal School of Mines, London. This area being at the junction of two main faults, it is not surprising to find the igneous rock much crushed. Specimens from Macaroni Hill above the Stann Creek limestone quarry are described as remarkably crushed and mylonitized biotite granite. The highest degree of metamorphism noted is where Mullins River enters the coastal plain. At the western end of the intrusion and close to the main east-west fault are aplites, pegmatites, and altered hornblende gneisses.

Washings from the creeks draining this area were separated by bromoform and yielded anatase, andalusite, brookite, chiastolite, epidote, garnet, ilmenite, kyanite, magnetite, molybdenite, monazite, rutile, sphene, staurolite, tourmaline, and zircon.

From the western end of the Mountain Pine Ridge, aplites and altered igneous gneisses are mentioned. A specimen from Silk Grass Creek was defined as a biotite granite. No petrological examination has been made of granitic areas drained by Swasey Stream.

Immediately south of the Swasey the igneous rocks change entirely, the granite ends, and the quartz-feldspar porphyry area begins. The only porphyry dyke noticed to the north is at the extreme northwest corner of the Mountain Pine Ridge. The ridge between Swasey and Rio Trio has not been traversed, so it is uncertain what relation the porphyry of Rio Trio has to the Cockscomb granite. Petrological examination of a specimen from Rio Trio is described as quartz porphyry or altered rhyolite, while the rock of Swasey Stopper itself may be a crushed andesite or diorite. A large mass of quartz-feldspar porphyry is exposed on Rio Bladen and extends westward through some of the highest parts of the Maya Mountains. Sapper is probably correct in mapping it as extending almost to Dolores. Porphyry is also seen at the head of Austral Creek and in several gullies off the Quartz Ridge. This "porphyry" embraces intrusions, dikes, sills, flows, and probably ash beds. The country being rough and uninhabited and carriers difficult to obtain, no detailed mapping has been attempted.

UPPER CARBONIEROUS STRATIFIED ROCKS

These rocks are exposed over an area of about 1,020 square miles and consist mainly of schists and slates. Sandstones are few and there is a thin bed of blue limestone. The whole of the series is much crushed, but metamorphism is only severe near the contact with intruded rocks. The region of greatest metamorphism is near Mullin's River, where chiastolite slates and andalusite schists are recorded. As a contrast, the dark-blue slates near the sources of the Rios Chiqubal and Trio are within a few degrees of horizontal.

The usual slate dip is about 65°, the direction being determined by its position in relation to the intruded igneous rocks. The prevailing strike is 250°. These rocks are confined to the mountain area, and their succession has not been worked out, but the thickness must run into some thousands of feet. The eastern extension of the slates and porphyry of the Quartz Ridge is seen at Long. 88° 50′, and there is a small outcrop of slate on the edge of the coastal plain.

The blue crinoidal limestone has yielded the only fossil evidence, and forms a good horizon, but unfortunately has only been noticed at the Rio Trio and a point 4 miles south of the Bald Hills. Sapper, in his traverse from Cayo to the Cockscomb, mentions conglomerate and blue limestone only once each; but while descending to Deep River, conglomerate is mentioned several times. Where weathered it is difficult to distinguish from a shattered quartzite.

The Manatee-Cayo scarp marks the northern limit of exposed Paleozoic rocks in Central America.

MEXICO AND GUATEMALA

As the republics of Mexico and Guatemala adjoin British Honduras, brief mention of the formations across the borders is desirable. The limestone of northern British Honduras extends throughout Yucatan, but otherwise Mexico gives little assistance in elucidating the geology.

A geological map of Guatemala, including British Honduras, was published by Carl Sapper in 1899 and contains much useful information. His oldest rocks are the "Ancient Schists," but Sidney

Powers[1] and the author think that some represent only the Upper Carboniferous series metamorphosed by the granitic intrusions. The beds strike east and west, and associated with them, though marked younger by Sapper, are the great serpentine belts of the Caribbean streams. Serpentine was not seen in British Honduras.

The Bay Islands off the Honduras coast are mainly schist and represent the extension of the Sierra de Meredon. Utilla is the most westerly, and pre-Tertiary rocks are absent, the highest point,

FIG. 2.—Geological model of the Caribbean: (1) Paleozoic and intrusions; (2) Mesozoic (mainly Cretaceous); (3) Lower Tertiary; (4) Upper Tertiary; (5) Volcanic; (6) Submarine. Photo by Sweeting.

Pumpkin Hill (300 feet), being basaltic tuff containing fragments of coral reef. Nearby is Stuart Hill (170 feet), of olivine basalt capped by small coral reefs. Powers thinks that it was an active cone in quite recent times.

The Pacific slope of Central America is composed of the same volcanic ejecta that mask the high plateau, with volcanoes reaching up to 13,000 feet in altitude. Yucatan appears to have been free from vulcanism since Paleozoic times.

TECTONICS

British Honduras is the most northerly exposed portion of the Honduranian geosyncline. As the folds lie parallel to those of Gua-

[1] S. Power, "Notes on the Geology of Eastern Guatemala," *Jour. of Geol.*, Vol. XXVI (1918), p. 507.

temala and Honduras, they are considered to have been produced by the same series of movements at the close of the Paleozoic. Igneous intrusions follow the crests of these east-west folds and are more numerous on the faulted Caribbean side. The granite of the Mountain Pine Ridge has, in addition, NE.–SW. trends. About Lat. 16° 40′, Long. 88° 50′, the slates lie almost horizontal, so it is possible that Upper Paleozoic rocks underlying the limestone of Peten are little disturbed. It is suggested that the Maya Mountains formed a geanticline, the adjoining synclines to the north and south being now filled with limestone. This could explain the scarp along the edge of the slates at Lat. 17° 5′, but from features in Peten and soundings northeast of Glovers Reef, an east-west fault is assumed. There may have been a syncline between the Maya Moun-

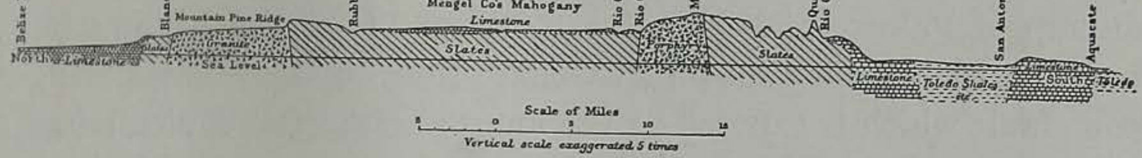

FIG. 3.—Section across British Honduras. Cayo–Punta Gorda

tains and those of Guatemala, but it is agreed that faults now mark the Miocene uplift to the south of the Rio Usumacinta.

Only Upper Carboniferous and Lower Miocene fossils have been identified from British Honduras; but as the latter are from low altitudes, the mountain limestone can be treated as Oligocene. Even if the sandstones interbedded with this limestone in southeast Peten are of hydrothermal origin, the associated mudstones indicate that the Maya Mountains were land surfaces at that period and that the drainage was westward. Serpentine grains in the Toledo series mean a Guatemala origin and a northeast drainage for that district. The denudation necessary to expose the granite now overlain by the Oligocene limestone could have taken place in Eocene times, but some Lower Mesozoic denudation is likely. The 3,000-feet Maya Mountain peneplain shows that the Paleozoic rocks were planed off to sea-level before the commencement of the Miocene uplift. On the southwest the slates of the Quartz Ridge rise rapidly 500 feet out of a 2,500-feet limestone plateau, but on the northeast metamorphic rocks rise out of dissected limestone of about 500 feet elevation.

On the frontier the limestone descends gradually in a northwest direction from the Maya Mountains to the source of the Rio Hondo, and is crossed by the prevailing NE.–SW. faults. In the vicinity of one of these faults, at the mouth of the Cayo gorge, is the only record of folded limestone. On the southeast corner of the Maya Mountains the limestone decreases in altitude until, at Swasey, it consists only of a few acres capping a granitic hill. The junction here follows the general strike of the slates. South of the Quartz Ridge there is a rapid fall, beyond which the limestone appears to merge into the thin-bedded Toledo series. The junction of the Toledo beds and the limestone to the south of San Antonio follows an east-west fault. Farther south the junction of the limestone with the coastal plain is a fault with the usual 210° trend. The limestone hills of the Toledo district coastal plain also trend in this direction. At the mouth of the Rio Sarstoon there is a small outcrop of Paleozoic(?) rock due to the uplift of the Livingstone limestone block which cut off El Golfeto from the sea. This Livingstone fault which is exposed at the mouth of the Rio Dulce gorge, trends 300°, or at right angles to the main fault system. The most important fault off the British Honduras coast lies to the east of Lighthouse Reef. Southward this can be traced to the Rio Ulua, and northward almost to the Yucatan Channel.

The Barrier Reef is diverted from the general northeasterly trend by right-angle bends toward the shore. Cross-faults are suggested; but owing to the lack of soundings, data are available only at the southwest corner of Turneffe. Soundings of 1,146 and 1,641 fathoms to the northeast of Glovers Reef, and 1,677 and 1,922 off the southeast corner of Lighthouse Reef, give a dislocation with a downthrow to the north. This may run westward into the Stann Creek Valley or die out to the south of Turneffe. Between Stann Creek and Belize the 210° trend lines become north-south features. With the exception of the Livingstone and the Rio Ulua faults, all features in Southeast Guatemala have the 250° Honduranian trend. As the coral does not rise above sea-level, the Barrier and outlying reefs belong to an area of subsidence. The coral probable rests on Tertiary limestone.

The long line of quartz and quartzite veins that traverse the alluvium, almost parallel with the coast, belong to the main fault system. Grits on the Mountain Pine Ridge that overlie the limestone at 1,400 feet elevation, and even cap the 3,000 feet Bald Hills are evidently derived from siliceous springs discharging on the high side of the faults. The thick quartz veins that form a prominent NE.–SW. feature in the Mountain Pine Ridge are of no great antiquity. Sand is contemporaneous with the limestone at the Pocton Pine Ridge, which is the southwest extension of this line, but it is equally probable that this silica may be connected with the east-west vein that forms the crest of the Quartz Ridge. Silicification even amongst the Paleozoic rocks appears to be of Tertiary age.