Igneous rocks

Tamán Formation.

Well-bedded, black, fine-grained and microcrystalline limestones, alternating with black shales and forming an anticlinorium in the centre of which is the village of Tamán. For nearly 10 km the river flows through this series of over 1000 m thickness. The fossils were determined by the late Dr. C. BURCKHARDT as Upper Kimeridgian: *Haploceras fialar* (OPP.), *H. transatlanticum* BURCKH., *Perisphinctes cyclodorsatus* MOESCH in FONTANNES, *Aspidoceras* of the *longispinum*-group, *A.* cf. *polysacrum* FONT., *A. eligmoptychum* FONT., and abundant *Aulacomyella lata* sp. nov. and *A. heimi* BURCKH.

Pimienta Series.

The Tamán Beds seem to pass upwards into a series of black or black and white, thin-bedded, dense limestones with many layers of black chert, 100—200 m. thick. The age is supposed to be Portlandian.

Tenestipa Limestone.

White, dense, massive limestone with chert, about 100—200 m thick, at the village of Tenestipa, and several hundred metres thick at Pimienta, on the opposite side of the great anticline. The relation of this limestone, which may be Cretaceous, to the overlying Upper Cretaceous of the Xilitla region could not be studied. Possibly, the Tenestipa Limestone is a facies of Tamabra.

III. Igneous Rocks.

Igneous extrusions and intrusions took place in Eastern Mexico at various dates (see MUIR 1936, W. STAUB 1922, 1937, 1939). The following types were found in the region mapped, or its immediate surroundings:

1. Granite and basic intrusions, more or less metamorphosed, in Novillo and Peregrina Canyons: Pre-Mississipian.
2. Gabbro, serpentine, diabase, etc., intruded into the Red Beds at Huizachal and Novillo Canyon (Textfigs. 2, 3; Pl. XVII, Sections 2, 3): Pre-Cretaceous, probably pre-Jurassic.
3. Green tuffs (bentonite), interstratified with the Xilitla- and San Felipe Formations: Turonian to Coniacian.
4. White tuffs in the Mendez Marls: Upper Senonian.
5. Basic necks or cones at widely separated localities:

(a) Bernal de la Purisma, 400 m high, overlooking the mesa of that name (Pl. XVII, Sect. 5).

(b) Bernal de la Clementina, at the village of that name, south of the Rio Guayalejo.

(c) Bernal de Horcasitas, 1111 m, SE of Magiscatzin, visible on a clear day from Tampico, 100 km away. A basalt column 1 km thick and 600 m high, rising above a flat, basaltic lava-shield of Hawaiian type, 6—8 km in diameter (ARN. HEIM 1934).

(d) Cerros Morcielago and Nopal, north of the San Luis Potosí railway and 30—37 km NW of Guerrero (Pl. XVI), connected with basalt dykes and lava-flows.

(e) Cerro Guajolote, the southernmost neck, 500 m in diameter, on the Aquismón-Tancanhuiz trail. The rock seems to be a gabbro or diorite and has metamorphosed the Mendez Marls at the eastern contact.

All these necks and plugs are later than the Mendez and probably than the Chicontepec. Judging from their state of preservation, they may be younger Tertiary or Quaternary, and partly seem to be related to the basalt mesas.

6. Basalt Mesas. They are widely developed in the region between Xicotencatl and Lavín, near Ciudad Victoria. Their average elevation is 350 m, or 250 m above the plain. The mesas are indicated approximately on our map, and in Pl. XVII, sections 5—6, but extend farther east near the Victoria railway. (On the topogr. map 1:100000 of Mexico, these flat mesas are drawn like folded mountains.) The thickness of the basalt at Mesa Josefeña was estimated at about 50 m. It usually lies on a eroded surface of Mendez Shale. The extrusion and erosion may be placed near the end of the Tertiary. Since then, slight uplift must have occurred to allow dissection of the mesas and to aggrade the present alluvial plain, 200—250 m below, processes which probably took place chiefly during the older Quaternary.

7. Basalt Streams. Two long but narrow streams of subrecent basalt have been encountered (Plate XVI).

One follows the small Rio Boquilla which crosses the two eastern ranges and ends, after several interruptions, in the eastern Tamabra gorge. In the cascades of the western or Chamal Range, the lava has slightly metamorphosed the immediately underlying Tamabra limestone.

The other stream probably derived from the same source west of Sierra de Chamal. It followed the synclinal valley of Nuevo Morelos through the channel of Rio Mesillas which now runs along the western side of the lava stream. This stream has been followed for more than 50 km upwards of its termination. The lava must have been extremely hot and liquid to flow on such a distance in a valley so slightly descending. These lava streams are much younger than the basalt of the mesas and may have flown in historic time.

IV. Structure.

The structure is reviewed by natural divisions:

The Huizachal Anticline.

The main structure of the first range between Victoria and the broad Jaumave Valley is the gentle Huizachal Anticline, 15—20 km wide and 2—3 km in structural height. At Huizachal Ranch, on the crest of the Anticline, erosion has stripped the sedimentary mantle down to the gabbro. In the next canyon to the north, that of Novillo, west of Victoria, even gneiss is exposed. While the main anticline's axis runs N-S, the vertical layers of the gneiss and amphibolite strike NW to WNW, thus making an angle of 45 — 75° with the later folding. At Peregrina, the gneiss seems to be cut off by a pre-Cretaceous NNW-SSE fault from the fossiliferous Peregrina Beds.

The anticline is associated to the east with numerous minor anticlines, with local contortions and steep dips. They are secondary folds on the easterly limb