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H. NUBACH

The work on the Morre-Musea area was concluded. On December 17th. the writer left for Bucaramanga, in order to take samples from Fehr's survey of the Rio Lebrija Tertiary and to extend the stratigraphical reconnaissance to the Cretaceous and older beds. He met Drs. Trümpy and Pichter at San Gil on December 27th. and returned with them to Bogotá on December 30th.

Preliminary Report on the Geology of the Bucaramanga region and Foothill zone.

The area examined is situated between Puerto Santos - La Ceiba-Bucaramanga - San Gil - San Vicente de Chucurí. The journey from Bogotá was made via Duitama-Charalá-San Gil. For the return, the route of Bucaramanga-Pamplona-Northern Central road was taken. Routes used are indicated on the sketch map.

The area has been formerly studied by Reitter (Kordillere von Bogotá), by Ritter (The Hague, G.R. N° 7573), by de Boeckh and Richardson (see Gregory: Structure of Asia), by Hottelstein (under Schuchert: Antillean Region), by Herritt 1), by Fehr (G.R.4) and by Ochsner (PR 22) stillé (Obstet des Rio Magdalena) studied the region to the North, on the Ocaña-Cucuta trail.

STRATIGRAPHY

Tertiary :

For the survey of rio Lebrija, the work of Fehr (G.R.4) and the observations to this report by Ochsner (P.R. March 38,) were used. Samples were taken from the railway station of Puerto Santos, in the upper Real, as far as Venegas, in the upper Cretaceous.

Upper Tertiary sandy clays and gravels are present on the E side of the Ciron fault, W of Bucaramanga. They may be Tilatá.

No clear separation between the Chuapas conglomerate and the Lower Real could be recognized.

Foraminifera are expected from the Mugrosa-Emeraldas zone, the sands of which are Charte like.

The La Paz contains abundant black chert pebbles and for this reason it is hazardous to correlate it with the Mirador and Cache quartz sandstones.

No Mirador could be seen in the Orocué (Lisama) but Ochsner's opinion (P.R. March 38) cannot be rejected. The Orocué shows a similar lithology and a similar subdivision as does the Guaduas at Bogotá. The

- 1) See result under: A report on the Palaeontology of the Lebrija Section, Colombia, S.A. by H.N. Coryell and Doris Malkin, New York City Dec. 1, 1935. It refers to Carboniferous, Cretaceous and Tertiary fossils.

lower part is thick and consists of unctuous, banded shales with limestone concretions; it will be considered here as Unir s.s.

Guaduas-Guadalupe boundary. This boundary was studied on the Puerto Wilches railroad W of Vanegas and at Nuevo Mundo on the pass of the San Vicente de Chucurí-Barrancabermeja road.

At Vanegas, the top of the Guadalupe probably coincides with the yellow sandstone at Km. 78.5. This sandstone would represent the Tierna sandstone, which persists from Bogotá to Chitagá, and is overlain by Unir.

At Nuevo Mundo, it is not known whether the sandstone of the place of Nuevo Mundo itself is the top of the Guadalupe, or if the top is the next sandstone 150m. above. The latter could not be exactly determined on the road.

Cretaceous.

The Guadalupe is well defined by the mentioned top sandstone, and by the ammonitiferous Frontera limestone which marks the top of the Villeta.

In the Vanegas region, it is composed of shales and "plaener" horizons, the latter being limy and cherty, and partly sandy. There are two plaener horizons in the Guadalupe, shown on Pehr's map. Between both, the gap at the railway is made up of shales, containing coal beds which outcrop farther South. Evidently in the same position lies the coal horizon of San Francisco, on the San Vicente-Barranca road. It indicates that the Landázuri coal may still be in the Guadalupe.

The guide for the Upper Villeta is the Frontera limestone, developed in plaener facies. It is found at the Vanegas anticline (E of Vanegas) and farther E, at El Conchal, where it is in fault contact with Lower Cretaceous. From the ridge just E of Lisboa, on the Bucaramanga-Barranca road, E of Rio Lebrija, one can follow it to Quebrada El Razo, always bearing ammonites. Farther S. however, on the road W of San Vicente it could not be identified. It is possibly represented by a sandstone horizon which rests about 200 to 300m. below the Vanegas plaener (plaener of station Vanegas). This shows difficulties in the upper Cretaceous stratigraphy in the San Vicente region, increased by minor thrusting.

About Km. 55-56 of the Bucaramanga-Barranca road, at C. Agua Blanca, on the N side of Rio Sogamoso, *Exogyra Hermeti* limestone was found. It may rest about 50m. below the Frontera limestone, but exact data could not be obtained because of tectonic complications. According to Coryell and Martin E. *hermeti* (*Squamata*) also occurs at the Conchal fault, but has been mixed in the collection with lower Cretaceous fossils.

The Middle Villeta (Una) seems to be absent, due to faulting. It can be partly recognized at Lisboa, where it rests above Albion platy shales and is in fault contact with the Frontera limestone. It is composed of black pyritic shales and sandstones. It also may be present in

the San Vicente region, but subfolding impedes a rapid orientation.

The Lower Villeta is evidently composed of an upper, thick shale- and a lower sandy limestone member. The best exposure is found on the Barranca road, E of Lisboa, but fossils seem to be rare. In the upper part are platy shales with *Inoceramus* and ammonites of Albian type. Immediately below are shales with large limestone concretions. Then follow shales, occurring in a synclinal axis. Farther E. below the shales are the sandy limestones with *Trigonia*, *Cucullaea*, etc., also well exposed on the road at Rio Nogoteso and at Quebrada Ramos and, on the Puerto Wilches railroad, E of El Conchal. On the San Vicente-Zapatoca road (only western part recognized) *Pulchellinae* are found in large limestone concretions, resting 100-150 below black platy shales with pressed ammonites. The *Pulchellinae* zone is situated about 300m. above the sandy limestone member, thus indicating this member to be older than Barremian and not Velez equivalent. The 300m. intermediate beds are shales. For better interpretation of this section, Fichter and the writer will make a revision when possible.

The boundary Villeta-Cáqueza cannot yet be well fixed. It may be about the lower part of the limestone member, containing medium to coarse grained sandstones, alternating with shales and grey crystalline limestone. West of Nogotes, Fichter found ? *Astieria*, which may help to fix the boundary.

The presence of Cáqueza on the high East flank of the Chucuri valley, is proved by the abundance of lower Cáqueza ammonites at the house of Portugal, a locality indicated on the sketch map. They rest below the sandstone-limestone beds of the Villeta-Cáqueza boundary. Fichter considers these ammonites to be Valangian to possibly upper Jurassic; Dietrich determined Valangian ammonites from Zapatoca, collected by Karsten. Below the black ammonite shales are weathered shales and sandstones with few bivalves. The boundary with the underlying Giron of Giron is not determinable, due to weathering conditions. A better exposure can be expected on the San Vicente-Zapatoca road.

Observations made between Nogotes-San Gil, Aratoca-Los Santos- W side of Páramo de Santurban, indicate the following possible sequence for the lowermost Cretaceous:

Sandy limestone with *Trigonia*, *Cucullaea*, *Exogyra boussingaulti*, etc.
pre-Barremian, 100-200m.

dark shales with lenticular, dense limestone, with ? *Astieria* on
San Gil-Nogotes road. 100m.

medium to coarse grained sandstone; some bivalves. -50m.

dark shales with dense limestone in upper part, =? Portugal shale
100m. Valangian or upper Jurassic.

well bedded, light grey, medium to coarse grained, hard sandstone
20-40m = Santos sandstone, observed from Nogotes to Los
Santos and Páramo de Santurban.

opaque red, grey, greenish and yellowish sandy shales (silt) and mostly soft, medium to coarse grained, often conglomeratic sandstone of the same colours. Observed from village of Sogamoso to Arcabuco, Floresta, Negoten, Aratoca, Los Santos, Páramo de Santurban. At Floresta-Santa Rosa as well as at Aratoca tuff like beds are characteristic.

UNCONFORMITY OF LOS SANTOS (Notestein). The lowermost Cretaceous transgresses at Mesa de Jéridas (Los Santos) on Soapaga, farther E on crystalline schists and then on granite; at Aratoca, it rests on ?Pipiral and crystalline schists, at Portugal probably on Giron of Giron.

Los Santos Unconformity. Notestein determined the angular unconformity between Cretaceous and "Giron" beds (Soapaga) at the village of Los Santos. As shown above, the Cretaceous also transgresses on older rocks.

Older Mesozoic.- The Giron problem.

Hettner committed a serious error when he considered his Giron of the Bucaramanga region to be lowermost Cretaceous. According to present points of view, it includes three different formations, viz. the red conglomeratic Soapaga, the Giron of Giron of the Boeckh, and the Carboniferous of Bucaramanga - Las Bocas. The writer and other authors used the term Giron in an erroneous manner.

The type zone for elucidating the Giron problem is found at the Rio Lebrija section, along the railroad from Las Bocas to about Km. 92 E of El Conchal (see profile of de Boeckh). The true Giron of Giron by de Boeckh, rests on the black Bocas shales which are more or less Carboniferous and is overlain by a red conglomerate and red shale formation which is evidently the Soapaga of the narrow of Soapaga (G.R. 37). This Soapaga is overlain by the Cretaceous. The Village of Giron lies near E of the Giron beds, in Quaternary gravels.

The Soapaga is a formation composed of red sandy shales, red, shaly sandstones and mainly by red grits and medium sized, subangular to rounded conglomerates. Greenish weathering zones occur in this formation. Light beds seem to be absent or very rare in the true Soapaga. At Bucaramanga, it is found from S of the village to the W side of Mesa de Jéridas. It also occurs apparently in an ancient valley filled with Soapaga-on the S side of the named Mesa and is present W of Aratoca, on the S side of Rio Chicamecha. At Los Santos, it overlies the crystalline mantle schists, while at Km. 92 of the Puerto Wilches railroad, it rests on Giron of Giron. At Santa Rosa-Floresta, it may rest on Pipiral; at the Páramo de Guantiva, on the Onaga road, it transgresses on coarse granite. The Soapaga can be easily confused with the lowermost horizon of the Cretaceous, described above.

West of Buitana, there is a thick Soapaga like formation, probably younger than the Montebel formation of Trumpy and Fichter, containing horizons of light sandstone, grits and conglomerates. Its stratigraphical position is not yet defined.

The true Soapaga shows variable thickness, from 0 to 2000m or more.

The age of the Soapaga may be Jurassic, as indicated by the Rio Lebrija outcrop;

The Giron of Giron is exposed on the old peneplain like surface between the village of Lebrija and Las Palmas. On the surface of the peneplain it is deeply weathered; continuous, fresh outcrops are found along Rio Lebrija. The formation is mainly composed of gritty to fine conglomeratic (subangular), quartzitic sandstones of grey to light grey and whitish colours. The components are mainly quartz, but dark pebbles of the Bocas shale type are frequent. The sandstones compose almost exclusively the upper part (more than 2000m) of the series. In the middle part, at Las Palmas red, olive blue grey and grey sandy shales (claystones, silts) prevail; in the lower part, the same shales make up about half of the sediments.

The olive silts give the impression of diabase tuff.

The series is more than 3000m. thick; de Boeckh shows 16000 feet.

The Giron of Giron, according to its position, may be Triassic.

So far, no equivalent of the Giron of Giron has been determined. It may be represented by some M.P.C. members of the Murillo section of Rio Murgua. The Montebel formation, made up of medium grained to fine conglomeratic sandstones and mostly black (yellowish weathering) shales with some coal shales, plant remains and molluscs, is lithologically different from the true Giron. N of Rio Negro, on the Bucaramanga-La Ceiba (-Ocaña) road, grits of Giron of Giron type are found alternating with red silts, but containing black shales; tectonics are highly disturbed.

Paleozoic.

Carboniferous of Bucaramanga-Las Bocas.

The Carboniferous (Permo-Carboniferous of Schuchert) was first known from the E side of the E Cordillera. Merritt (verbal information) first found it on the W side, S of Puente de Tierra, on the Bucaramanga-Bocas road.

So far observed, this Carboniferous occurs in an anticline (Vijagual anticline). The E flank looks rather regular, while the W flank, towards Las Bocas, is subfolded and possibly faulted. Apparently the Carboniferous transgresses on granite. In the lower part occurs a limestone bed with bad fossils, placed between grey, olive and red hard shales. Above, on the E flank, are red, grey and olive shales, chert-like, and sandstones with few thin limestone and marl beds. At the top, in a narrow syncline occur dense, thick bedded limestones and a limestone conglomerate, exposed at Rio Suratá. On the W flank of the Vijagual anticline, towards Bocas black shales with gritty chert and limestone lenses, alternating with olive, diabase tuff-like silts seem to substitute the red shales of the E flank, but this is uncertain. The

black shales are disconformably transgressed by Giron of Giron at the bridge, 1 km W of Bocas.

The thickness of the Carboniferous may be 1000 m.

Pipirai.

The only place where red shales and sandstones of Pipirai type were found, is at Aratoca, on the S side of rio Chicamecha (San Gil road). They are altered into phyllitic rocks. Stille describes red phyllites from the Paramillo region, E of Cacha, on the trend of the Aratoca outcrop.

Mantle schists.

On the W side of the granitic-gneissic Santander massif, dark greenish schists and arkose schists, phyllites and mica schists seem to form a typical mantle formation. They are intruded by the granite of the Santander massif on the S side of rio Chicamecha. The occurrences are shown on the map. Similar schists on granite were found E of Casaga.

The schists of Mutiscua with marble seem to be different from the mantle schists.

The age of the schists may be Early Palaeozoic to ? pre-Palaeozoic. They are not the Archean type of the Macarena series.

Santander granite.

The granites of the Santander massif have been described by Stille, who recognized the transition into granite gneisses in the Cacha region. These granites seem to continue to Negotes and possibly may be represented by the coarse grained granite S of Casaga underlying the Casaga.

de Boeckh shows the rocks of the Santander massif on the Bucaramanga-Pamplona profile.

Palaeontology.

The Corres fossil horizon of Pehr, at the top of the Kemeruidae series, escaped to the writer.

One marine fossil horizon was found about km 77,5 in the lower Guadua (Unir), W of Venegas. It looks to be Tertiary.

Abundant ammonites of the Frontera and Piedras type occur in the Frontera zone. At the top are Inoceramus and fish scales of the same type as at La Frontera (Cundinamarca). The Albion contains Inoceramus and ammonites. The Barremian is shown by Puzosia. Valangian or upper Jurassic ammonites were found by Trampy and Fichter at Portugal.

Neither the Soapaga nor the Giron of Giron contain fossils.

The Carboniferous contains good brachiopoda 60 m SE of the cross of Agustin Lamus (Bucaramanga-Bocas road), about the middle part of the series. Fichter also found crinoids and brachiopoda in the upper and in the basal limestones.

Silky shale pebbles found by Fichter at Nogotes, seem to contain Devonian fossils.

TECTONICS

Foothill zone.

The Chucurí-Vanegas foothill zone is folded and faulted. A steep anticline, probably followed to the E by a syncline, is present N of Vanegas. A syncline is developed W of San Vicente and can be followed N to Rio Sogamoso. At El Conchal, a thrust brings in contact the lower Cretaceous (E side) with the upper Villeta. The same thrust probably passes through Lisboa (contact Vae-Frontera and must be expected to go farther S. Between Lisboa and the house of Girardot (W of Lisboa), minor thrusting is probable. It is possible that minor thrusting and folding is more extended in the foothill zone than was expected up to now.

W of San Vicente, the upper Cretaceous forms the La Llana syncline. The La Paz sandstone is supposed to describe a bend N of this place.

Lebrija peneplain

On the Bucaramanga-Barranca road, one finds a wide, gentle anticline in the Giron of Giron of the peneplain. Towards the E border, a narrow syncline occurs W of the village of Lebrija; it widens toward S. Close to the Bucaramanga plain, the Lebrija plateau is irregularly folded and then evidently thrust; vertical and steep upper Tertiary is in contact with Giron of Giron. This is the Giron thrust, which strikes N25E from the village of Giron to the E. At rio Lebrija, the peneplain seems to form the W flank of the Bocas anticline, extending from the Bocas shales to the Lower Cretaceous of El Conchal. E of the station Las Palmas, a gentle anticline passes on the W side of rio Lebrija. In the river, at Las Palmas, no anticline was observed.

The tectonic features of the foothill zone and the peneplain seem to be cut by the Bucaramanga thrust, as shown on Ritter's map. This is inferred from a trip from Bucaramanga to La Ceiba.

Bucaramanga plain

This plain is covered by a thick layer of sand and gravel.

quaternary age. Towards Giron, steep Upper Tertiary beds occur. S of Bucaramanga, the Soapaga and Lowermost Cretaceous beds dip gently W becoming moderately steeper towards the Giron thrust.

The Giron thrust on the W side of the Bucaramanga plain can be followed far South. Toward N it may disappear toward the subfolded region of El Café (railroad station of Bucaramanga).

The Bucaramanga thrust, shown by Ritter at La Tigra evidently continues toward Fortachuelo (N of Rio Negro). At Rio Negro, reddish Carboniferous beds, dipping steeply E, are thrust against granite. At Rio Suratá, the contact of the apparent upper part of the Carboniferous with the granites and gneisses of the Santander Massif, indicates that the Bucaramanga thrust may still be present. At Piedecuesta and farther S it could not be recognized.

Santander massif.

The high part of the massif is a peneplain, probably of pre-Cretaceous age. On the W border of this culmination, a lowermost Cretaceous syncline, plunging N, was observed. It indicates that de Boeckh's nappe may not exist.

OIL PROSPECTS

Salt is reported to occur at Curití (lowermost Cretaceous).

Oil seepages are reported from the foothill zone at Vanegas and Vegarica (N side of Rio Sogamoso).

The Frontera zone and the uppermost plain zone of the Guadalupe are highly bituminous and contain oil residues in cavities. They prove the upper Villeta and the Guadalupe to be the main oil generating levels on the E side of the Carare basin. The Vanegas plain does not seem to be bituminous.

Porous rocks are rare in the Cretaceous. The top sandstone of the Guadalupe is rather dense. Better beds occur in the Lower Cretaceous. The Tertiary contains abundant porous rocks.

A structure which may be of some oil interest is the anticline of Vanegas, open in the upper to middle Villeta. Expectations are confined to the Lower Cretaceous, which, however, does not look like an oil formation. Since it thins from the Front toward the Santander massive, old oil accumulation cannot be discarded at all.

H. Rubach