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RECENT DISCOVERIES IN NORTHEASTERN NICARAGUA: GRANITE HILLS, MOUTONNÉD RIDGES AND GOLD-CONTAINING LODES OR REEFS, AND LEADS OR PLACER MINES.

BY J. CRAWFORD, RIO WANQUE OR COCO, AT SAN RAMON, NICARAGUA.

DURING the past year, commencing August, 1892, ten months of nearly continuous exploration have been spent by the author over an area of some 10,000 to 12,000 square miles in the uninhabited wilderness and jungle that cover a large part of northeastern Nicaragua, examining the geology, minerology, and flora existing in great attractiveness and variety in that part of the country. Among the numerous interesting features and peculiarities discovered or noted that are worthy, from both a scientific and economical point of view, of a more special description than was given of them in my paper, "Hydrographic Area of the Rio Waukey, or Coco-Nicaragua," published in *Science*, in April, 1893, are the following:

(a) The granite outbursts exposed on the tops of oval-shaped *Cerros* or mountains, and which also form the *Cima del Cerro* and longer axis of long, high, mountain ridges.

(b) The numerous moutonnéd ridges and lateral and terminal moraines, in series that evidence the former existence of a glacial epoch which covered an area of several thousand square miles in Nicaragua with a flow of glacial ice.

(c) The erosion-sculptured *Cerros* that intervene between the granite hills and moutonnéd ridges, composed of debris denuded from both the nearby granite mountains and materials from mountain ranges found further to the southward.

(d) The reefs or lodes (many of them auriferous) and dykes (of diorite) in which auriferous quartz veins are discovered piercing the mountains and ridges parallel to the length of the series of the system; and also the Post-Pliocene leads of drifts of gravels and boulders. Gold is found exposed in the banks at sides of streams, that appear to extend through the erosion-sculptured hills near their base, and also the alluvial leads, drifts of gravels, gold, etc., found in the channels of the creeks and in strata in the lower parts of valleys.

(e) The composition and fertility or non-fertility of the soil and its fitness, in places, for the vigorous growth of certain kinds of trees or plants, also the peculiar formation where groves of some kinds of valuable trees were found growing to large dimensions.

(f) The apparent geological history of the granite hills, dykes, reefs or lodes, moutonnéd ridges, erosion-formed ridges, and of the leads or placer mines.

The region in northeastern Nicaragua chosen for description in this paper as typical of a few others in that part of the country is a wilderness unoccupied by man[1]; and although this locality is a part of Nicaragua, neither the government nor the citizens of that country have even a vague conception of its importance and its truly great undeveloped wealth in valuable minerals and metals, timber, and agricultural lands. The centre of this chosen locality is about longitude 85° W. (from Greenwich) and latitude 14° N., and embraces the headwaters of Nawawass, Wilson, Loccus, Umbra, Waspoopoo, Moorawass, Sangsang and Daka Creeks, and Wasspook River, confluents to Rio Waukey, or Coco River, and also the line of *Cerros*, about sixty miles long, just south of the Wasspook River.

The granite masses appear to be in two parallel lines of elevation, but connected together as one mass and composed of rock of the same mineral composition, usually amphibole, syenites (with and without quartz), and also protogene and plagioclose varieties appear most numerous. The cooling has permitted the crystallization of the minerals so similarly at about the same depth from the surface (isogeothermal zone) in each line of ridges, as to indicate that the two exposed lines were of the same mass and lowering in temperature at the same rate. The granite has been exposed by erosion, and the hills, also, have been eroded deeply at many places, and the rocks have, at several places observed, become disintegrated and decomposed, *in situ*, to depths of five to twenty feet. The exposed granites are in series of spurs and ridges that extend northeastwardly for about ninety miles from the Barbar Mountains (at the southeastern termination of the Matagalpa system of mountains), and form an angle of about 120° with the southeasterly and northwesterly direction of that mountain system, which is composed largely of Archean and Silurian era rocks.

The northeastern termination of these granite spurs and ridges is near to the confluence of the Rios Wasspook and Wauque, at a distance of about one hundred miles west from the Carribbean Sea, on the eastern coast of Nicaragua, and about the same distance south from that sea on the northern coast of Nicaragua. The forces causing this upheaval of granite appear also to have fissured the superimposed and adjacent systems of rocks for many miles[2]. These fissures are now filled by deposition of minerals and metals from hot solutions, and are now reefs or lodes, containing quartz, gold, metallic ores, and other minerals. Near the northern termination of these granite ridges were found patches, of varying size, of auriferous sands, gravels, clays, and boulders—detritus transported by water from the denuded granite hills and from ranges in the Matagalpa system of mountains. These deposits of detritus increase in size northwardly, until covered northwardly by the sands and mud composing the delta of the Rio Wauque; and on the west the deposits of detritus were in large quantities, and subsequently have been sculptured by erosion into hills and ridges; also found resting in small areas on the granite ridges are boulders in size from a few pounds to over two hundred pounds each, of varieties of bluish glaucophanyte, or hypers-

[1] Recently two or three Latin-Americans have, in a crude way, simulated placer-mining work in one or two of the mineral localities. They appear hopeful and cheerful.

[2] It is very difficult, frequently impossible, to trace the extent of the outcropping of lodes or reefs, and even of dykes, in this wilderness of dense growth of trees, vines and plants and a deep soil.