

X. THE PRESUMED PLEISTOCENE GLACIATION OF
THE SOUTHEAST BRAZILIAN ITATIAIA MOUNTAINS

In volume 53 of the Arquivos do Museu Nacional (pp. 1-54, 15 fig., 6 tables) there is an interesting ecological account on the vegetation of the famous Itatiaia Range by Mr. F. Segadas-Vianna and Leda Dau (co-author on climatology).

The advantage of these two papers (vegetation and climate) is that they provide pertinent data and a fair description.

Of the inland range in Southeast Brazil the Itatiaia massif (c. 1450 km²), situated at 20° 25' S, 44° 50' W, ranges highest with c. 2787 m height. It is one of the largest outcrops of nephelinic rock known (a hard, uniform, ash-gray type of syenite), of igneous origin of course. The climate is distinctly seasonal at all levels (l.c. 40, fig. 2), but in the higher parts Sphagnum and moss-covered trees occur freely. Above the plateaus at c. 2000 m the upper part consists of steep castle-like peaks (Agulhas Negras, Prateleiras) of bare steep rock with vertical grooves, steep gorges with dejection fans and disaggregation of large and small blocks from their slopes.

Although the author admits the reluctance of geologists and geomorphologists to accept glaciation during the Pleistocene Ice Age, he accepts this (l.c. 10) light-heartedly, waving away the arguments.

To him "the lowering of a few degrees in the annual mean temperature would be enough". Obviously he is little acquainted with figures obtained from observation of glacial phenomena on mountains in other tropics. To have a glacier on top of Mt Itatiaia would mean, even if precipitation was heavier, a lowering of the temperature of at least 10° C, which is out of the question. U-shaped hanging valleys and cirques he accepts as due to glacial phenomena. These are, however, by no means exclusively bound to formerly glaciated mountains.

He even goes so far to venture the hypothesis that the numerous and deep grooves, which run parallel to each other along the steep slopes of the Agulhas Negras and other ridges, are nothing else but glacial grooves deepened and modified by the constant flow of waters with a high oxydizing power (notably CO₂ and NO₂ formed by rain-storms). Such grooves occur, however, in many places of the world on limestone, granite, andesite, etc., at all altitudes. I have a large number of data on this, since I first found such grooves on a low hump of granite at 75 m above sea-level in the island of Natuna, at equatorial latitude (De Trop. Natuur 21, 1932, 29, fig.); this occurs also in Borneo on the steep granite walls of Mt Klamm (summit 943 m) (l.c. 68).

Another feature of the heavy 'erosion' is the exfoliation of igneous rocks, so frequently found at both high but also low altitude everywhere, and especially obvious on the bare or almost bare 'inselbergs' under often arid conditions (Mediterranean, Sahara, tropical Africa, Australia, etc.).

The author stated that nothing is known about the floristic composition of the plain level (400-700 m), as these forests were destroyed in the colonial period for coffee estates; at the end of the 19th century these were replaced by sugarcane-cultivation, which fields in turn were abandoned because of increasing erosion in the early 20th century. All this country is now cattle pasture land, by the use of fire: it is open savannah and grassland. At lower montane level up to 2000 m, colonisation took place in the early 20th century for orchards which failed and resulted in forest degradation (timber, charcoal, sleepers, etc.). The edge of these depleted woods is generally occupied by a dense belt of bamboos; when submitted to fire, they gain dominance. The middle montane level is an open subclimax dominated by *Cabralea* (Meliaceae) and *Tibouchina fissinervia* (Melastomataceae). The upper montane level (1700-2000 m) is a lower forest of about the same composition, but more mossy and without lianas. The highland level (2000-2400 m) contains bogs, woods and grassland, but as his fig. 7 shows with often sharp forest borders; the author declares the steppe as the climax here. In the deep, very steep valleys is *Araucaria* forest which the author explains as a relic from the Ice Age, as well as *Podocarpus* which is also accepted as a relic of a vegetation which must have covered in the past great areas of the massif. The summit level (2400-2700 m) of abrupt steep topography is as far as not almost bare rock with lichens, often dominated by a dwarf bamboo in humiferous pockets. It is accepted as the climax "in spite of its being an edaphic climax" (l.c. 24). The poorness of this vegetation is ascribed to extreme conditions of wind, temperature, drainage, and mechanical and chemical erosion.

Obviously the author has little experience and knowledge of tropical montane vegetation at altitudes below 3000 m, otherwise he would have known that such "alpine imitations" are always due to disturbing factors at heights of 2400-2700 m, either by volcanism or by man.

Furthermore, he is obviously not aware that under each climatic regime all climaxes are in last instance edaphic.

It is curious, but not unusual, that the summit level vegetation is just taken at face value, though every vegetiologist should be always aware that all vegetation types must be explained and evaluated in terms of past time and that nothing can be taken for granted, even in the so-called primary tropical rain forests.

Especially here, the author should have considered this as he stressed man's influence and his fire for the lower zones, but failed to do so for the high levels. It should have been done of course, as white man has been here for at least two centuries. Naturally man will mainly have ascended Mt Itatiaia in the dry season and needed fires on the summit level (for heat, cooking, etc.). And before him Amerindians will have been here, and done the same.

There is no doubt to my mind that Itatiaia was forest-clad to the summit in its virgin condition. The steepness of the summit zone will have been no obstacle to the growth of trees as the deep unaccessible valleys "with almost vertical slopes" are still covered by Araucaria forest (as they are in the European Alps, the alps of Formosa etc. by other conifers). And though it can be readily admitted that the igneous rock skeleton was steep, this was certainly no obstacle for tree growth. And a forest brings along a soil profile, hence less surface erosion; under the forest canopy was no frost and no grassland, but here and there small outcrops of rock and bogs harbouring grasses, sedges, and other subalpine herbs, small shrubs, and dwarf bamboo, in notably sparser populations than today. The original forest of Itatiaia was through the hard rock and presence of a seasonal climate distinctly susceptible towards destruction. Under these conditions steep rocks, once bared of forest, and stripped of their soil, remain of course bare almost for eternity as rock abrasion sets in; the process of destruction is almost irreversible through the essential change of the microclimates. Denudation once started, inevitably proceeds; by the charcoal remains of former fires, new fires become easier and more destructive; herbs, sedges, small shrubs and dwarf bamboo find a stronghold in clefts and shelter of rocks and perennials and geophytes gain in number being able to withstand fires and the depauperating microclimate. Also in Formosa dwarf bamboo thickets develop tremendously through fire. They are only physiognomically (by height and density) comparable to natural high-subalpine thickets of Juniperus, bordering on the true alps a thousand metres higher up.

I am glad to have seen the more pertinent data on Itatiaia as they fully confirm what I concluded from less detailed data in my essay on Frost in the Tropics (Proc. Symposium on Recent Advances on Tropical Ecology, Varanasi, 1968, 154-167). Hence, I felt the need for a further comment.

It would be worthwhile to examine whether there are, in the summit level, sufficiently deep old bogs where palynological proof could be obtained for the evaluation offered here, a point of view which is in agreement with experience on tropical montane vegetation elsewhere on the globe.