were beamed nationwide via a geosynchronous satellite. Care was taken that these programmes concerned themselves with technology appropriate to village life: crop rotation, water purification, and the like. Programmes we might watch on "Nova" were sedulously avoided. The antennas by which these satellite broadcasts were received themselves were a triumph of appropriate technology - a mere few wires suspended from poles stuck in the ground. The SITE experiment reached twenty thousand villages and went on for a year; its place has since been taken by a series of half-hour broadcasts each night. This modest, low-technology enterprise has gone more to benefit the bulk of India's population than any amount of "Western-style' science.

In saying this, I am far from arguing that science should not be pursued in a country like India. I am saying that its justification must involve arguments of a different order, and I would argue that the real justification for science is the same in India as in the West; the benefits of learning something of the true scheme of nature and of our place in that scheme. These are enough for me. They are enough for most scientists; I have yet to meet a one who works for the good of humanity.

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Control of science in India is highly centralized, and its directors are largely answerable only to themselves.

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BLACK SOILS OF COIMBATORE DISTRICT, TAMIL NADU

Introduction: Raychaudhuri, *et al* (1963) consider that black soils have been formed from the Deccan Traps in western India and from granites and gneisses, rich in lime and soda-lime feldspars, in some other areas of the country. While discussing the weathering of Deccan Traps, Krishnan (1982) has observed that the trap rocks, on weathering give rise to deep brown, red and black soils. According to Wadia (1987), the most characteristic black soils are traced on the Deccan traps, but black soils are known to occur on granites, gneisses and the sediments of the Cuddapah and the Vindhyan basins; and the black colour of the soils might be due to the presence of iron, iron-titanium compound, carbon and organic matter. In this context, the occurrence of patchy black soils in association with red soils in the Precambrian gneissic terrain of the Coimbatore district, Tamil Nadu, may prove to be of some interest.

Black soils in the Coimbatore district : In Tamil Nadu, black soils are traced in areas of semi-arid conditions, covering a total area of 67 lakh acres, in several districts (Raychaudhuri, *et al*, 1963). The Coimbatore area which lies in the rain-shadow region of the Western Ghat hill ranges, receives an annual rainfall of 690 mm, distributed over just 45 days in an year (Antony, 1972). Precambrian gneissses are extensively exposed in the area and as expected, in an oxidising environment the rocks break down and release haematite which lends a red colour to residual profiles. The derivation of the red soils from the subjacent gneisses is evidenced by a gradational transition from the subjacent rocks below to the soils above, as evidenced in some well sections. Besides, formation of kankar from the gneisses is evident and some well sections show sheet-like kankar along joints and fractures in rocks. Kankar nodules are also strewn in the soil cover.

The mode of occurrence of black soils is as patches within red soils. Pit sections in the black soils do not bear out a gradational relationship between the country rocks and

Generally, the black soils about 1-2 metres in thickness are underlain by dark brown gravelly soils. Nodules of kankar and gypsum are seen both in the gravelly and the black soils. It is interesting to note that some nodules are partly of kankar and partly of gypsum and some gypsum nodules have a core of kankar. This mode of association is suggestive of the formation of gypsum from kankar.

Discussion: In analysing the significance of the patchy nature of occurrence of black soils in a terrain predominantly covered with red soils, a study of the LANDSAT imagery (band 5) of the area (Subramanian and Muraleedharan, 1985) and the views of Ramanujam (1968) on the palaeoclimatic pattern of the east coast of south India in Mio-Pliocene and post Mio-Pliocene times, are interesting. The imagery indicates the definition of the signature of a palaeo-river system with an easterly slope (Subramanian and Muraleedharan, 1985, Fig.3, p.34). The moot point to consider is the stretch of time in the geological past, when the semi-arid tract of the Coimbatore area experienced rains to a level necessary to sustain flowing streams and rivers.

Along the east coast of south India, a long stretch of sandstone patches of Mio-Pliocene age is traced from Andhra Pradesh in the north to the extreme south of Tamil Nadu. In Neyveli, the sandstones (Cuddalore sandstones) are known for thick lignite seams, the presence of which is indicative of the accumulation of enormous amounts of plant remains. Ostensibly, there was luxuriant growth of vegetation sustained by the requisite amount of rainfall in Mio-Pliocene times. In the Tiruvakkarai area, located 43 km. to the northeast of Neyveli, spectacular petrified tree trunks are preserved in Cuddalore sandstones. Ramanujam (1968) recognised both moist-loving and evergreen and deciduous (moist or dry) taxa among the fossil wood and suggested that the Cuddalore flora might be brought under the moist tropical and semi-evergreen forest type; and that the eastern coast of south India turned drier and warmer in Pleistocene, compared to the humid and warm climate of Mio-Pliocene. Climate is a feature of regional significance and so the climatic patterns of the east coast of south India in Mio-Pliocene and post Mio-Pliocene are applicable to the hinterland as well. In essence, it is considered that in Mio-Pliocene, the incidence of rains was to the level necessary to sustain a river system in the hinterland, stretching into the Coimbatore area and there was profuse growth of vegetation. With the onset of dry conditions in post Mio- Pliocene times, flow of river ceased, perhaps by stages, leaving behind relicts of river courses. Apparently, the now extinct proto-Amaravati river and the mostly dry Noyil river of the present day in the Coimbatore area were perennial rivers in Mio- Pliocene.

The wet climate of Mio-Pliocene would have been favourable for the formation of lakes in the low lying areas of the hinterland and the inward drainage of the lakes would have led to the filling up of the lakes with sediments and organic material from the surrounding areas. With the onset of arid conditions in the post Mio-Pliocene times, flow in the rivers would have decreased and desiccation of lakes initiated. With continued desiccation of the lakes, the organic materials present in the sediments would have petrified and produced hydrogen sulphide, which would have reacted with the kankar nodules in the sediments to give rise to gypsum. Obviously, the process of gypsification of kankar did not progress to the extent of fully converting all kankar nodules into gypsum, thus accounting for the presence of nodules which are partly of kankar and partly of gypsum. The black clayey soils are lacustrine sediments formed towards the end stages of the desiccation of the lakes. Thus, the origin of the black soils and gypsum nodules are considered to be linked to a change from a wet to a dry environment, as a result of a distinct change in the climatic pattern of the past.

Raychaudhuri *et al.* (1963) have observed that in many areas in Tamil Nadu, black soils occur at lower elevations than red soils. This picture is true of the Coimbatore area

and it may perhaps be due to the formation of black soils in depressions marked by lakes, while red soils were derived from crustal rocks at varied elevations.

Conclusion: The mode of origin attributable to the black soils of Coimbatore may not be applicable to similar soils in other areas in the country. However, the theory of formation of black soils by the weathering of different types of country rocks needs to be viewed with circumspection. The Deccan Traps are known to have given rise to lateritic bauxite by subaerial, residual, physico-chemical weathering, a process defined in an oxidising environment. If a black soil is to result from the trap rock, the process should be one of mechanical weathering under a reducing environment, not conducive for the chemical weathering of the silicate minerals of the rock. Under such a circumstance, the black colour of the rock may be expected to be retained in the mechanically weatheredk fragments. Then, the physical parameters warrented for the reduction of the rock to clay-sized particles and the formation of the clay mineral montmorillonite present in the black soils (Krishnan, 1982), need to be explained.

The environment of deposition of the inter-trappeans in the Deccan traps could have been different from that of the black soils traced on the Deccan Traps. However, if the inter- trappeans were deposited in depressions in the interval between flows, a similar mode of origin for the black soils is plausible. Montmorillonite is found in the black soils of Coimbatore (Raychaudhuri *et al.* 1963) as also in those associated with the traps. A comparative study of black soils traced on varied rock types in different parts of the country on the basis of field evidences, interpretation of aerial photographs and imagery, palaeoclimatic patterns and other lines of study as warranted, may prove to be an interesting excercise.

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