government) agencies engaged in land speculation. These glaring facts render the concept Utopian, impossible to implement in reality. However, that does not really redue the value of the concept because as we all know, Utopia is not merely a useless idea. Provided with the right incentives, it might become a material source in directing the future cities.

But the summation of all the issues raised, what one could call the ultimate observation, has come from Correa himself Recently in an interview in Calcutta he said, "In the final analysis cities cannot be planned". One wonders whether anything could be truer than this.

Kuntala Lahiri Dutt

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TROPICAL GEOMORPHOLOGL

BY DR. H. S. SHARMA

New Delhi, Concept Publishing Company, 1987, pages 385,figures and tables.

To those geomorphologists who are interested in the geomorphology of Rajasthan and of India in general the name of Dr. H. S. Sharma is synonymous with the geomorphology of Aravalli Ranges that straddle, like the vertebral column, the terrain of Rajasthan. For the last two decades Dr. Sharma has been consistently investigating the different facets of the geomorphology of these extremely old geological formations of India of the world. These investigations, as would be expected of an accomplished scientist, focus on both the geomorphological features and the genetic processes.

The title of the book and the chapter titles are extremely modest, they deal with a much larger canvas of related themes than are indicated by their phrases. Essentially it is an investigation of the morphogenesis of Rajasthan: the term morphogenetic here really refers to and is ensconced by the widely discussed principles formulated by Tricart, Birot, Budel, Peltier, and Seuffert and a host of their colleagues and research associates. Their basic premises even though the concepts, methods, and arguments are involved in seemingly intractable controversies and contradictions, are surprisingly similar: the principal determinant of geomorphological processes and the features and attributes generated by them is to be found in the intricate details of climates and the climatic processes. Dr. Sharma does a commendable analysis of the present and past climates and a very detailed morpho-chemical analysis of typical soils which themselves can be considered as constituting important climatic indicators. This is further supported by a long, interesting, and balanced discussion on **kankar** formation, a subject that has been investigated by a host of scientists since the last century. By de-

termining their age, the genetic processes of **kankar** formations and the climatic roles were identified — a very interesting and convincing method of unraveling the geologic age, the climatic conditions, and the genetic processes. Dr. Sharma's book is replete with such innovative techniques. In splendid details he analyses the palaeoclimatic conditions and the related geomorphologically significant desertification. The eroded pediments, fossil sand-dunes, interdunal lats, boulders and gravals, have been analysed with the same explicit objectives — the palaeoclimates and their geomorphic significance.

Indeed, the **piece de resistance** of the entire discussion is the comprehensive analysis of the palaeoclimate and desertification. There is in it an impressive referencing and scrutiny of literature as also that of the evidences of the palaeoclimatic changes in Rajasthan. Essentially, Dr. Sharma has focussed on three kinds of evidences: geomorphological, archaeological, and palaeo-botanical. As a competent and established geomorphologist as he is, Dr. Sharma analyses each of the geomorphological evidences with detached objectivity that enhances enormously its scientific tenor and merit. For all the evidences, it is not only the careful scrutiny of the current research and generalisations resulting therefrom, but the field observations and careful translation of the landsat imagery data on to the real ground and cross-sections that would impress a scientist of geomorphological patterns and processes. The reconstructions of the palaeoclimatic conditions are, at once, extremely complex but the arguments are convincing and the collation of data is logical. Consider his discussion of the **kankar** deposits: the geomorphic situation, the proportion of Calcium Carbonate, C14 dating of **kankar** particles, origin of **kankar,** and the climatic inferences of **kankar pan.** This is just an example, but Dr. Sharma performs the scientific task with equal competence and dexterity in analysing each and every evidence and extracting from them the associated climatic data. It becomes amply evident from the vast gamut of analyses that there have been several phases, clearly distinguished one from the other, in the complex history of the Rajasthan palaeoclimatic changes from 10,000 B. P. to our times. Dr. Sharma has proposed at least seven phases, alternating between humid and arid, desertification and de-desertification. To the extent that the data of the geomorphological evidences converge the reconstruction is fully validated and the book becomes a model of research of Tropical Geomorphology of one of the most prominent arid regions of the world. Dr. Sharma does indeed present an innovative method of the study of tropical geomorphology: beginning with the reconstruction of tropical palaeoclimates involving the geomorphological and archaeological and palaeobotanical evidences. Not many Indian geomorphologists, let alone geographers, ever care much for evidences that are generated outside of their traditional domain. Dr. Sharma, thus, opens other paths for geomorphologists. This is a highly eclctic section, Dr. Sharma selects only those facts from the mass which can, with reasonable assurance, be fitted into the structure of arguments of reconstruction. Another noteworthy innovation in methodology evolved by Dr. Sharma is in abandoning the path of hypothesis-evidence – hypothesis validation, and, instead, discovering a problem, a question, a simple statement, and then searching

for a comprehensive body of evidences. Obviously, this has yielded splendid results but if the support of laboratory experimental data and geochemical data were also available the exact processes and the conditions in which the processes had operated, the reconstructions would have been further strengthened In the charting out of palaeoclimatic trends Dr. Sharma has acted upon a credo 'a good geomorphologist must operate in a three-dimensional framework.' The third dimension, the time, is amply demonstrated in the profuse, elaborate, detailed profiles and sub-surface geological sections. Indeed, he has dug the past to reveal the past.

Following the longish discussion on the reconstruction of palaeoclimatic changes and stages are the innovative syntheses of morphogenetic forms and processes related to aeolian and fluvial landscapes, basin morphometry, morphogenesis of ravines, and planar surfaces and inselbergs. More than their own complexity, they certainly reveal in bold outlines the complexity of Rajasthan landscapes: it is interwoven with the patterns of the Peninsular, the North Indian Plains, and the Indian Desert landscapes. Unravelling the constituent threads of this complexity is a difficult task that Dr. Sharma has performed with great success. It goes to his credit that he has also attempted, with convincing results, the discovery of an unifying structure that overarches all the interpenetrating landscapes. This is forcefully exemplified by a splendid, large geomorphological map of Rajasthan. This map presents lithological units and geomorphologic units: the latter also displays in detail the structural, denudational, and fluvial geomorphic units. This is a geognostic map in the best tradition of geological geomorphology. In addition to portraying the lithology-geomorphology relationship it produces a synthesis of all the main features of geomorphologic landscape diversity. The map and the clearly identified geomorphological features set the Aravallian landscape apart from those of the Peninsular and North Indian Plain cognates. This map should draw the attention of all the geomorphologists who are working in a complex area of older geological formation and Quaternary processes. There are interesting and pleasant surprises in the chapters of Part Two: contrary to expectation the fluvial forms and systems and processes have prompted much longer discussion than the aeolian counterparts. Within the aeolian discussion the greatest emphasis has been placed on the sand-dunes. In the discussion of sand-dunes what must be noteworthy are the identification of types, alignment, composition, lithology, and temporal changes in forms, and the illustrative support given by the maps, sketches, toposheets, and landsat imageries.

In the detailed discission on fluvial morphology there is a thorough description and explanation of the various geomorphic feature produced by fluvial processes. Most interesting are the reconstructions of the evolution of important drainage systems and relationships with lineaments: all of them being identified faults. In basin morphometry Dr. Sharma attempts a convincing correlationship with rainfall, the dominant climatic parameter, with each and every basin morphometric element, specially runoff, discharge, silt load and sinuosity index. The correlations are good and convincing and thus validate the basic premises of both climatic geomorphology and tropical geomorphology.

Ravines and the process of ravination are familiar geomorphic events in many parts of India. Although they are widespread and their role in geomorphic damages and socio-economic degeneration are well known, their origin and evolution and spread are still a matter of debate. Dr. Sharma, after giving us a detailed description of the different ravine systems related to major rivers Chambal and Morel, arrives at the crucial topics of mechanisms and stages of ravine growth and a detailed and critical analysis and review of all the theories of origin of ravines. He pleads for a search for a theory that takes due notice of geological structure, vegetation, topography, rainfall characteristics, and human activity. Based on a wide reading of current literature and his own extensive observations Dr. Sharma proposes the rejuvenation theory of ravine origin. This is his own original contribution. Dr. Sharma posits a lowering of base-level caused by recent upliftment following a pattern of rejuvenation that expresses dynamic disequalibirium in which several events occurring successively result in an interrupted sequence of ravines. The rejuvenation theory needs to be scrutinised carefully through application over extensive areas. This is an important original contribution.

Moving through planar surfaces and inselbergs Dr. Sharma attempts, in the final section, a grand synthesis in the form of morphogenetic regions and land systems. This will be useful for a large gamut of practical purposes including the planning of the military movements and warfare. This purpose is further strengthened by the identification of component land units comprising the land systems.

Dr. Sharma has almost fully realised the objectives of the project. He deserves credit for the successful application of the concept and related techniques of troprical geomorphology to the state of Rajasthan, an area of great diversity in lithology, climate, soil, vegetation, hydrological characteristics, and geomorphology, an area where aeolian and fluvial processes have been clashing against each other for more than 10,000 to 15,000 years and as a result creating the vast complexity of geomorphic parameters and features. This is a book that must be on the shelfs of every geomorphologist.

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