walls increase. Moreover, N_{u1} is found to be negative in case of $\phi_l = 0, \phi = 1$ for larger β, inplying thereby that heat is transferred from the fluid.

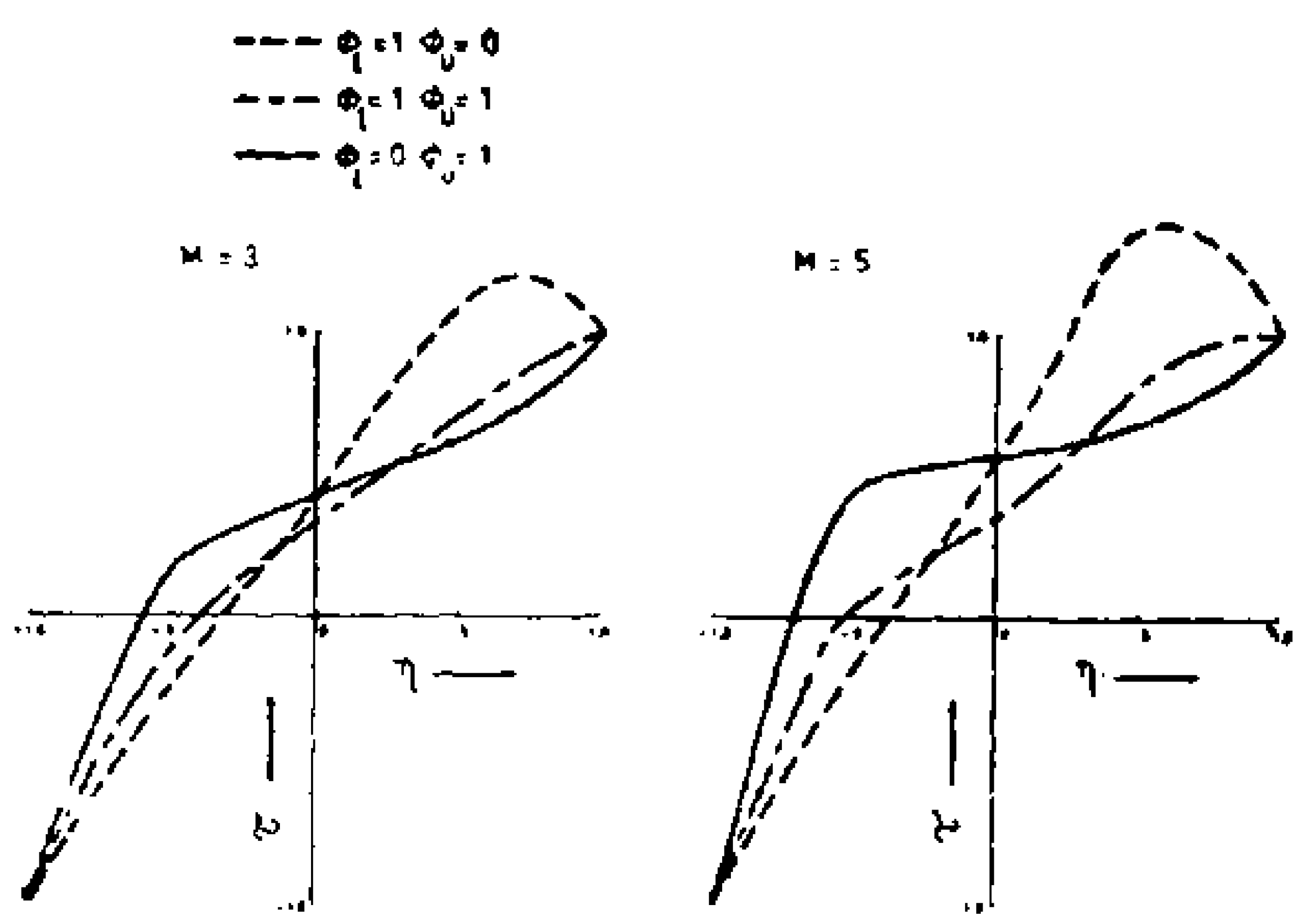

Fig 2 Temperature distributions for $R_e = 3$ $\beta = 10$

Figure 2 reveals that the non-dimensional temperature distribution rises in case of $\phi_l = 1$, $\phi_u = 0$, in the region $\eta = 1$, $\eta = \cdot 5$ and then turns rather abruptly to meet the value $\tau = -1$ at $\eta = -1$. In other cases it steadily falls. This behaviour is more pronounced for larger values of M.

ACKNOWLEDGMENT

The author is indebted to Prof. M. K. Jain, Department of Mathematics, Indian Institute of Technology, New Delhi, for suggesting this investigation.

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CLASTIC DIKE FROM BAGA, GOA

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IN the course of investigations carried out on the geological setting of northern Goa coast, an uncommon feature of an occurrence of a clastic dike was noticed in Baga headland. Clastic dikes and related sills are tabular intrusive rock bodies analogous to igneous dikes in appearance and also in their field relationships. These are injections of mobilised sediment into fracture zones and bedding planes of sedimentary sequences and reported from widely scattered regions throughout the world. It is for the first time such an occurrence of a clastic dike intrusive is reported from the Goa coast; though first such an occurrence was reported by Diller (1890).

Clastic dikes have been reported as intrusives ranging in age from Precambrian to Quaternary. The country rock is usually sedimentary and includes rock types such as shale, sandstone, argillaceous siltstones, limestones and dolomite. The origin is considered to be related to processes penecontemporaneous with sedimentation. It is stated that the orientation of these dikes is controlled by fracture patterns in relatively undeformed strata (Smith, 1952), by folding (Duncan, 1964) and also by faulting (Peterson, 1966). Further it is reported that clastic dikes have also been found to be cutting granites, gneisses (Cross, 1897; Birman, 1952) and also occur as relict structures in highly metamorphosed rocks (Hopson, 1964). Equally, they are considered to be found within the soil horizons and mostly occurring in the B and C horizons, but never in the A horizon.

Broadly, two kinds of clastic dikes are noticed. (1) those which are primarily sedimentary infillings of open fissures (Fackler, 1940; Birman, 1952), and (2) those which resulted from forceful intrusion either upward (Waterson, 1950) or downward (Vitanage, 1954) or both as seen in certain places (Smith and Rast, 1958).

At Baga, the clastic dike encountered is a vertical, wall-like mass of argillaceous sandstone. It is 0·5 m (1½ ft) wide, 4 m high, trends East-West, and cuts across sandstone (which is the country rock, showing current bedding) and shale but not the overlying laterite.

It is exposed along a wave cut cliff—a slope of the hill, outcropping to about 15–20 m (only the stumps are exposed) but its inward extention into the hill is not traceable due to the overlying laterite cover. It is light brown, moderately indurated and iron stained (sometimes plates of iron oxide stand out very prominently since it is highly resistant to weathering), thus it contrasts well with the greyish colour of the country rock (even though it is highly weathered). Several smaller dikelets are seen associated with this, and all of them pinch out or taper out after some depth of penetration into the country rock. This dike is an intrusive into the country rock (sandstone) as seen in Fig. 1. The sandstone dike is in conformity with the joint pattern in the rock, wherein the joints are spaced nearly 3 m apart. The dike is composed of very fine-grained, angular, fractured quartz, biotite, feldspar and traces of heavy minerals, and impregnated with iron oxide which sometimes gives rise to highly resistant 2–4 mm thick plates along fractures and joints present within it. These thick plates may be secondary in origin and subsequently enriched. Though it is reported that gypsum is the cementing material (Smyers *et al.*, 1971) in many cases it is chiefly iron oxide with traces of calcium carbonate that forms the cementing material in the sandstone dike at Baga. Gypsum is totally absent.

solidated nature of the dike and fairly recent lateritisation, it may be that the age of the clastic intrusive dike is either Neogene or Quaternary.

The authors are indebted to Dr. N. K. Panikkar, Director, National Institute of Oceanography, for his interest and encouragement. One of the authors (B. G. Wagle) was enabled to undertake this work through the grant of a C.S.I.R. Research Fellowship.

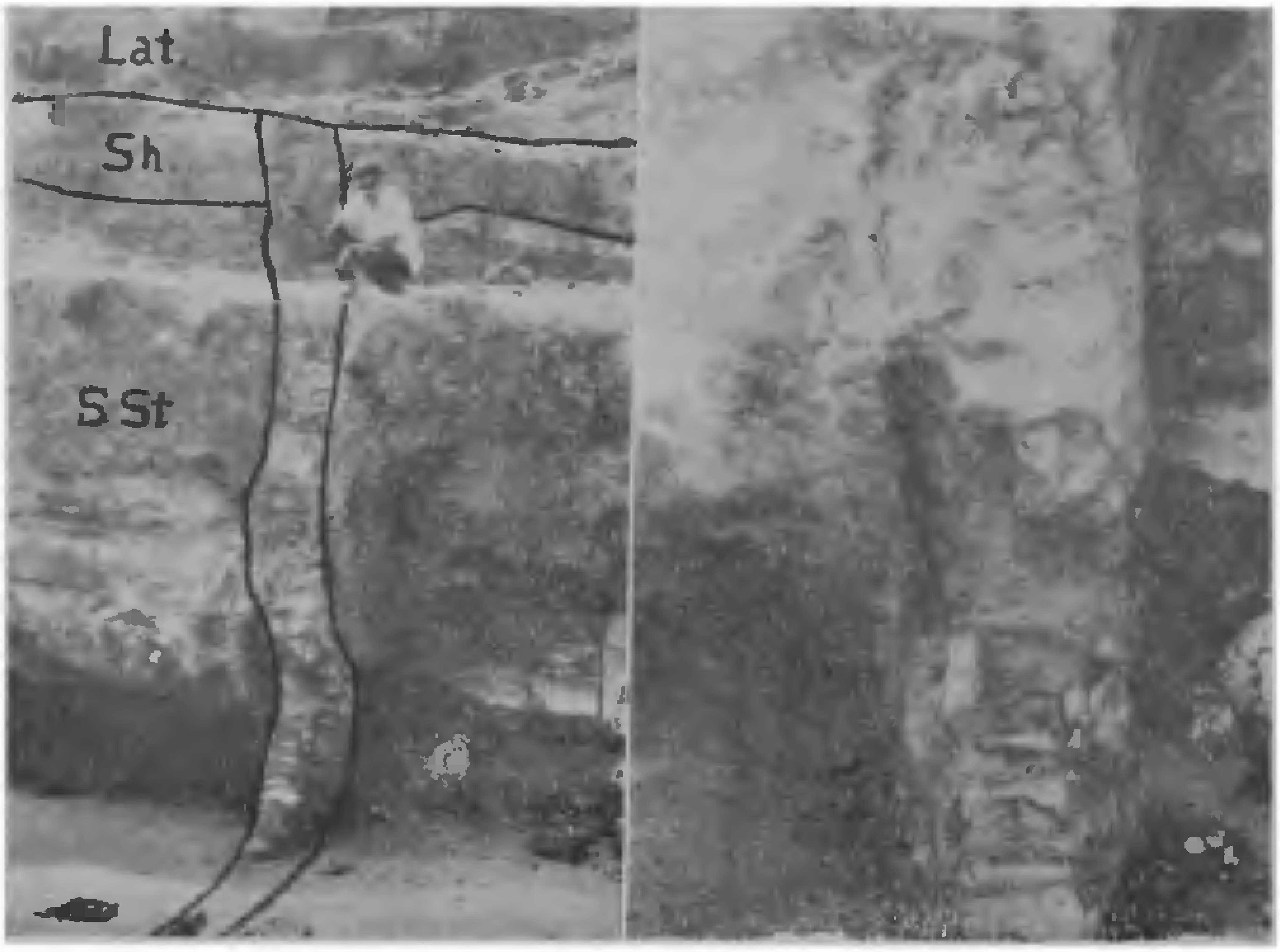

FIG. 1. Clastic dike intrusive into sandstone-shale sequence at Baga, Goa.

This region is an area of heavy monsoon, high humidity, tropical climate with good drainage where the rocks show effects of weathering and a high degree of lateritisation. The thick cover of laterite that envelops all the other rock types does not give any clue to the type of rock that underwent lateritisation, as such it is not quite discernible what constituted the overlying shale layer which (presently being laterite) was probably a source rock for the clastic dike.

Some of the smaller dikelets which are seen in the vicinity taper out into the country rock. It is considered that the dike which is primarily a thick unconsolidated argillaceous sandy material is injected downward into sets of joints present in the country rock, as a low viscosity slurry, under great pressure that finally resulted in a somewhat hard and semi-consolidated rock.

According to Oertel (1958), the country rock (sandstone and shale) is Precambrian (Cuddapah) in age, and therefore, in the absence of any other evidence, the age of the dike can be stated as post-Cuddapah. However, based upon the semicon-

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