plagioclase, microcline and calcite. Feldspar is infrequently developed as rounded or embedded inclusions in equidimensional nepheline grains and very rarely with serrated edges. Amphibole occurs as subhedral to anhedral crystals with slight alteration at the edges and along cleavage traces. It is strongly pleochroic with X = greenish yellow, Y = yellowish green and Z = bluish green colours. Flaky biotite is generally seen associated with amphibole, and it is moderately pleochroic with X = Yellowish green and $Y = Z$ = dark greenish brown. Slender needles of apatite and ameboid sphene are seen in association with mafics, while subhedral or rounded crystals of polysynthetically twinned calcite occurs in association with nepheline.

The massive variety is characterised by the presence of weakly perthitic microcline with subordinate amount of plagioclase, whereas in the gneissic type the K-feldspar is invariably a non-perthitic microcline with considerable amount of plagioclase. The discrete plagioclase in massive type is relatively fine grained, invariably untwinned and generally interstitial to K-feldspar. In the gneissic type the plagioclase is medium to coarse grained, rarely twinned, and K-feldspar is interstitial to it. Felsic mineralogy and absence of clinopyroxene are similar to those exhibited by the Kotappa Konda rocks[3] and the marginal facies of the Elchuru Pluton[5].

Detailed studies of the Settupalle pluton are now in progress and will be published elsewhere.

The authors thank Prof. C. Leelanandam for his guidance, and the Council of Scientific and Industrial Research for fellowships.

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DRAINAGE BASIN ANALYSIS IN THE WESTERN TERMINATION OF THE BHAVANI LINEAMENT

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THE great majority of rivers of Kerala that originate from the Western Ghats flow west and fall into the Arabian sea. Bhavani on the other hand flows east. This river follows an almost SSE straight course from the foothills of Billimalai up to Mukkali in the Attapadi valley. Here it takes a sharp turn and flows through the Attapadi valley, following an almost straight NE course for about 20 km before entering Coimbatore District, Tamil Nadu (figure 1). The river in the past has been suggested to be flowing towards SW from Mukkali as against its present NE course[1]. The sudden sharp bend in the course towards NE at Mukkali has tempted the authors to undertake the analysis of the drainage nets in an area of 150 km^2 on either side of the river along its NE course in Kerala.

The area is made up of Precambrain crystalline rocks and their products of weathering. While in the northern part of the area hornblende gneiss with patches of quartz-biotite schist and hornblende-actinolite schist are the main rock types, in the southern part quartz-biotite schist with patches of hornblende gneiss and schist predominates[2].

The structure of the present area has been investigated[2]. The area constitutes the western termination of the Bhavani lineament, one of the major NE-SW trending penetrative lineaments of Peninsular India. This lineament, which is a zone about 10 km wide, can be traced from Mukkali for over 300 km in a general NE direction. Three generations of folds with axes of the first two generations trending ENE–WSW and the last one N-S have been recognised. The dominant trend of steeply dipping foliation (60–80°) is NE–SW. The development of the first two generations of folds is controlled by movements along the Bhavani lineament[2]. Foliation attitude shows considerable variation on account of superposed folding by the last generation of folds. Joints are well-developed especially in hornblende gneiss. Detailed analysis[3,4] of the joint pattern has revealed three major trends *viz.*, WNW-ESE, NNW-SSE and NE-SW, maximum number of joints trending NNW-SSE.

A drainage map of the area was prepared from Survey of India toposheet No. 58 A/12. Third order basins were delineated on the map (figure 1). The different morphometric properties of third order basins namely basin area, basin perimeter, stream length, drainage density, basin elongation and slope and third order stream trends were determined.

The basins were grouped into two—those in the hilly region and those in the low land. The statistical morphometry[5] method was followed. Correlation between each morphometric property was computed for the two groups and the significance was tested at 5% level.

The correlation coefficients for the basins in the hilly region (table 1) reveal an interdependency of basin area, basin perimeter, stream length and basin

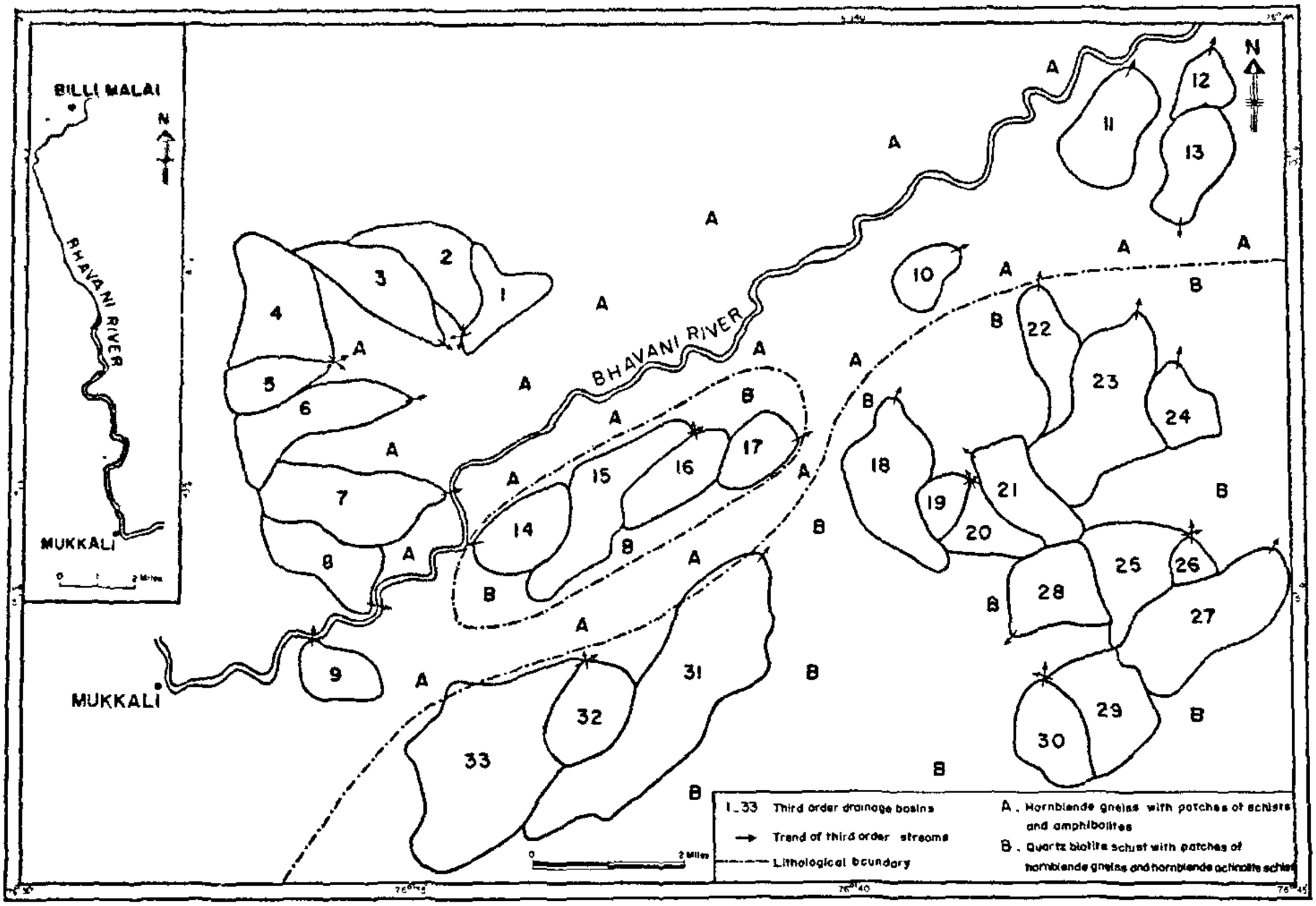

Figure 1. Drainage basin map of the western termination of the Bhavani lineament. Inset:—Course of Bhavani river from origin to Mukkali.

elongation. Drainage density and slope which show correlation among themselves are not interdependent on the other parameters. In the lowland basin area, basin perimeter, stream length, basin elongation and slope show interdependency (table 2). Drainage density shows no significant relation with these parameters.

The drainage nets essentially depend on lithology, structure and climate. Within the limits of the analysed area, the climate is uniform. A comparison of the drainage map and lithological map of the area shows that out of the 33 basins 20 are in schistose part and only 13 are in the gneissic part. The localisation of more basins in schistose region suggests lithological control.

Rose diagram of the trend of third order streams

TABLE 1
Correlation matrix

	Basin area	Basin perimeter	Stream length	Drainage density	Basin elongation	Slope
Basin area	1·00	0·928	0·929	*–0·0626	0·920	*0·417
Basin perimeter	–	1·00	0·800	*–0·165	0·950	*0·412
Stream length	–	–	1·00	*0·288	0·873	*0·621
Drainage density	–	–	–	1·00	*0·0371	0·735
Basin elongation	–	–	–	–	1·00	*0·571
Slope	–	–	–	–	–	1·00

*Not significant at 5% level

TABLE 2

Correlation matrix

	Basin area	Basin perimeter	Stream length	Drainage density	Basin elongation	Slope
Basin area	1·00	0·973	0·966	*−0·173	0·954	0·579
Basin perimeter	–	1·00	0·939	*0·199	0·980	0·626
Stream length	–	–	1·00	*0·043	0·894	0·553
Drainage density	–	–	–	1·00	*0·273	*0·349
Basin elongation	–	–	–	–	1·00	0·650
Slope	–	–	–	–	–	1·00

*Not significant at 5% level

(figure 2a) shows four major trends with corresponding mean trends of N10E-S10W, N35E-S35W, N55E-S55W and N30W-S30E. Maximum number of streams (20%) flow along the most significant trend, namely N55E–S55W. This trend is parallel to the regional NE–SW strike of foliation of rocks and the axial trends of major folds. Further, it is also parallel to the Bhavani lineament. The general pattern of orientation of third order streams and joints is similar (figure 2b). However, the most significant trend of joints (NNW–SSE) does not coincide with dominant trend of third order streams which is parallel to the trend of regional foliation major fold axial trends and the Bhavani lineament. The failure of the major joint trend to control the development of third order streams may therefore be due to the predominating influence of the NE–SW trending major structural elements *viz.*, foliation and folds together with the Bhavani lineament.

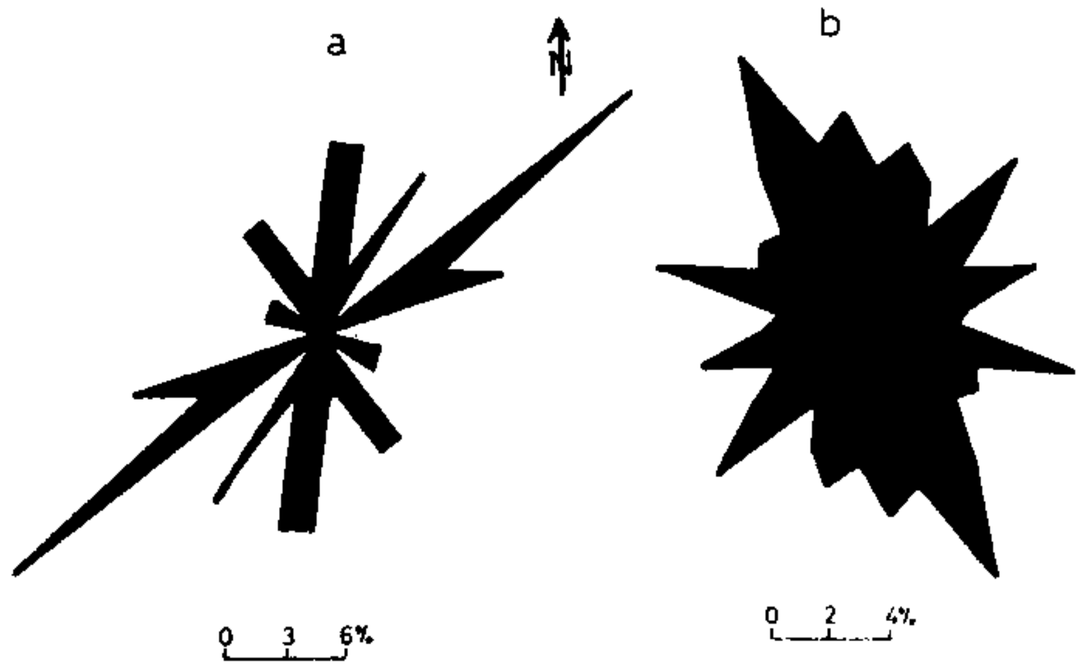

Figure 2. (a) Trend of 33 third order streams. **(b)** Strike of 253 joints.

From the analysis it can be concluded that the formation of third order basins and the sudden change in the course of Bhavani towards NE at Mukkali are strongly controlled by the Bhavani lineament.

The authors are thankful to Dr. K. P. Thrivikramaji for useful discussions and suggestions and to Dr.P. K. Rajendran Nair for facilities and critically reading the manuscript.

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HOLOTHUROIDS FROM JURASSIC TETHYAN SEDIMENTS, MALLA JOHAR AREA, KUMAON HIMALAYA, UTTAR PRADESH

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THE note records for the first time the occurrence of holothuroids from the Jurassic of Himalaya. Earlier, the Mesozoic holothuroids have been frequently recorded from various localities of India by several workers[1–9]. However, holothurian occurrences in the Himalayan region are confined to the Triassic of Kumaon[5, 7], Kashmir[6] and Spiti and Ladakh[8].

The holothuroid bearing samples now reported belong to the Tethyan Jurassic sediments exposed in the Malla Johar area of Kumaon Himalaya (Uttar Pradesh). These samples were collected from the