

aluminium chloride. The potassium salt of this acid on treatment with formalin gave the lactone of β -benzoyl- γ -hydroxybutyric acid (II), b.p. 165 / 0.5 mm which crystallised from dry ether as white plates, m.p. 66. Treatment of this lactone with concentrated sulphuric acid at 99 gave 48% of 1-keto-2-indanylacetic acid (III), m.p. 148. Reduction of the acid (III) with NaBH_4 , followed by lactonisation of the resulting hydroxy acid in presence of sulphuric acid, gave a stereoisomeric mixture of the desired lactone of 1-hydroxy-2-indanylacetic acid, b.p. 160 / 3 mm, m.p. 66 (pet. ether), containing major amount of cis variety¹.

The Friedel-Crafts condensation of the lactone (I) with benzene in presence of AlCl_3 gave as expected, a secondary alkylate consisting of a stereoisomeric mixture of trans 1-phenyl-2-indanylacetic acid (IV), m.p. 156, as the exclusive product, isolated through the ethyl ester, b.p. 150-53 / 0.5 mm, in 69.04% yield; amide, m.p. 173 (ethanol). The acid on PPA cyclisation afforded 66% of trans 2-keto-1, 2, 10, 11-tetrahydro-3, 4-benzfluorene (V) which crystallised from benzene as yellow needles, m.p. 135; 2, 4-DNP, m.p. 236-37. The structure of the ketone was confirmed by its reduction to the hydroxy compound, m.p. 140, followed by dehydration and dehydrogenation by Pd-C (10%) to 3, 4-benzfluorene (VI), m.p. 123; picrate, m.p. 129.

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DISCOVERY OF PERMIAN FOSSILS FROM TAL NADI SECTION OF THE GARHWAL HIMALAYA, U.P. *

THE stratigraphy and structure of the Garhwal Himalaya is based mainly on the occurrence of fossiliferous beds associated with the Tal and Subathu Formations. The structure of this region has recently been considerably modified due to discoveries of fossils (Ganessan, 1972; Ravi Shanker *et al.*, 1973; Kalia, 1974 and Mehrotra *et al.*, 1976).

A recent collection from the Tal Nadi section, Garhwal Himalaya, Uttar Pradesh has yielded a rich bivalve fauna. This was made from the shale horizon of the rock formation which has been considered so far as Subathu of Eocene age. The collection includes *Eurydesma* cf. *mytiloides*, *E.* aff. *cordatum*, *E.* aff. *allatum*, *Megadesmus* (*Megadesmus*) *nobilissimus*, *M.* (M) sp., *Schizodus* spp. *Astartila intrepida*, *Astartila blatchfordi*. These fossils are comparable with the Lower Permian assemblage reported from the Agglomeratic Slates of Kashmir and Salt Range rather than the Eocene.

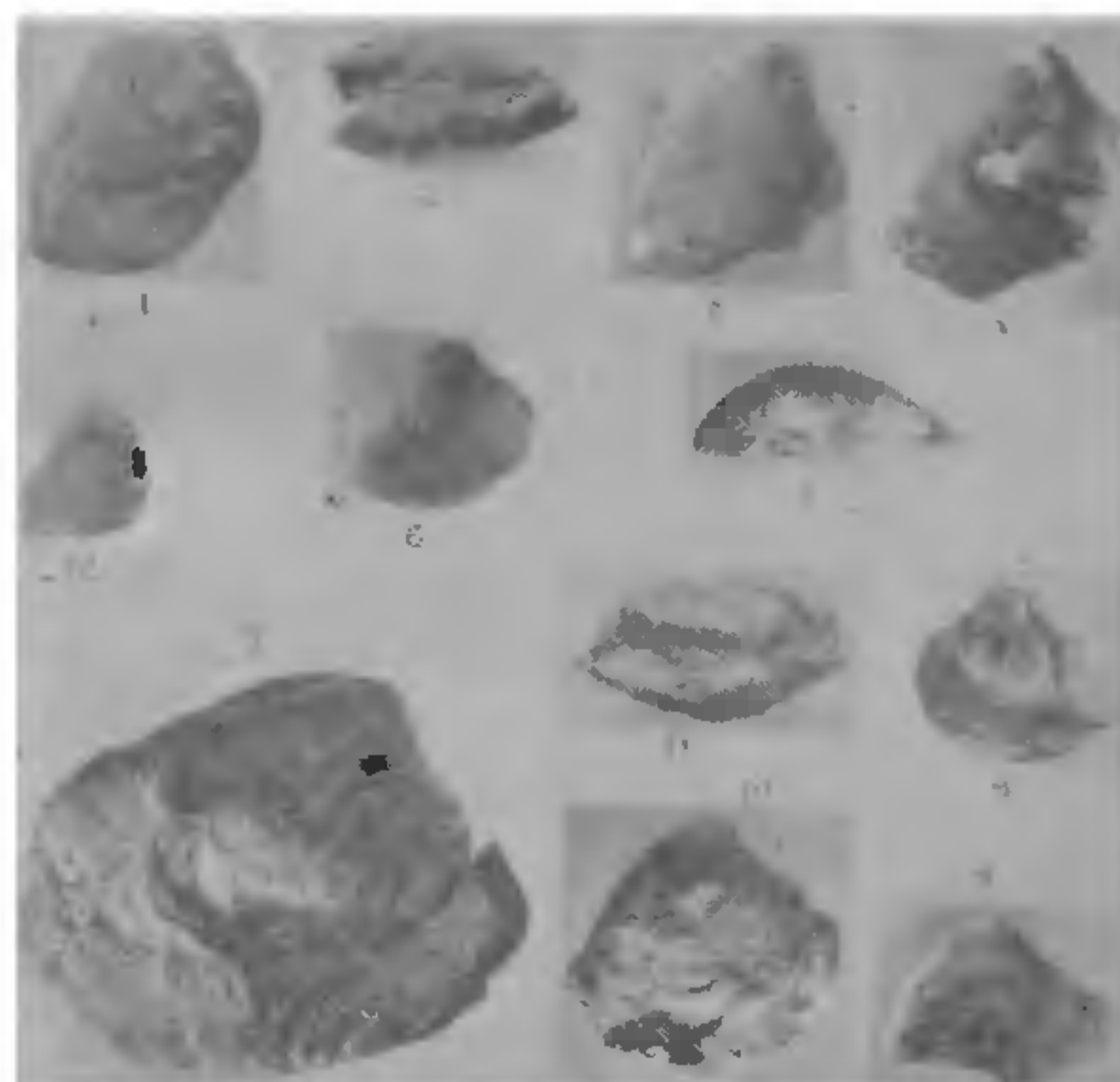


FIG. 1-12. 1-3, *Eurydesma mytiloides*; 4-5, *E.* aff. *alatum*; 6, *Megadesmus* (*Megadesmus*) *ovalis*; 7, *M.* (M) *nobilissimus*; 8, *Astartila intrepida*; 9-11, *Astartila blatchfordi*; 12, *Schizodus* sp. (All the specimens are reduced to $\frac{1}{5}$ of the natural size).

Preservation of these fossils is rather poor but definitely identifiable upto generic level. They are mostly internal casts and a few show attached tests. None of them is comparable with any of the Eocene or Cretaceous forms.

Prior to the present record, a number of publications on the Garhwal Himalaya have shown the presence of Devonian (Tewari)⁷, Carboniferous (Ganessan^{2,3}) Permian (Kalia)⁴ and Mehrotra *et al.*⁵. This fossil find now fills the gap between the Carboniferous and Upper Permian, and confirms the existence of a continuous but overturned succession in the lower part of the Garhwal Nappe of Auden¹.

The Subathu litho-units mapped here mainly on the basis of the lithological similarity may, in part, contain the extension of these Permian beds now reported by the authors and, as such, needs re-mapping and re-interpretation of the stratigraphy and structure of the area as a whole. It may be mentioned here that the structure and tectonic evaluation of the Garhwal

Himalaya was hitherto based mainly on the existence of a continuous and normal superposition of the different rock formations and the grade of metamorphism. The presence of overturned succession recorded here on the evidence of lower Permian fossils in the Lower Bijni Unit would contradict the earlier theory of 'Four Tier' structure offered by Ravi Shanker and Ganessan⁶. A simplified and more rationale interpretation of the structure of Garhwal Himalaya is possible with the evidence of overturned succession.

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DISCOVERY OF STONE AGE SITES IN THE PALERU VALLEY—COASTAL ANDHRA PRADESH

THE Paleru river Valley in Prakasam District lies between 15° 15' and 15° 30' N latitude and 79° 15' and 80° 5' E. longitude. The Paleru river originates in the Velikonda hills and drains through Kanigiri and Kandukur taluks into the Bay of Bengal. The Paleru Valley has yielded 18 Stone Age sites. The sites discovered are : Gannavaram, Veligandla, Jillallapadu, Ballavaram, Perugupalle, Tammanenipalle, Chiná Alavalapadu, Katretipuram, Yeruvaripalle, Pedda Alavalapadu, Agraharam, Muppalla, Oguru, Singarayakonda, Nandanamarella, Tsallagirigala, Kanigiri and Tsakirala.

In the simple stratigraphic sections studied, the Acheulian tools are located in the Conglomerate bed overlain by a thin deposit of fine sand, which in turn is topped by light reddish clay. In fine gravel, Middle Palaeolithic tools are found in a few places overlying the conglomerate. On the eroded surface of fine gravel are located the Upper Paleolithic sites. Most of the sites are situated on the gravel fans emanating from the Velikonda hills or on the colluvial gravel in the source region.

At Pedda Alavalapadu, Agraharam and Muppalla, the Paleru river cliff-sections showed an implementiferous conglomerate gravel bed resting on the rock, clearly indicate the sinking gradient of the river bed. The geomorphological features in this valley show that the gradient of the river had undergone changes during the Stone Age. An interesting evidence of ancient sea-level is available near the village Vaviletipadu situated at an altitude of about 8 m above the present sea-level. Here the coastal sand dunes are seen around the village. These fluctuations seem to be related to changes in land and sea relationship in this part of the coast during Quaternary. For the first time we have been able to find evidence of some kind of sea-level changes during the Late Acheulian (the later pleistocene) times in coastal Andhra Pradesh. The significance of this discovery is apparent as a similar evidence of sea-level changes and the occurrence of Acheulian industries has been established in Saurashtra on the West Coast of India (Marathe¹).

The sites are generally located close to water sources. However, a few of them are situated at the feet of the hills. Many of these are open-air camp sites as well as factory sites. The material utilized in the manufacture of tools is predominantly quartzite and quartz which are locally available in the old gravel bed. Quartz is also available as veins in the proximity of the sites. The tools are mainly made out of waterworn pebbles and from the flakes detached from them.

The tools discovered from this valley belong to Lower, Middle and Upper Palaeolithic Cultures. The Lower Palaeolithic tools include handaxes, cleavers, choppers, discoids, scrapers, knives, etc. (Fig. 1).



FIG. 1. Lower palaeolithic tool types.

Handaxe is the predominant tool type, and cleavers and choppers are less. Handaxes show careful and extensive flaking with small, and shallow flake-scraps and are refined. On technotypological considerations the Lower Palaeolithic tools belong to a late phase of