activity with α-ketoglutarate only in semi solid medium (46.6 nmol C₅H₇red/24 hr/5 ml). Isolate 3B showed highest nitrogenase activity (10, 41.2 and 180.7 nmol C₅H₇red/hr/mg cell protein in solid medium and 158.3, 60.5 and 260.8 nmol C₅H₇red/24 hr/5 ml in semi solid medium at 6.8 and 10 mM of succinate, fumarate and malate, respectively. These results indicate that nitrogen-fixing isolates from barley roots vary in their requirement for carbon compounds for nitrogen fixation. Hence, no generalization can be made with regard to the suitability of carbon compound for nitrogen fixation by associative bacteria. When sodium malate was replaced with sugars in the basal medium both the isolates grew satisfactorily except in the presence of ribose and arabinose where the growth was poor. Isolate 3B showed nitrogenase activity in the medium containing glucose, mannose in both semisolid and solid media (table 1). Pentoses were not suitable among the sugars tested for ARA under cultural conditions. The data show that the 2B and 3B isolates can utilize carbohydrates for nitrogen fixation but are less effective compared to TCA cycle intermediate compounds.

Among the amino acids tested at 2 mM and 4 mM concentrations, glutamate enhanced the expression of nitrogenase activity of 2B and 3B isolates over control in both the media (table 2). Aspartate and methionine were suitable only for 2B isolate. This suggests that glutamate and aspartate are actively involved in steps of nitrogen fixation by nitrogen-fixing organisms.

These studies suggest that barley roots are associated with a high concentration of nitrogen-fixing bacteria which remain active till flowering stage. These are mainly of two types, Pseudomonas sp and gram-negative rods. They need a mesophilic temperature, neutral pH, specific carbon and nitrogen compounds for optimal nitrogen fixation.

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Inspite of a rich yield of Stone Age tools the gap between Middle Palaeolithic and Mesolithic cultures (which elsewhere is characterized by the Upper Palaeolithic) was still not filled in the area. However, last season’s (1981–82) collection of lithic materials from Daubaro (22° 59' N: 79° 06' E) and Belghat (One km east of village Devakachar, 23° 23' N: 79° 07' E) reveal the presence of Upper Palaeolithic element in the Central Narmada Valley. The tools collected from these sites include blades, burins, scrapers, flakes, blade-scrapers, blade-cores, etc. Apart from this area other river valleys and caves of Central India, e.g., Banjer, Wainganga, Belan, Son, Mahanadi, Bhimbetka, etc., have yielded convincing evidence of Upper Palaeolithic culture.

Field work carried out during the 1982–83 field season in the Narsingpur district of the Central Narmada basin, has yielded an Upper Palaeolithic site (Mungwani rastoria–22° 48' N: 79° 26' E) which is about 3 km to the southeast of the village Mungwani (22° 49' N: 79° 25' E). Also three Middle Palaeolithic sites (Khamaria–22° 50' N: 79° 25' E, Magardha–22° 57' N: 79° 19' E, and Shiam Khera 22° 56' N: 79°
21° E) in the Sher river system and one fossilsiferous site (Patlon-22° 55' N; 78° 48' E) on the river Shakkar (see figure 2) have been discovered. The Middle Palaeolithic assemblage consists of scrapers, borers, notches, knife, flakes and cores. Among the fossils only two genera *Trionym* and *Equus* can be identified with certainty at this stage.

The Upper Palaeolithic tools which are confined to a limited area (about 15 × 15 mtr) at Mungwani-rastoria occur within the red clay band overlying the Deccan Traps. High percentage of finished and unfinished artefacts suggest that it was a factory-cum-habitational site.

On the basis of techno-typology all the artefacts of the Upper Palaeolithic Culture can be classified under blade-tool types. The tool kit at Mungwani-rastoria comprises of backed-blades, scrapers, burins, points, borers, multiple tools, flake-blades, blades, micro-blades, flake-cores, blade-cores and chips (figure 3). The artefacts are made on blade and flake-blades and flakes. The principal raw material is chert, followed by chalcedony, and jasper. All the tools are in mint condition.

On the basis of Late Pleistocene fauna, C-14 dates, and geomorphological evidences from some other Upper Palaeolithic sites in India the present industry can be assigned to late Pleistocene. Geological and faunal data from the Narmada Valley suggest that during late Pleistocene times the climate was humid and the area was covered by deciduous forests and grasses. Presence of fossil reptiles, hippopotamus and elephants from the neighbouring areas suggests that swamp and pool environment existed during this period.

A detailed study of the lithic material is under progress.

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NEW TECHNIQUES FOR SELECTIVE ISOLATION AND PURIFICATION OF MUCORACEOUS FUNGI

S. S. Ali and R. C. Jain
Bioscience Department, Ravishankar University, Raipur 492 010, India.

Two simple methods were found successful for a selective isolation and purification of some mucoraceous fungi. They are described as follows:

1. **Agar-plug moist-chamber** (APMC) method:

   250 ml conical flasks containing 50 ml water were plugged with cotton and sterilised. The inner bottom of the cotton plug was then smeared with a previously sterilised and molten plain-agar medium. The agar containing portion of the plug was then inoculated with the sample used for isolation. It was allowed to incubate at room temperature. In 2–3 days pendant cottony growth appears from the base of the agar plug, if any mucoraceous form exists in the inoculum.

2. **Whole milk medium** (WMM) method:

   Cow or buffalo milk (15–20 ml) was taken in a culture tube and sterilised. On getting cooled to room temperature, it was inoculated with a bit of soil/substrate sample, shaken gently and then allowed to incubate at room temperature. In 2–3 days, superficial cottony growth appears on the surface of the medium.

   By use of these methods several mucoraceous fungi have been isolated directly in pure cultures from soil, air, spoil food, and rotting plant material. The organisms thus obtained were *Absidia corymbifera* (Cohn.) Sacc. and Trotta, *A. spinosa* Lendner, *Circinella muscae* (Sorok.) Berl. and De Toni, *Mucor circinelloides* van Tiegh., *M. racemosus* Fres., *Rhizopus oryzae* Went and Geerligs, *R. stolonifer* (Ehrehb. ex Fr.) Lind., *Zygorhynchus exponents* Burgeff., *Cunninghamella echinulata* Thaxt., *C. blakesleena* Lendner, *Syncephalastrum racemosum* (Cohn.) Schrot., and *Thamnosyrum piriforme*.

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A NEW DISEASE CYCLE OF WILT OF PIGEON-PEA

R. S. Upadhyay and Bharat Rai
Department of Botany, Banaras Hindu University, Varanasi 221 005, India.

Pigeon-PEA (*Cajanus cajan* (L.) Mill sp.) is one of the most important pulse crops in India commonly attacked by *Fusarium udum* Butler causing the wilt disease. The perfect state of the pathogen *F. udum* was