Figure 3.6 *A botanical specialist at Cotswold Archaeology examining soil samples for charcoal. The typical patterns in the grain of the different species of wood are displayed behind the microscope.*

identified by species and then analysed in similar ways, using microscopes for plant and invertebrate remains. Once identified and categorised, material is quantified and recorded through drawing or photography. A descriptive report is then produced by the specialist undertaking the work – often illustrated with drawings, charts or tables.

ANALYSIS OF INORGANIC MATERIALS

Lithics

Lithics or stone tools are virtually indestructible. They have been used for all but the earliest stages of human development and for many sites and periods are the only definite sign of human activity. Lithic artefacts can tell us much about

Figure 3.7 *Lithics*

This hoard of unused Neolithic, polished flint axes from a Danish bog illustrates a high level of knapping skill. The drawn record of these daggers would aim to show size, shape, thickness and the method of manufacture including direction of flaking.

technology, manufacturing and what they were used to process. Artefacts can be sorted by type of stone, colour and **typology**. Most hard stone has been used at some point in the past and lithics also include related materials such as obsidian (volcanic glass) and flint. Specialists will use reference material for relative dating and suggestion of function. Amongst the common classifications of stone tools are core (where a tool has been made by removing material) and flake (where a tool has been made from a fragment struck off a core). A blade is a long flake where the length is more than double the width and thus has a very long cutting edge. Microliths are made by snapping a blade to form tiny, rough, triangular shapes. These were used in the Mesolithic to make barbs for harpoons and in the Neolithic as edges for sickles. Arrowheads are classed as projectile points as we are sometimes not certain that they were not small spear tips, while tools which are flaked on two sides to get a sharp edge (e.g. hand-axes) are called bifaces.

The method of manufacture tells us much about the skills of the maker and the technology involved. The earliest tools (**Oldowan**) from around 2.5 mya (million years ago) (▶ p. 196) were stones from which a few chips had been removed by striking the core with a hammer-stone to give a sharp edge. This technique is called direct percussion and for most of human history this was the only technique. The angle of impact determines how much of the core is flaked off and whether the flake is thick or thin. More control over flaking is gained by using a punch between the core and the hammer-stone. This is indirect percussion. Striking with a soft hammer such as antler can produce thinner flakes than with stone, while tiny flakes can be removed by pressing with antler or wood in what is known

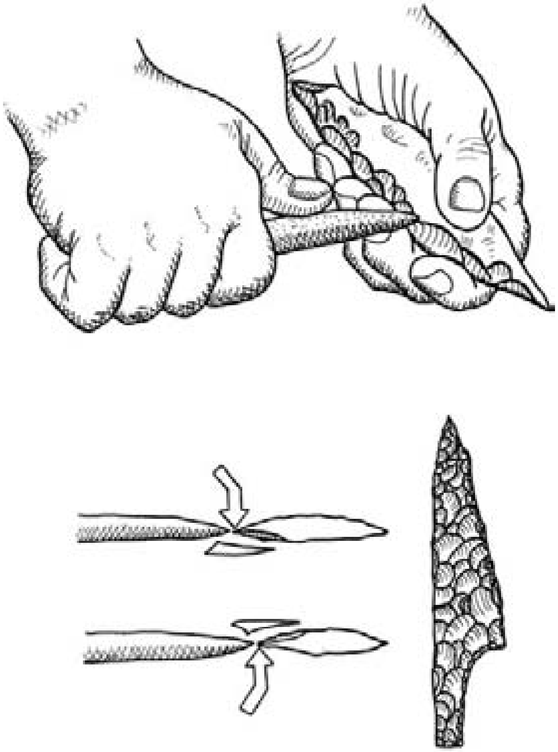

Figure 3.8 *Pressure flaking*

Pressing with bone or antler will prise thin flakes away from a part-finished artefact to gain greater definition or sharpness. Recording of markings on the artefact would enable researchers to understand how this technique had been used.

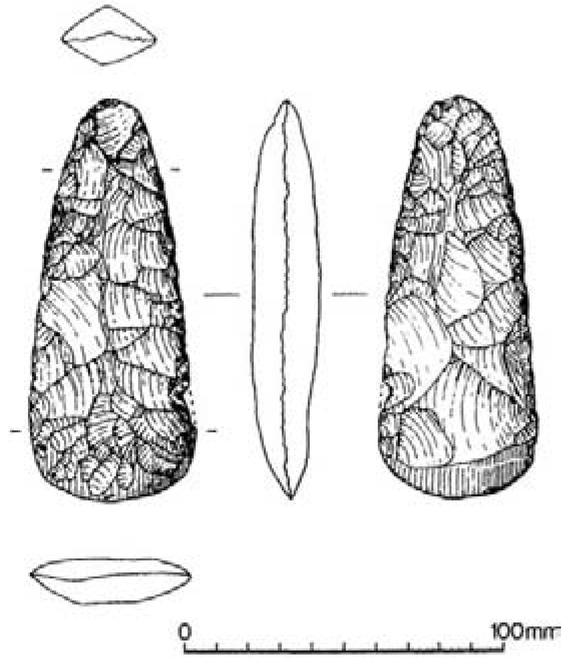

Figure 3.9 *Neolithic flint adze from Leadenham which illustrates the conventions of drawing lithics. (Archaeological Services WYAS)*

as pressure flaking. A second manufacturing technique is polishing. An artefact might be roughly shaped by chipping and then its surface would be ground using an abrasive such as sand and water. Using this painstaking method, stone jewellery and polished stone axes were manufactured from the Neolithic onwards. With the addition of a drill (▶ p. 182), this method was adapted to make sockets and to bore holes through stone.

Examination of their surface can determine whether lithics were manufactured by flaking, pecking or polishing the original stone. Reference to experimental or ethnographic examples (▶ p. 180) can explain how the techniques were carried out and also suggest how the artefacts were used. Manufacturing debris (debitage) such as flakes or chips is of particular value. It provides evidence of raw materials, the production process and the tools used. Sometimes debitage can be refitted to show the exact sequence of manufacturing (▶ p. 61). The surfaces of stone artefacts will often bear scratches, chips and polishes from their use. For example, half an hour cutting cereals will leave a polish on a flint blade very different from the use-wear from cutting bone. Use-wear studies (microwear analysis) combine microscope examination with information from experimental archaeology to try to identify the signatures (▶ p. 176) of past activities. However, this may only reveal the last activity the tool was used for. The detection and description of wear marks is greatly enhanced by the use of a scanning electron microscope (SEM). This sweeps a band of electrons over the surface of the tool and gives much improved depth of focus and higher magnification. This enhanced image can then be displayed on a screen. Examples include the study of starch grains on stone blades and the analysis of blood residues on some of the equipment carried by Ötzi the Ice Man (▶ p. 104). In some cases DNA analysis can tell us which animal the blood came from.

Characterisation

The exact type of raw material and sometimes its precise source is determined through characterisation studies. These are based on identifying the elements and mineral structure within the material. Sometimes the distinctive colour and shape crystals of each mineral can be seen using handheld magnifiers but in other cases specialist equipment is required.

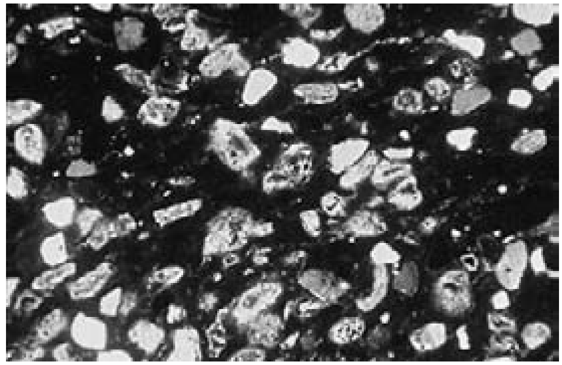

Figure 3.10 *Thin section from an amphora found at Amarna (▶ p. 405) in Egypt*

The clay fabric (Amana Fabric 1) of this vessel contains chalk, limestone and quartz sand inclusions which enabled it to be sourced to the coast of Israel or Lebanon. Tiny quantities of basalt and chert enabled refinement of the location to the Jezreel Valley where identical vessels have been found. (Dr Paul T. Nicholson)

Petrology

This is a geological technique developed for identifying and locating the source of minerals. A small sample of a stone artefact is cut and then glued onto a glass slide and ground and polished till it is about 0.03mm thick. At this point it is transparent and the thin section is examined under a polarising microscope. This highlights colour contrasts between minerals by filtering out particular lightwaves. Its high-resolution image also enables distinctions to be made by degree of transparency, texture shape and the nature of fractures. Thin sections of pottery can also be studied to provide information about manufacturing techniques. By identifying particular combinations of key minerals, the original source of lithics and ceramics (▶ p. 368) can be established with reference to geological maps. The technique can be used for building materials including stone and, in some cases, brick. It has been used extensively in Egypt to identify the quarries (▶ p. 370) used to build the temples at Karnak and the pyramid complex at Giza. Extensive studies which plot the locations of finds of the same material have helped us understand ancient trade patterns (▶ p. 402). For instance, the sources for the early medieval period trade in lava quernstones throughout north-west Europe have been traced back to quarries in the Eifel Mountains of Germany (▶ p. 409). Petrology does not work in all cases. Thin sections of obsidian and flint look remarkably similar regardless of where they originated. Similarly any ceramics which lack distinctive mineral tempers will require other techniques in order to source them. While petrology has been the most widely used means of characterising lithics, other techniques (▶ p. 131) are increasingly used.

Ceramics

Like lithics, materials of fired clay survive well in most environments and are found on most archaeological sites from the Neolithic onwards. Ceramics are often the most numerous surviving artefacts. They provide dating evidence and are used to make inferences about exchange, economy and society. The earliest fired clay artefacts actually come from the Gravettian period of the