similar at the microscopic level, consistent with turbostratic graphene. The electron energy-loss analysis of the carbon K-edge showed a small difference in the plasmon energy, indicating that the smooth cones have a slightly higher electrical conductivity, probably because of their better structural order.

These structures were produced by chemical vapour deposition of carbon onto thin carbon filaments (~5 nm in diameter) made by a catalytic method[1,2]. We carried out the deposition process under a flowing atmosphere containing 33% methane and 67% hydrogen for a duration of 160 min. (Argon gas was flowed through the reactor at all times when the temperature was elevated and these reactants were not present.) When this process is carried out at 1,000–1,150 °C, the common result is deposition of a relatively even layer of carbon that builds the diameter of the filament at a rate of about 10 μm h^{-1}. When we raised the deposition temperature to 1,300 °C we then observed the formation of the bead and cone structure. Before, between and after the growth trials that produced the new structures we executed control experiments at 1,100 °C to verify that the reactor produced 'normal' deposition under this condition.

The mechanism by which the carbon has organized into two such different textures is not yet understood. One possibility is that two distinctly different deposition processes occur simultaneously, one of which uses the core filament as a template for relatively well-ordered carbon layers, and another which perhaps proceeds slightly faster and is less ordered, creating the crumpled sheet texture in beads. In this case, to explain the cone shapes, it would be necessary for each new layer of the well-ordered growth to start near the beads and progress outwards. This would result in a natural lag in the progression of growth from one layer to the next, creating the cone geometry.

Although it cannot be demonstrated conclusively from our images, it is plausible that such growth is occurring in the pattern of a helically wound scroll, a mode for which there is recent precedent[3]. Another possibility is that our deposition process has somehow produced a composite structure of well-ordered graphite surrounded by rough graphite, and that this structure is then etched by contaminant species (for example, oxygen) inside the oven as it cools down, to create the observed structure.

These novel carbon structures may have interesting applications. There has been substantial recent interest in filled nanotubes[4–6]. The cones may be a convenient system for such studies to be carried out inside individual nanotubes. The material composing the body of the cone structurally reinforces the core nanotube making it mechanically robust, while the nearby beads could provide a grasping point for manipulation. Also, the shape of the cone makes the entry point of the nanotube easily located even under a normal scanning electron microscope. Another feature for exploitation may be the unique texture of exposed graphene edges at the cone surface. Such a characteristic could be useful for various purposes, such as grafting of chemical groups, bonding to a matrix, or use as a catalyst support.

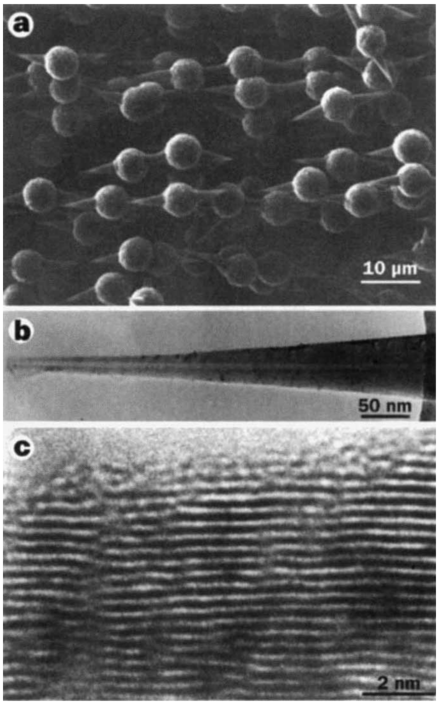

Figure 1 a, **Scanning electron microscope image of carbon beads with protruding cones.** b, **Low-magnification transmission electron microscope image of a small cone. Note the hollow nanotube at the cone's core.** c, **Transmission electron microscope image near the surface of a cone. Note that the graphene planes are parallel to the cone axis (which is parallel to the bottom edge of the picture frame), and not the cone surface, leaving open plane edges.**

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DNA analysis reveals the sex of infanticide victims

For many centuries, infanticide was an accepted practice for disposing of unwanted babies. We have obtained archaeological evidence of infanticide in Roman Ashkelon, on the southern coast of Israel, where skeletal remains of around 100 babies were discovered in a sewer[1,2]. In ancient Roman society, infanticide was widespread and practised mostly against unwanted female babies[3]. We were therefore surprised when, by analysing ancient DNA, we found a significant number of male victims in Ashkelon.

We found the infants' remains beneath a bathhouse, built in the fourth century over earlier Roman villas, where lamps decorated with erotic images had previously been found[1]. The Greek inscription "Enter, enjoy and...", which we discovered in the bathhouse, indicated that it might have also served as a brothel, as was common in the Roman empire[4]. The infants' bones were mixed with animal bones, potsherds and coins, in the gutter. Bone size, dental development and lack of neonatal lines in the teeth indicate that the human remains were 1- or 2-day-old infants. The combination of the death of so many babies showing no sign of disease or skeletal malformation, and the mode of disposal, implies infanticide[2].

There is ample evidence for infanticide of females in Graeco-Roman society[3,5]. The most explicit reference comes from a letter in 1 BC, dated 17 June, written by a certain Hilarion to his wife Alis: "I ask and beg you to take good care of our baby son.... If you are delivered of child... if it is a boy keep it, if a girl discard it"[6].

It seems likely that many female babies were disposed of promptly after birth. We therefore thought that the Ashkelon bones would probably have been from females. The reliability of morphometric analyses for gender identification in infants is low, especially in the case of incomplete skeletons. Therefore we planned to deal with the gender question by DNA analysis of the X and Y alleles of the amelogenin gene.

Because studies of ancient DNA are prone to numerous artefacts[7], stringent precautions and appropriate controls were required[8]. We extracted DNA from left femurs only, to avoid testing the same individual twice. We tested a total of 43 left femurs, and examined the reproducibility of the results in three independent extractions, using two different methods[9,10], and done several months apart. We performed three polymerase chain reactions (PCRs) for each DNA extract, using conditions and primers previously described[11].

DNA amplification was successful for 19

of the 43 specimens: 14 were found to be males and 5 females. The results for 17 of the specimens were reproduced in at least two separate DNA extracts. Significantly, there were no conflicting results in any of the different PCR analyses for a single specimen. We verified the authenticity of the amplified fragments by sequence analysis of male and female samples.

The significant number of male victims was unexpected and raised the intriguing possibility that these infants may have been the unwanted offspring of courtesans working in the bathhouse. This study exemplifies the usefulness of DNA analyses of human skeletal remains in obtaining unambiguous evidence to clarify otherwise open archaeological and anthropological questions.

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Medicinal alkaloid as a sex pheromone

The sex pheromones of more than 1,300 species of insect[1] have been identified since the milestone finding of bombykol more than 30 years ago, thanks to increasingly sophisticated analytical techniques and a great deal of effort. These sex pheromones, which number in their hundreds, are mainly restricted to a small group of chemicals with remarkable structural similarities. Female Lepidoptera, for example, largely use alcohols, aldehydes, acetates and hydrocarbons (including epoxides of hydrocarbons).

We have now identified an aromatic alkaloid, 1,3-dimethyl-2,4-(1*H*,3*H*)-quinazolinedione, as the sex pheromone for the pale-brown chafer, *Phyllopertha diversa* (Coleoptera: Scarabaeidae). It is interesting that this compound was synthesized more than 40 years ago, and has been reported to have anti-inflammatory[2,3], analgesic and anticonvulsant effects[3]. We report its first isolation from a natural source.

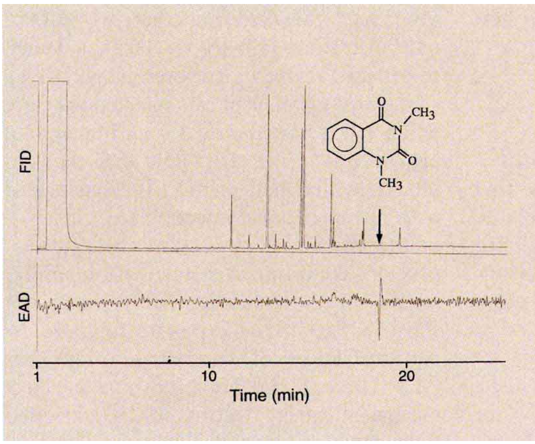

Figure 1 **Parallel flame ionization detector (FID) and electroantennographic detector (EAD) chromatograms obtained from the injection of 5 female equivalents of the whole-body extract (ether) of female *P. diversa*. Chromatographic resolution was obtained on a BP-20 SGE capillary column operated at 100 °C for 1 min, rising 10 °C min^{-1} to 260 °C, and held at this temperature for 10 min. A male antenna exposed to the effluent from a gas chromatograph responded only to a tiny FID peak (arrow). Top right, molecular structure of the EAD-active compound.**

The pale-brown chafer is a devastating turf pest in Japan, for which environmentally sound methods of control are badly needed. Evidence for the occurrence of a strong female-released sex pheromone (which accounts for the formation of a ball of males around a single female) was obtained more than a decade ago[4]. Several groups have been trying to identify this sex pheromone, but the tiny amount released by the females (at the picogram level) prevented its characterization.

When we subjected a sample of a biologically active ether extract, obtained from females collected from the field, to gas chromatography with an electroantennographic detector[5], we observed only one active peak (see Fig. 1). The amount of the semiochemical was so small that it was almost undetected by the flame ionization detector. Spectral data suggested that the natural product would have a benzene ring fused to a cyclic diamide moiety, that is, 1,3-dimethyl-2,4-(1*H*,3*H*)-quinazolinedione.

We prepared this compound by treating benzoyleneurea with sodium hydroxide and iodomethane in dimethylsulphoxide and found that it was indistinguishable from the natural product. In the field, traps baited with the synthetic alkaloid captured as many as 153±52 males per trap per hour, whereas the hourly catches per trap for the control were as low as 0.4±0.5 (t-test, 28.0865; $P > F$, 0.0001).

Molecules that have signal value in nature sometimes turn out to be of use to humans[6]; well-known recent additions to our therapeutic arsenal include ivermectin, cyclosporin, FK-506 and taxol*. The discovery of an insect sex pheromone with medicinal properties is, therefore, fortuitous, but not entirely unexpected.

It has been suggested that insect-pheromone recognition is mediated by a family of G-protein-coupled receptors[7,8]. The analgesic effects of non-steroidal anti-inflammatory drugs are primarily attributed to the inhibition of prostaglandin biosynthesis both in the peripheral and central nervous system, but other modes of action (for example, via G-protein dependent pathways) are also considered[9]. Identification of an insect pheromone with aspirin-like anti-inflammatory and analgesic properties for mammals may therefore contribute to better understanding of the interactions of this class of drugs with the nervous system.

*Bristol-Myers Squibb has registered Taxol as a trademark and wishes the scientific community to use the name paclitaxel.

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