Environmental clues

We brush dirt from our shoes and vacuum dust from our homes, but when a crime is committed, these substances often form valuable evidence. The minerals, fibers, and other particles they contain are the signatures of the outdoor and indoor spaces they came from, and can hint at a suspect's job, hobbies, movements, and habits.

Dust and dirt are so familiar to us that we only notice them as we clean them away. Even then we give scarcely a thought to their significance or composition. In a forensic context, dust and soil can provide direction to an entire police investigation, and may provide crucial evidence to link a suspect to the crime scene. Soil is mostly mineral and plant matter, but can incorporate small quantities of manufactured and building materials, depending on location. Dry, fine soil particles dominate outdoor dust, but indoor dust is mostly fibrous.

Collecting dust and dirt

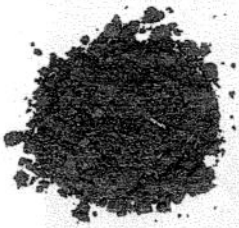
At a crime scene, investigators use tape lifts to sample superficial dust, or a forensic vacuum to collect ingrained dust from surfaces such as vehicle seats or carpets. A laboratory provides a more controlled environment for dust recovery from evidence such as clothes. Technicians pick out larger debris with tweezers or tape, and vacuum smaller particles.

A complete analysis of dust or soil is time-consuming, but fortunately, the need to do this is rare. More often, investigators want answers to specific questions, such as "Does the mud on the rape suspect's jeans

COLLECTING SAMPLES:

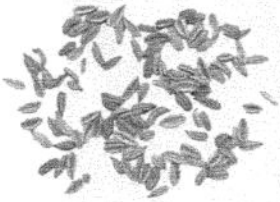
1. *Sieves in progressively finer meshes grade soil by particle size.*
2. *String grid provides measurement baselines in order to locate source of each sample on sketch of site.*
3. *Flags mark location of other evidence.*
4. *Here investigators are retaining large samples, but only a few spoonfuls are needed for soil analysis.*

CLUES IN THE SOIL

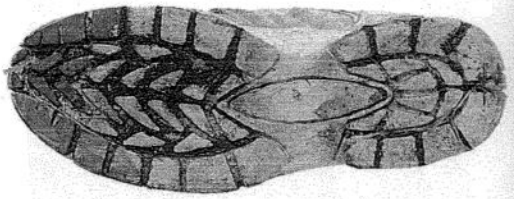


◀ **SOIL COLOR**
from crime scene and suspect may look similar, but only microscopy can prove they are the same.

▶ **PARTICLE SIZE**
is mixed in most soils: the large grains here are silt. Clay is also present, but too small to see.

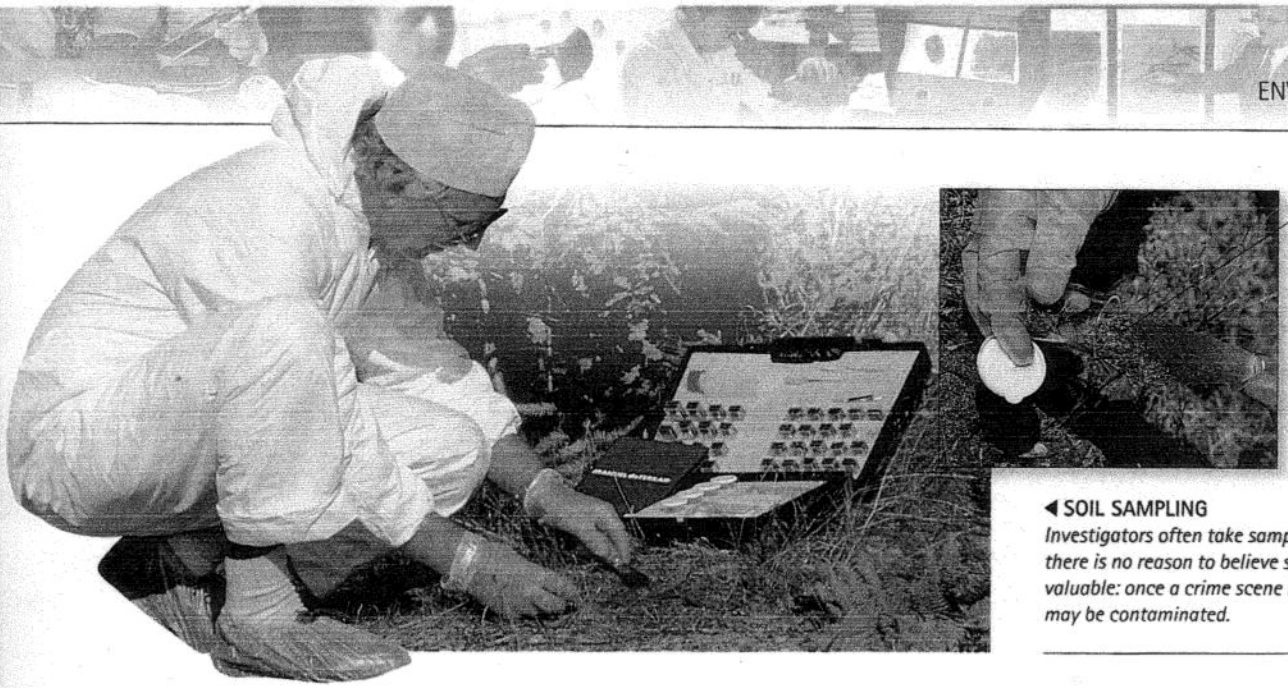


◀ **SEEDS**
and especially pollens resist decay in soil, and can often be identified by their shape and size.



Shoe treads collect soil easily.

A GRAVE FULL OF EVIDENCE ▼
Investigators recovering human remains take soil samples to compare with material found on a suspect's clothes, shoes, and vehicle. Pollen traces on the body can confirm whether it was moved, and soil may retain drug or chemical residues from the body.



To preserve the integrity of soil evidence, it is placed in a clean container that is sealed. Police change clothes between taking samples from crime scene and suspect to avoid compromising the evidence.

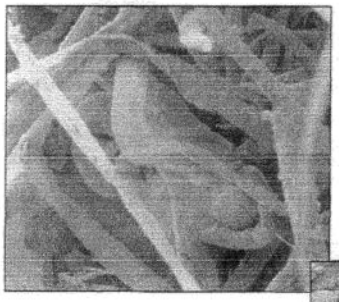
◀ **SOIL SAMPLING**
Investigators often take samples even when there is no reason to believe soil evidence may be valuable: once a crime scene is released, the soil may be contaminated.

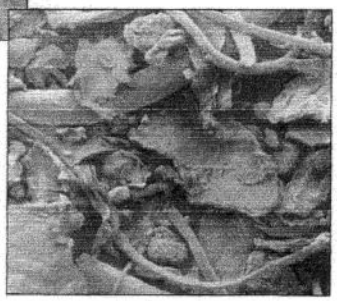
match mud found at the crime scene?"

Forensic scientists answer such questions by directly comparing the two soil samples. They analyze color, pH levels, and types and sizes of the particles the samples contain. Mineral particles have the properties of the rock from which they weathered, such as limestone or quartz. Particle shape can also provide clues; grains of ocean sand and desert sand, for instance, have quite different and distinct shapes. Botanical material, such as leaf debris, seeds, pollen, and fungal spores, may be more important because it can provide copious and highly specific information. In a 1960 abduction case in Australia, for example, investigators identified the culprit because a seed found on the victim's body came from a rare type of cypress tree that grew in the kidnapper's yard. Also, the proportion of different pollen types, a "pollen signature," found on suspects' clothing has been used to narrow search areas for buried bodies. Pollen and seeds can provide chronological information, too. Plants shed them only at certain times of the year, so their presence on clothing not only places a suspect or victim at a particular scene, but also indicates the season that they were there.

Under the microscope

Initial analysis of dust and soil relies on visual identification, using an optical comparison microscope coupled with a polarizer. More detailed analysis requires a scanning electron microscope. Microscopists need an encyclopedic memory for the many different particles they are likely to find, but they are aided by reference collections of the more common types. (Most labs accumulate such samples over time, but—bizarrely—it is actually possible to buy collections of dust.)





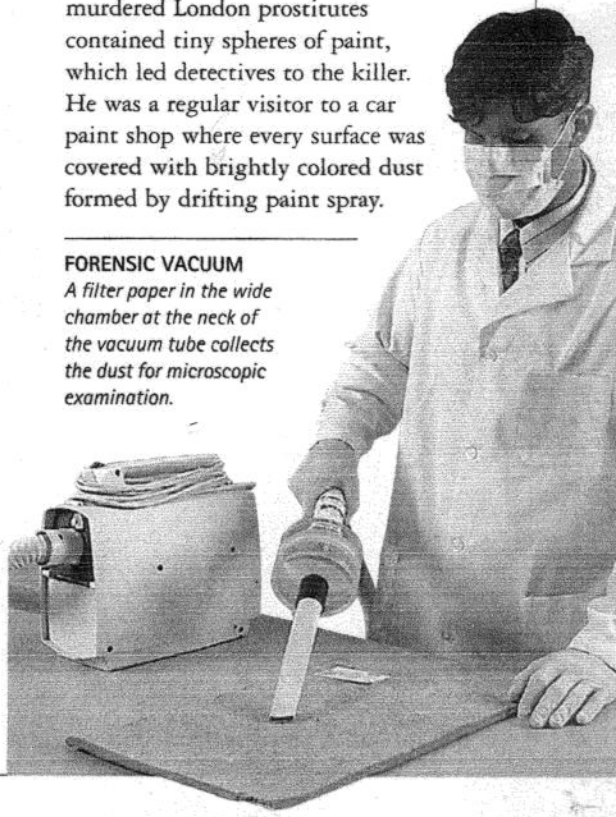
HOUSE DUST
These magnified images illustrate how dust from different homes looks nothing alike. So finding a dust match makes for strong evidence. These samples include pet hair, skin flakes, dust mites, and fibers of clothing and carpets.

Microchemical analysis and X-ray spectroscopy can be used to provide further information if needed.

Damning dirt

Most importantly, dust and soil can give detectives new leads to follow. Soil samples may contain minerals from outside the area where the crime was committed, or the seeds and pollen of plants that do not grow locally. In these cases, mineralogists and botanists may be able to suggest locations where the police should focus their investigation.

Dust can be equally specific. Some house dust, for example, contains particles that are unique to the rooms from which it was collected. Bathroom dust contains talcum powder and cosmetics, and there is often flour and ground spices in kitchen dust. Industrial workers carry with them dust that identifies their employment. Yeast spores cling to brewers and bakers, and printers' clothes are ingrained with ink droplets and paper fibers. A 1960s case demonstrated how valuable industrial dust can be. Dust found on the bodies of murdered London prostitutes contained tiny spheres of paint, which led detectives to the killer. He was a regular visitor to a car paint shop where every surface was covered with brightly colored dust formed by drifting paint spray.



FORENSIC VACUUM
A filter paper in the wide chamber at the neck of the vacuum tube collects the dust for microscopic examination.