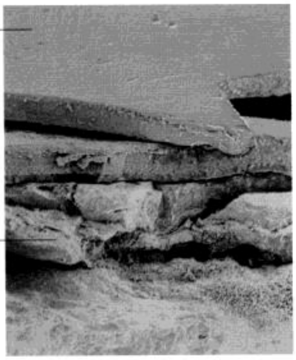
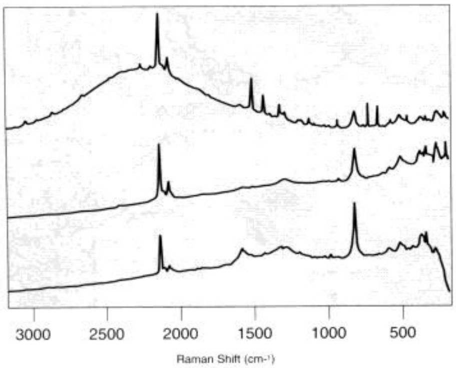
Material witness

To the forensic scientist, tiny particles of glass, fibers, and paint can tell intriguing stories. These manufactured materials add a limitless variety of color and sparkle to our everyday environment. It is this sheer diversity that makes minute traces of them such a powerful aid in linking the crime scene or victim with the suspect.



▲ RESPRAYED CAR PAINTWORK



PAINT COMPARISON ▲
A microspectrophotometer can distinguish between two paint samples of virtually the same color. The composition of each sample is analyzed and shown as a line with output peaks on a graph. The graph above shows three samples that are not from the same source.

Open a decorator's color chart, and you will get a glimpse of the rainbow variety of house paints available from just one manufacturer. Multiply this by the number of brands, and you realize that if paint from a crime scene matches a fleck found on a suspect, it strongly suggests a link between the two. But paint is seldom applied in a single layer. If several coats match, the link between suspect and crime is very compelling indeed.

Motor vehicle paints vary widely between makes and models. If a sample from the scene of an accident matches one taken from a suspect vehicle, the odds against a different vehicle being involved may be as high as 16,000:1.

Looking closely

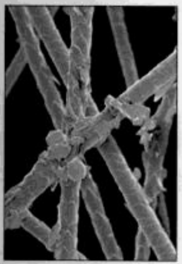
Even at low magnification, the colors of each coat in a paint fleck are often clearly visible. If simple visual examination is inconclusive, then cutting and polishing paint samples can make the colors and their sequence more obvious. More subtle methods of analysis include microspectrophotometry—an electronic study of the energy wavelengths of light absorbed and emitted by a sample.

In crimes where there are already suspects, paint samples taken from them and from the crime scene can be compared directly, but paint can also help in cases where the criminal's identity is unknown. Police forces maintain databases of vehicle

TRACING HIT-AND-RUN DRIVERS
Road accidents can leave traces on both the victim and the vehicle. Car bodywork retains incriminating clothing fibers, and leaves behind paint, glass, and plastic.

TYPES OF FIBERS

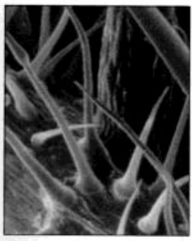
Investigators study not only fiber origin but also other identifying factors. These include fiber count, the twist direction in a spun strand, the thickness of a strand, and textile weave.



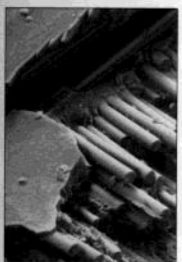
◀ **ANIMAL FUR** *is usually finer than human hair, and differs markedly between species. Each strand of this cat fur, for example, is covered with distinctive overlapping scales.*

▶ **SYNTHETIC FIBERS** *are less distinctive than natural fibers under the microscope. Their method of manufacture gives them a regular pattern, though texture may vary.*

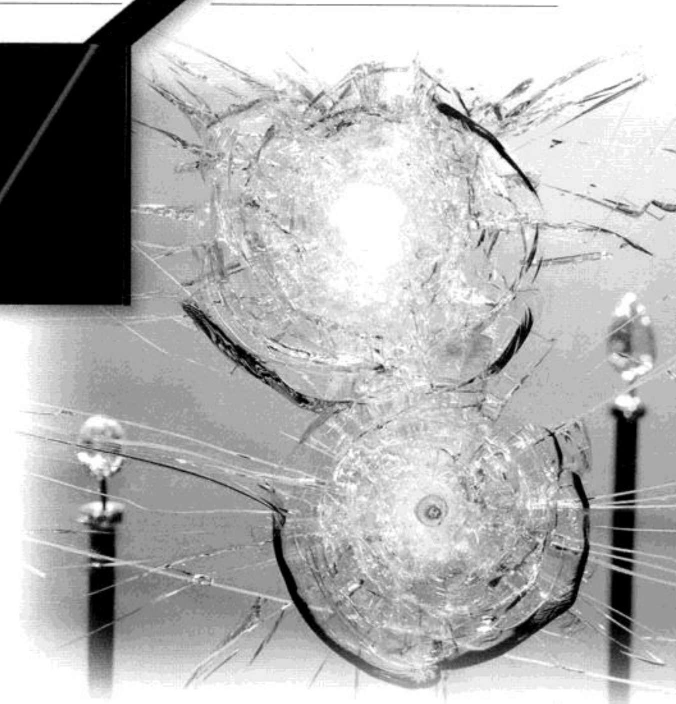
◀ **PLANT FIBERS** *have typical shapes. Cotton (shown here woven) is ribbon-like and twisted. Linen fibers look like knobbly tubes, and are pointed at each end.*



▶ **LEAF MATERIAL** *such as this stinging nettle is easy to distinguish from the fibers of cultivated plants, but only botanists can identify the particular species.*



◀ **GLASS FIBERS** *found together can indicate what they were applied in—aligned in mats, as here, they are widely used to reinforce tough plastic structures, such as boat hulls.*



BENDING LIGHT ▶
Refractive index can link glass pieces to a pane broken in a crime. To measure a shard's refraction, technicians immerse the sample in an oil that changes its refractive index when heated. At the right temperature, the sample all but disappears. For larger pieces of glass, a laser can be used for measurement.

paintwork, and in a hit-and-run case, this can help narrow down the search to a particular make, model, and even year. It is sometimes possible to fit a paint chip exactly back on to the surface from which it flaked. This physical match would be important evidence.

Transparently obvious

Flakes of glass can occasionally be matched in a way similar to paint, like pieces of a puzzle. Where this is not possible, investigators see if they can find a match by looking at the refractive index (light-bending ability) and density of the glass sample. Different types of glass bend light to different degrees. The method of measuring refractive index is explained above. Density measurement works by comparing the glass with two liquids that have different densities. Glass floats in the heavier liquid, and sinks in the lighter. Technicians mix the fluids until the glass sample neither sinks nor rises, then work out the glass density from the proportions of the two liquids.

If these two diagnostic methods produce a match for a pair of glass samples, investigators then refer to databases of glass types. This will tell them how common or unusual the glass is.

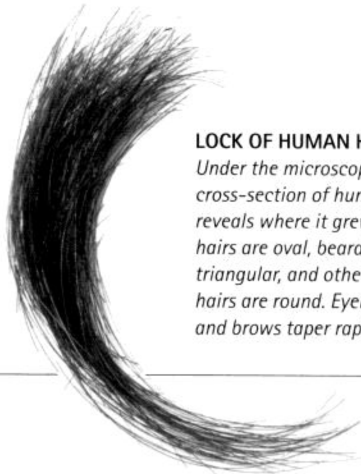
Matching fibers

To the unaided eye, most fibers of similar color look broadly alike. But under the microscope, the differences are amazing. Natural fibers vary enormously in cross-sectional shape. Animal fibers have characteristic scales on the surface, and have a varied thickness. There is a much wider variety of synthetic fibers, which can be identified by their solubility and melting point; by optical qualities such as refractive index; by their shape; and by chemical analysis.

Dyes add yet another dimension—by analyzing their component colors using thin-layer chromatography (see p. 82) or by microspectrophotometry, investigators can distinguish between otherwise similar fibers.

Common or rare?

Traces of glass, paint, and fibers have provided investigators with important leads in countless cases, and their collection is a routine part of police work. However, it is important to remember that their value as evidence depends on how common they are. Just one fiber of an unusual fabric can be all the evidence that is needed to put a criminal on trial, but undyed cotton is so common that fibers of it found at a crime scene are quickly disregarded.



LOCK OF HUMAN HEAD HAIR
Under the microscope, the cross-section of human hair reveals where it grew. Armpit hairs are oval, beard hairs are triangular, and other head hairs are round. Eyelashes and brows taper rapidly.