

The Store-front Cat

In any city worthy of the name are many commercial areas about three blocks long—clusters of small shops that offer shoe repair, vegetables, insurance, gourmet coffee, used books, real estate, flowers, and greeting cards. They have changed little over half a century. Needlework stores may give way to rapid printing, or dry cleaners to laundromats, but the dominant characteristic of the neighborhood shopping street remains the same, a permanence unchallenged by even the glossiest shopping mall.

The geometry of each little cell is the same. A glass door and a display window form the wall fronting the street; the shop itself is a long narrow rectangle, filled with the scents of the trade—coffee, or steam, or dust, or roses, or shoe polish.

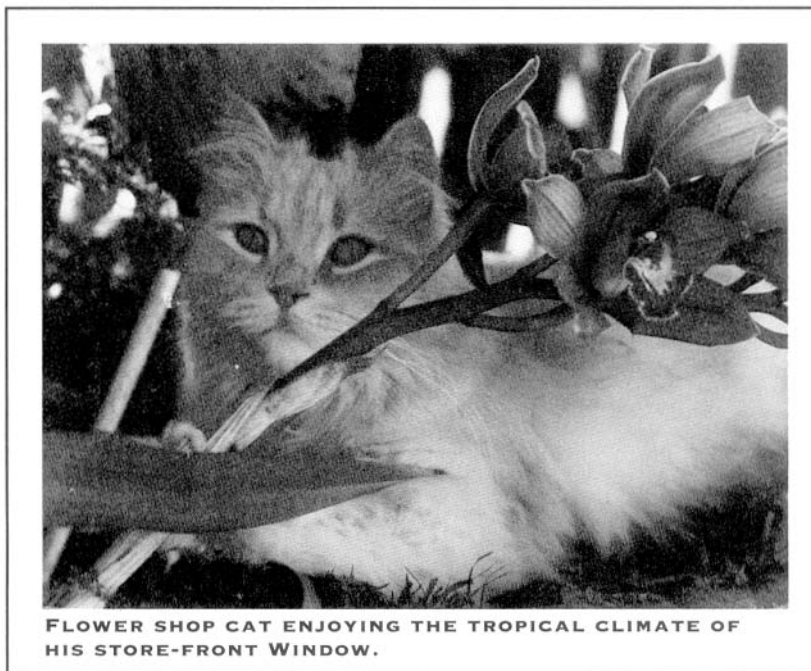
And there in the front window, exactly where I first saw him many years ago, lies the cat. He curls up between easel-mounted photos of houses for sale, or on top of the latest diet book, or under expensive floral arrangements. Outside, curious children tap on the glass, wondering how he can sleep so soundly on such a public bed.

The store-front cat is an expert on radiation theory. He knows that the

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optical properties of materials are wavelength-dependent. Even on the coldest day, he argues, some solar energy in the visible region will pass through the window, to be absorbed in his high epsilon fur. And he himself is shielded from radiation loss to the cold

dark grayish-brown skin, he readily absorbs light (UV, visible, IR, anything he can get) and his body rises to operating temperature. Within half an hour of sunrise, he is off catching insects with his agile tongue, or flashing away from predators.



The desert temperature continues to rise all day. By midafternoon the rocks and sand are scorching. But though he's now in danger of dehydration and overheating, the lizard must continue to hunt and to run. This means continued exposure to the fierce sunlight. Fortunately for the collared lizard, he has a "smart skin" that changes color with temperature. This is not a concealment strategy; it is a thermal strategy for establishing dynamic balance between temperature and absorption. By 3:30 p.m., the collared

lizard is perceptibly lighter in color. He reflects a greater percentage of incident light, and his body temperature remains in the best working range for racing over the rocks and snapping up insects until sunset. (See photos, page 72.)

sky outside by the glass, impervious to his $9 \mu\text{m}$ output. All the objects around him (greeting cards, hairbrushes, halfsoles) have been placed there to absorb light, rise in temperature, and contribute to the thermal environment of his couch. He sleeps the contented sleep of a physicist who has solved a difficult problem—how to stay warm without effort.

Instrument and system designers often forget the wavelength dependence of material properties. From their efforts arises the phrase "smoke test" as part of our standard technical vocabulary. But in the wider animal kingdom, it is not just embarrassing to neglect thermo-physical properties; it may be fatal.

The desert collared lizard, *crotaphytus insularis*, is torpid, as cold as the desert around him when he wakes up at dawn. But since he has a

ON THE SAME WAVELENGTH? Animals are appealing examples of wavelength awareness. Some are expert mainly in dealing with visible light. Others, like the cat, handle the entire electromagnetic spectrum with astonishing sophistication. Unlike the cat, young children are dubious about IR and UV. They naturally gauge the complete spectrum by the small part that they see. A glass window is "transparent"; it looks like a window, so it should behave like a window, and not become a wall the moment one's back is turned.

Fortunately, there are plenty of visible examples, but first it is necessary to introduce the idea of color, which will serve as "wavelength" until you get around to more advanced physics.

Here, too, there is a considerable

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barrier: most junior high students aren't really convinced that white light contains all the visible colors. And why should they be? Most have never seen a prism or a grating, much less a demonstration of dispersion. Seeing is believing, at least in the visible. If you don't see it, why should you believe it? One high school honor student grumbled, "The teacher *said* that white light contains all the colors, so I *guess* it's true."

Let's assume for a moment that a child has seen the prism experiment, and knows that sunlight can be broken into its various "colors." Then you can say, "If this shirt looks blue, and that sweater looks red, what's happening when the white light strikes these colored objects?" If you have a flashlight and a colored filter (and a darkened room), you can try shining red light into the red sweater and the blue shirt. This gives you the elementary wavelength dependence of optical properties for those materials. It shows that the materials themselves interact differently with the same light source.

Examples of wavelength dependence and radiant energy conversion are all around us. Why do you park your car under a tree in summer? Why do you haul a clumsy umbrella to the beach? Why does the snow remain on the north side of a hedge, when it has melted everywhere else? How does suntan lotion protect skin from UV,

though it is transparent to visible light? What is that warm sensation you get when you place your hand near the case of your TV set? Why should you not leave your dog in the car?

All these questions can be readily answered by readers of this article. After all, light is your business, and light comes in all colors, most of them invisible. But for young people just beginning to understand the physical world, the answers are not obvious. The light itself is seen as the main actor in the drama; the illuminated material is not considered an active participant.

What part does that "passive" material play? The lizard knows the answer to that question, at least in the visible region. If you want to get really complicated, you have to ask the cat. The cat knows, better than the average human, that the electromagnetic spectrum is more than visible light, and that the whole spectrum can be put to good use.

ACKNOWLEDGEMENTS

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