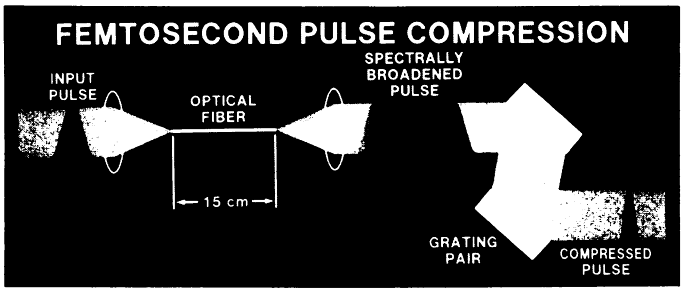
Splitting seconds ultrafine with light

A femtosecond is 1×10^{-15} of a second, a thousand-million-millionths of a second. Thirty femtoseconds is not a span of time easy for a human consciousness to try to imagine. It is even a bit short for the equipment of modern physics, but it has been measured off by a pulse of laser light. That pulse is the shortest light pulse ever generated, according to the people who did it (C. V. Shank, R. L. Fork, R. Yen and R. H. Stolen of Bell Laboratories in Holmdel, N.J., and W. Jack Tomlinson of Bell Laboratories in Allentown, Pa.).

Shank expects that 30-femtosecond pulses will be a very useful tool in investigating the behavior of atoms, especially in condensed matter.

Speaking for the group, Shank described the method at last week's joint meeting in Phoenix of the Topical Meeting on Optical Fiber Communication and the Conference on Lasers and Electro-Optics. The shortest pulse obtainable from a mode-locked ring dye laser is 90 femtoseconds.

To squeeze it down the experimenters first transmitted the pulse along an optical fiber that has special "nonlinear" optical properties. This fiber will take incoming light of a given wavelength and generate new wavelengths, distributing the available energy among them. The greater the intensity of the incoming light, the more wavelengths are made. With sufficient energy in the incoming pulse, the fiber generates almost a white-light spectrum.



Bell Laboratories

This process necessarily stretches out the pulse, but the multiplicity of wavelengths provides a handle for a recompression that results in a pulse length only a fraction of the original. The recompression is accomplished by multiple reflection of the light between a pair of sawtooth gratings placed parallel to each other and at an angle of 30° to the original direction of the light beam. As the light bounces back and forth between the teeth of the gratings, different wavelengths are reflected at slightly different angles. Over many reflections the cumulative effect is to pile the wavelengths on top of each other and compress the whole burst of energy into a fraction of the space taken by the original 90-femtosecond pulse.

It may be possible, Shank says, to "study physics before it becomes statistical." That is, experimenters may be able to follow specific sequences of events without having to sort them out statistically from the multitude of things that can happen in the duration of a longer pulse. It may also be possible to deliver energy in such a way that a chemical compound that might form by bonding itself in one of several different ways is constrained to make only one kind of bond. *—D. E. Thomsen*

Drug death more common in uncommon places

Drug addicts develop a psychological tolerance associated with the ritual of drug administration and as a result are more likely to overdose in unfamiliar surroundings, according to a psychologist at McMaster University in Ontario, Canada.

Shepard Siegel, writing in the April 23 SCIENCE, suggests that a fatal drug overdose may frequently result from a normally tolerable dosage when it is taken under unusual circumstances. Addicts, Siegel explains, have been conditioned to respond to the pernicious effects of drugs, and such adaptive responses are triggered by environmental cues associated with the normal drug-taking ritual. When the circumstances of drug administration are altered and the cues are missing, the body fails to anticipate — and to counteract — the dangerous drug effects.

Siegel, in cooperation with psychologists Marvin D. Krank and Jane McCully of McMaster and Riley E. Hinson of the University of Western Ontario, ran a series of experiments in which two groups of rats, each in a distinct environment, were injected with small but increasing doses of heroin. The rats were then placed in one of the two settings and injected with a large dose of heroin. Although both groups of rats had a lower mortality rate than did inexperienced controls, the rats that received the large dose in a setting where they had grown to expect it were much more likely to survive the shock than were those injected in foreign surroundings. According to Siegel, animals learn the stimuli that predict the coming of pharmacological insult and can adaptively prepare for the drug.

Drug tolerance and overdose are psychological phenomena, Siegel suggests. The implication for human addicts, he says, is that drugs will have a greater effect if taken in strange context; death from overdose is frequently caused by a "failure of tolerance." In a yet unpublished study, Siegel told SCIENCE NEWS, he interviewed addicts at a New York methadone clinic who had survived a drug overdose, and he found considerable anecdotal evidence to bolster the findings from the animal studies. In most cases, he says, the victims reported taking the drug under uncommon circumstances on the occasion of overdose.

The environmental cue in the rat studies was white noise, and cues for human addicts can range from simple — physical surroundings, for example — to complex, Siegel says. The body's adaptation depends on the overall similarity between the usual ritual and the new situation. One solitary heroin addict, he notes for example, overdosed the first time he took the drug in a group. "If you usually shoot up in one environment," Siegel concludes, "and you then shoot up in a different environment, you are putting yourself at risk for suffering profound drug effects which could lead to a fatal overdose."

—W. Herbert

Technology for undersea cables

A few years ago sending telephone messages by light pulses through optical fibers was a possibility being tested in a few short installations in a few places in the world. The field has moved so fast that now there is already intense competition to see who will provide the technology for a transatlantic optical cable. Bell Laboratories wants to be that provider, and its representative in these matters, Peter Runge, described cable and regenerators designed for undersea use at the Topical Meeting on Optical Fiber Communications in Phoenix last week.

Runge stresses that this is no laboratory experiment. The cable and regenerators are designed to survive on the bottom of the ocean under a maximum 200,000 pounds per square inch pressure and to take strains of up to 8 percent during raising and lowering. Bell Labs has successfully sent signals over 101 kilometers of such cable without a regenerator in the length. This is the longest nonregenerated transmission of optical signals yet reported. (The fewer regenerators, the cheaper the cable is to make and maintain.) Bell's British and French competitors showed nothing approaching this.

After the Atlantic cable Runge envisions a Pacific cable. This, he feels, would have to be a compromise between American and Japanese technology with a switchover point in the middle of the ocean. Hawaii would be the most efficienct junction; cables from Australia and other South Pacific points are switched in there. If Hawaii became the junction, Bell would have to make a joint arrangement with General Telephone and Electronics, which owns the Hawaiian Telephone Company.

—D. E. Thomsen