was expecting to have established state-level coordinators in as many as 15 states, emphasizing those with appreciable portions of the country's space business.

William Van Cleave, senior defense policy advisor for Republican candidate Ronald Reagan, is setting up a "space science committee," but, he says, "I think there are no plans at all to go campaigning on space." Instead, according to Van Cleave, the committee is one of several being established "with an eye toward January 20," planning ahead on policy matters on the assumption of Reagan's election.

Anderson's space policy calls for "an expanded space program based generally on [the National Aeronautics and Space Administration's] current five-year plan." That plan, however, the policy statement avers, "does not include funding for several vital programs needed for the development of space science, technology and industrialization. Most of these programs, included in earlier plans and cut from the current proposal by the Carter Administration, should be reinstated." The areas identified by the Anderson policy include:

- "An intensified effort to achieve routine operational use of the Space Shuttle, with improvements in lift and on-board capabilities."
- "A more adequate fleet" of shuttle orbiters—five, says Fulda, instead of the Carter administration's four.
- "Establishment" of an operational Landsat-type earth-resources satellite survey system, "in lieu of the hesitant, half-hearted motions" of the administration.
- "Proper support of a long-term program" of solar system exploration, with specific mention of the Galileo orbiter and probe of Jupiter (already under development), the Venus Orbiting Imaging Radar (now being sought in NASA's FY 1982 budget after two unsuccessful attempts) and a flyby of comet Halley. (Some U.S. scientists fear that plans for a U.S. Halley mission, already well behind the Venus flight on NASA's "new start" priority list, may finally succumb to the alternative of U.S. cooperation with the European Space Agency's planned Halley effort.)
- "Establishment of a permanent U.S. presence in space through planning and design of a general-purpose orbiting space station."
- "Vigorous" continued studies of the feasibility of solar power satellite systems "until a rational basis has been established for deciding whether to develop it or not."

The Anderson statement does not cite specific cost estimates, but Fulda says that the non-shuttle portions of such a program could cost about 17 to 25 percent more in the course of NASA's 1981-1985 planning interval than they might in the sort of program inferred from Carter administration activities. Even so, the statement asserts, the space program "is one of the few taxpayer-supported programs which can show a greater return (by several fold) than our initial investment."

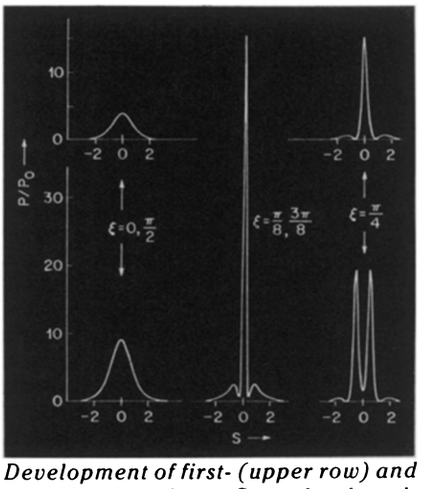
Echoing a General Accounting Office report from earlier this year (SN: 2/16/80, p. 102), the statement advocates encouraging greater participation by private industry. "Private industries should be allowed accelerated depreciation in all areas, not merely those related to space, for their capital stock and the existing investment tax credit should be extended to qualified research and development expenditures." Satellite-borne earth-resources systems and space manufacturing technology both should receive increased federal support, the document says, citing aviation and communications satellites as examples of government-initiated fields that have been successfully adopted by private enterprise. "There is no reason to suspect," according to the policy statement, "that the remote-sensing and space-manufacturing industries will not follow." It also calls for eased government regulations "to allow easier entry of private enterprise into space programs."

Besides teaching about space policy and energy policy at Fairmont State, Fulda is a member of several pro-space organizations including the industry-oriented National Space Institute and the Planetary Society (started by Carl Sagan and by Jet Propulsion Laboratory director Bruce Murray). NASA and the "responsible space constituency" generally agree on the overall distribution of the civilian space budget, says the policy statement. "One expects some disagreements among program offices as to the proper division of the space budget pie, but there is almost unanimity of opinion that there is a pressing need for a larger pie."

Predictably, the statement advocates increased international cooperation in space projects and, on the military side, the U.S. development of anti-satellite technology (unless the Soviet Union will agree to a ban).

A civil space policy issued by the Carter administration in 1978 was declared by NASA administrator Robert Frosch to consist of "straightforward directives and provide the basis for an exciting and productive space program in the years ahead." Critics claimed that the policy was not specific enough, in part because it seemed to defer key decisions until after the space shuttle demonstrated its ability. "As the resources and manpower requirements for shuttle development phase down" the Carter policy stated, "we will have the flexibility to give greater attention to new space applications and exploration, continue programs at present levels or contract them." At the time the policy was presented, however, the shuttle's maiden flight was targeted for last month. Now it is aimed at March of 1981—with an election taking place in the meantime to determine who will set the policies that follow. □

Soliton solutions in an optical fiber



Mollenauer, Stolen and Gordon

Development of first- (upper row) and second-order solitons. Second-order solitons split into two peaks and recombine.

Solitons, or solitary waves, appear in the theories of many branches of physics. Solitons represent solutions to an important and ubiquitous mathematical equation, the nonlinear Schrödinger equation. Now solitons are no longer entirely theory. A report of an experimental demonstration by L. F. Mollenauer, R. H. Stolen and J. P. Gordon of Bell Telephone Laboratories in Holmdel, N.J., was to appear in the Sept. 29 PHYSICAL REVIEW LETTERS.

A soliton is a single wave shape that is not part of a continuous train of waves, but that stands alone. Unlike ordinary pulses of waves, solitons maintain their shape as they propagate their way through the medium that supports them. Dispersion does not make them dribble away and dissipate like ordinary pulses. The experimental work of Mollenauer, Stolen and Gordon demonstrates, they say, the existence and propagation of soliton light pulses in an optical fiber.

For the production of solitons, the material of the fiber (its quartz core, that is) must satisfy two conditions: negative dispersion and nonlinearity. Dispersion is what a prism does to a light beam when it makes a rainbow. In a material medium, like quartz, the speed of light varies according to frequency. In most media this "dispersion" is usually "positive." That is, low frequencies go faster than high frequencies. But in some media over certain frequency ranges dispersion becomes "negative" so that high frequencies go faster.

For low intensity light, the speed of any given frequency in a given medium is a constant number. At the light intensities characteristically given out by lasers, that can change. In these nonlinear media the speed of light for a single frequency varies according to the intensity of the light. This causes a change of phase in one part of the

pulse relative to another. A slight frequency shift goes along with this phase shift.

The effect of all this is to raise frequencies in the trailing half of the pulse and lower them in the leading half, producing what is called a "chirp," after the acoustical phenomenon of the same name. Negative dispersion, working on this chirped pulse, tends to narrow it, because the trailing part keeps trying to over-run the leading part. In the experiment, negative dispersion narrowed input pulses produced by a mode-locked color center laser operating at 1.5 micrometers wavelength from about 20 picoseconds wide to 2 picoseconds wide and it made solitons out of them. The shape and behavior of the pulses conforms to the mathematical expectations. They rise and fall as they should, and when they fall, they give back the shape and frequency spectrum that came in. "That's the mystical part," says Mollenauer. One doesn't expect such exactness when dealing with actual matter.

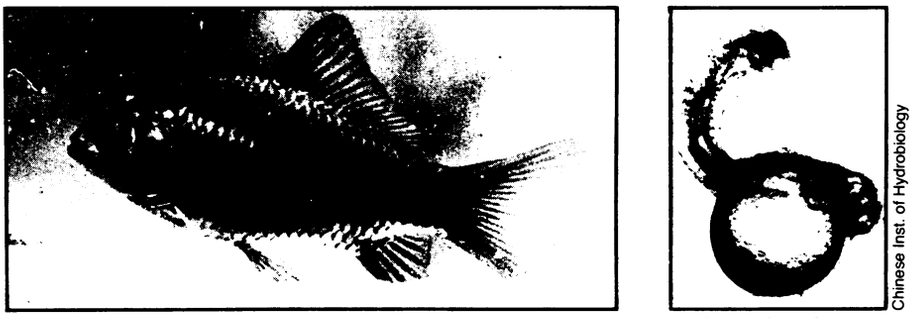
Mollenauer expects that solitons may be useful in communications someday, but not until the fibers are loaded with traffic at 1.3 micrometers. That is the wavelength at which dispersion is zero for quartz, and highly compressed, though not soliton, pulses can be made there. Later, perhaps, solitons at 1.5 micrometers could be added on the same fibers.

The work may also be of interest to those who are studying solitons in other branches of physics. Such studies have been mainly theoretical. These experiments have "opened our eyes, and we hope will open the eyes of other people," says Mollenauer. The experiments "have brought it down to the real world." □

Gene-splicer quits UCSD

The scientist who was charged with cloning the wrong virus (SN: 8/16/80, p. 101) has resigned from the University of California at San Diego. Samuel Ian Kennedy claimed that irreconcilable difficulties with the university's biosafety committee made it unlikely he could work there effectively in the future. The committee concluded its report on the incident with a statement that Kennedy had either cloned the Semliki Forest virus deliberately or made a mistake due to poor record keeping or a lapse of memory. Kennedy says he believes the virus was cloned due to accidental contamination of virus stock when vials were broken in transport from England. Kennedy and the committee differ on the chronology of events leading to the incident, and Kennedy charges the committee did not give him sufficient opportunity to explain the situation. It is widely agreed that no health hazard resulted from the error; cloning of Semliki Forest virus is now permissible under the National Institutes of Health guidelines. □

Chinese carp clone & cross-species embryo



Chinese Inst. of Hydrobiology

Now 4 months old and 4 inches long, this carp resulted from transfer of a nucleus from an embryonic cell into an enucleated, unfertilized egg. The source of the nucleus was a blastula, not an adult fish as had been reported earlier (SN: 8/2/80, p. 72). Among 189 attempted transplants, only two fish developed to the fry stage, say scientists at the Chinese Institute of Hydrobiology. More recently, scientists at that institute combined nuclei from one family of freshwater fish, grass carp, with cytoplasm from another, loach. The resultant embryo reached the "heart-beat" stage (right), but it died later of abnormal development. Chen Hongxi of the institute's laboratory of fish genetics and breeding suggests that techniques of somatic cell culture, genetics and nuclear transplantation soon may produce a new method of fish breeding.

Congress pledges a big spur to fusion

With a commitment reminiscent of President John F. Kennedy's May 1961 pledge to put a man on the moon, Congress last week cleared a bill calling for development of an operational fusion power plant by the year 2000, roughly 20 years earlier than is currently scheduled. Sent recently to President Jimmy Carter for his signature, the proposed Magnetic Fusion Energy Engineering Act of 1980 outlines a series of research and engineering objectives estimated to total around $20 billion.

The goal of magnetic-confinement fusion research is to enclose a hot, fully ionized gas of light nuclei, such as deuterium and tritium, within a "magnetic bottle" until the nuclei collide and fuse, liberating energy.

The magnetic-confinement fusion-power program aimed at developing commercial electric power plants is already 28 years old. Research developments, especially over the past two years, have boosted enthusiasm that conditions needed to achieve sustained and controlled fusion are "achievable...in devices now under construction," according to the bill's drafters, headed by Mike McCormack (D-Wash.).

For fiscal years 1978 through 1980, however, the magnetic fusion budget has declined 16 percent (after accounting for inflation). Stating that "progress in magnetic fusion energy systems is currently limited by the funds made available rather than technical barriers," the bill's sponsors claim their goals will require at least a doubling in seven years (after accounting for inflation) of the present annual magnetic-fusion funding, with a 25 percent funding increase necessary in each of the 1982 and 1983 fiscal years.

"[T]he present 2010 schedule for demonstration of practical fusion power is unnecessarily and undesirably long," said Robert Hirsch in testimony before the House subcommittee on Energy Research and Production last December. It is expected that schedule would lead to operation of a fusion power reactor by the year 2023. Added Hirsch, chairman of the subcommittee's independent fusion advisory panel, "After looking at details of the [Department of Energy's] planning...and considering past experience in other high-technology programs, we believe the engineering feasibility of fusion can be demonstrated before 1990 and that commercial fusion power can be demonstrated in the period 1995 to the year 2000." What's more, DOE agrees that operating a fusion demonstration plant as early as 1995 "is, indeed, credible," Hirsch testified.

DOE also estimates that the direct cost of the more rapid development schedule called for in the current bill would actually cut the program's total cost by about $2 billion (in 1981 dollars) over the $14.3 billion price tag associated with the present research timetable. Considering both price tags too optimistic, however, Congress proposes budgeting the accelerated program at $20 billion.

In addition to speeding the reactor-development schedule, the legislation calls for:

- creating a national magnetic-fusion engineering center to coordinate work at major fusion-engineering facilities,
- developing a detailed five-year plan that earmarks intended milestones and costs,
- receiving from DOE a comprehensive program-management plan — to be delivered to Congress no later than January 1982, and