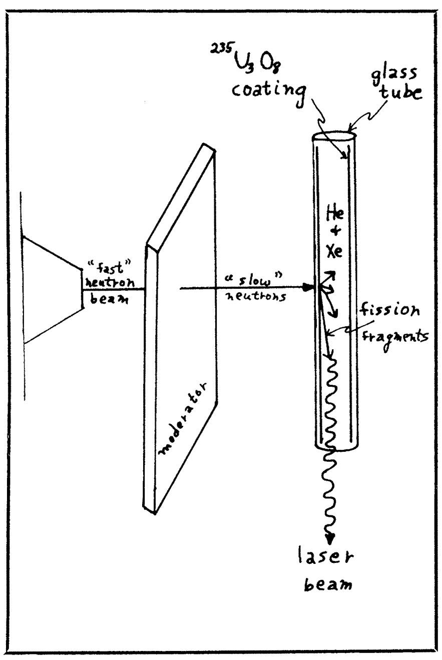
proportions in these compounds—the exact proportions of the record-breaker are one part lead, 5.1 parts molybdenum and 6 parts sulfur. In the testing of the many possible combinations, critical fields are higher than 600,000 gauss are expected to turn up. If they do, testing will be a problem. FBNML's best pulsed magnets can produce no more than 500,000 gauss.

In these cases there is always the metallurgical question whether the material can be made into wire and wound into coils, and whether the coils will behave the way the laboratory samples do. Foner is optimistic that both answers are affirmative. At these high fields a magnet must be carefully engineered with the strongest materials because the forces are so strong that it runs a danger of tearing itself apart. Nevertheless Foner believes that high-field magnets will be made of the compound some day. □

Reactor-powered laser developed

A long-standing barrier to more efficient use of nuclear reactors has been the difficulty of converting energy from a reactor's dense flux of neutrons directly into a more useful form. In conventional atomic power plants, conversion proceeds very inefficiently through several stages, ending with a steam-driven electric generator. In an important step toward liberating nuclear energy from the steam age, NASA scientists have succeeded in using a beam of neutrons from a pulsed reactor to power an infrared gas laser.

Working with the Godiva reactor at the Atomic Energy Commission's Los Alamos laboratory, T. F. Wimett, H. H. Helmick and R. T. Schneider took advantage of the reactor's exceptionally high flux of 10^{18} neutrons per square centimeter per second to cause fission of uranium atoms in the interior coating of a meter-long glass tube. Inside the 1.5-centimeter-diameter tube, at a pressure of about half an atmosphere, a gas mixture of 95 percent helium and 5 percent xenon was thus bombarded by nuclei resulting from fission in the coating. The resulting one-joule laser pulse, with 100 microsecond duration and a wavelength of 3.5 microns, shot out the end of the tube.



Reaction-powered laser: Fast neutrons from reactor are slowed in moderator and cause fission in uranium coating of glass tube. Fission fragments hit helium or xenon atoms causing them to emit a pulse of infrared laser light.

The development holds important implications for the feasibility of new laser applications and radical reactor designs. The project, the director of NASA's Research Division, Francis C. Schwenk, told SCIENCE NEWS, is part of a larger effort to develop an energy-efficient, fuel-conserving "gaseous reactor," in which fission occurs in a plasma of uranium atoms at very high temperature and pressure. Originally proposed as a propulsion system for interplanetary travel, the novel reactor now looks theoretically promising as an environmentally desirable, low-cost alternative to conventional and breeder reactors. But, unlike these other reactors, new ways of converting fission energy to more convenient forms must be developed before plasma reactors—still experimental—can become useful.

Direct conversion to coherent laser light now appears to be an attractive method of manipulating the hard-to-handle plasma energy. (MHD may eventually offer another method.) As coherent light, the energy could be transmitted over long distances—say, from an orbiting power station to other satellites or to the earth. Also, a laser beam of the proper wavelength can stimulate chemical reactions. Water, for example, could be dissociated into oxygen and hydrogen, and the latter used as part of a "hydrogen economy" (SN: 9/1/73, p. 135).

In a uranium plasma reactor, creation of laser light would not require the complex set of steps used in the Los Alamos experiment—the lasing gas would be mixed directly with the plasma and produce coherent light more or less automatically. Working with radio-frequency radiation under simulated reactor conditions, NASA scientists have been able to generate, from a tube containing argon, a flux of energy in the range needed for terrestrial power generation. □

Early protein lack: Malevolent effects

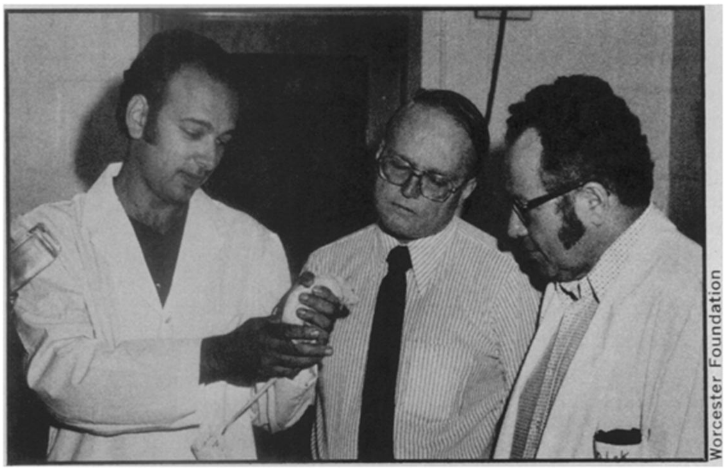
Many studies have suggested that malnutrition, specifically protein deprivation, can seriously harm the fetus and newborn. Total caloric restriction or protein restriction during pregnancy, for example, results in a smaller-than-average baby with a smaller-than-average brain. This brain will have fewer cells than normal, and with less DNA content than normal. Damage will be worse in certain parts of the brain than in others. Prenatal and postnatal malnutrition alters nerve transmitters and the enzymes that make them. It disturbs nerve cell connections. It can also lead to hyperactivity, emotional changes, decreased exploratory behavior and possibly learning problems.

Now a team of investigators at the Worcester Foundation for Experimental Biology, headed by Peter J. Morgane, Warren Stern and Oscar Resnick, has used neurophysiological, neurobehavioral, neurochemical and anatomical techniques to confirm and further underscore the malevolent effects of early protein malnutrition. Their work is in press with four journals: EEG CLINICAL NEUROPHYSIOLOGY, BIOLOGICAL PSYCHIATRY, DEVELOPMENTAL PSYCHOBIOLOGY and BRAIN RESEARCH.

The research group fed female rats a diet containing half their normal protein needs. The rats were mated and continued on this protein-deprived diet during pregnancy. Following weaning, their offspring were also maintained on a diet that contained half their protein needs. The investigators then studied the offspring before and after weaning for various brain and behavioral changes, comparing them with a group of rat pups that had not been deprived of protein during pregnancy and early life.

One of the things they found was that protein deprivation delays normal brain responses to visual stimuli. When they flashed a light in the eyes of the rat pups, electrical impulses were slow to register in the animals' brains. Prior studies have shown only that neonatal malnutrition, not protein deprivation specifically, produces such an effect. Although the Worcester team found that the delayed responses to visual stimuli returned to normal as the pups matured, they still believe that early delayed responses can hamper newborns' vision and normal development.

The Worcester investigators also found that prenatal and postnatal protein deprivation slowed central nervous system responses in the reticular formation, a core that runs up the brain stem to the thalamus and controls sleeping and waking. The responses became



Stern, Morgane and Resnick: Rodent studies demonstrate harmful effects of protein deprivation on the fetus and newborn.

slowest around the 13th day after birth, and then slowly returned to normal as the pups matured. Even though the responses returned to normal with maturity, the investigators believe the sluggish early responses to stimuli probably interfered with the animals' normal growth and development.

As for the behavioral effects of early protein deprivation, the Worcester scientists found that it enhanced the newborn rats' susceptiblity to seizure. They also found that the brains of these animals contained abnormally high levels of the nerve transmitter serotonin. This finding surprised them because past research has shown a strong link between seizures and low levels of serotonin. So they believe that serotonin cannot be a major determinant in seizures. They also found that these seizures could only be partly reversed by giving the rats adequate protein diets once they became adults. Thus, such damage appears to be irreparable.

The Worcester team has also shown that development of nerve cells in the cerebellum and hippocampus was retarded in the protein-deprived rats. The cerebellum is the area of the brain that controls movement; the hippocampus is the seat of memory.

These and past findings about the effects of early protein deprivation have practical implications for Americans, Morgane told SCIENCE NEWS. It appears that a mother need only be deprived of adequate protein right before and during pregnancy to harm the fetus she carries. And whereas the first 15 days of life are especially crucial for the rat's brain development, the last three months of pregnancy and the first year of life are crucial for humans' brain development. And many, if not all, of the harmful effects wrought during this period leave their marks for life.

It's quite possible—although exceedingly hard to prove—that many American children have learning and behavioral problems because they were deprived of necessary amounts of protein during fetal and neonatal life. □

Now you see it; Now you don't

Most people are familiar with the phenomenon of afterimages. If a person stares into the sun or at an intense light for any period of time, an afterimage will linger even though he or she may be looking away from the light source. Past research has shown that these images are not produced in the brain but originate in the eye itself.

Now two molecular scientists, Donald I. A. MacLeod and Mary Hayhoe, while working at Florida State University, have further pinpointed the site of afterimage production to be in the rods of the eye. Their findings are reported in the Sept. 27 SCIENCE.

When a person gazes at an object, the image is focused on the retina, somewhat like a newspaper photograph, as a series of points. The retina is made up of layers of rod and cone cells and each point of the image received corresponds to a rod or cone. Cones are best adapted for daylight, sharp stationary images and for color vision. The rods enable vision in dim light and are not color discriminative. When exposed to intense light, the cones take about five minutes to recover their sensitivity while rods take longer.

Prolonged afterimages occur when the visual pigments of the eye are bleached. The manner in which the afterimage appears depends upon the background it is viewed against. When the background is dark or the eyes are shut, the afterimage appears dimly against the dark background and is called the positive afterimage. When viewed against a bright background it appears dark and is called the negative afterimage. Afterimages against any unchanging background will fade within a few seconds. Generally a sudden change in background intensity will cause the afterimage to reappear.

MacLeod and Hayhoe found, however, that under some conditions a change in background will fail to revive the afterimage. In a series of experiments, they had an observer stare into a white light for 30 seconds. They found that for the first few minutes afterward, while the cones and rods remained insensitive, any change in background could revive the afterimage. But after seven or eight minutes, when the cones have recovered their sensitivity, the observer was able to locate a range of background intensities that failed to restore the afterimage. Above that range a negative afterimage would appear; below that range a positive image would appear.

In a second series of experiments, three totally colorblind persons (rod monochromats—persons for whom lights of different wavelengths appear identical to the rods) were asked to substitute background lights that are for them undistinguishable from the "condition" background. According to the researchers, the average radiances the rod monochromats chose were close to those chosen by the normal observers as having no effect on the afterimages. Thus only those backgrounds that are indistinguishable by rods (but very different for the cones) may be interchanged without reviving the afterimage. From this, MacLeod and Hayhoe deduce that the afterimages must be generated by the rods alone.

"During the first phase of recovery," MacLeod and Hayhoe conclude, "both rods and cones are locally insensitive and can generate afterimages. After seven minutes, the cones have recovered to the same fully dark-adapted sensitivity in the bleached area as in the rest of the retina. Being uniformly sensitive and uniformly stimulated, the cones cannot now create an afterimage, for they cannot signal a distinction between bleached and unbleached areas. Only the rods can now revive the afterimage, and they cannot revive it unless they detect the change of background." □

Early weapons to slay the mammoth

About 11,000 years ago in what is now the western United States, perhaps the first primitive North American hunters survived by hunting the fearsome mammoth. This extinct elephant had huge spiraling tusks often 10 feet long, and stood more than 12 feet high at the shoulder. It has always been difficult to understand how primitive men were able to down such giant prey.

Archaeologists Larry Lahren of the University of Calgary at Alberta and Robson Bonnichsen of the University of Maine at Orono report in the Oct. 11 SCIENCE the discovery of bone foreshafts in a burial site near Wilsal, Mont., and put forth a theory that