

minimum dating of 17,000 years." The Laguna findings therefore have more bearing on present archaeological controversies than do the Marmes discoveries.

For years anthropologists have been looking for conclusive evidence that human settlers arrived on the North American continent sometime before the opening of a corridor in the Canadian glaciers east of the Rocky Mountains. The glacial corridor is thought to have appeared roughly 11,000 years ago, and numerous human artifacts have been found in America dating from the same period. A few artifacts have been tentatively found to be much older than 11,000 years, though. Thus the Marmes Man discovery, with a maximum possible age of 13,000 years, was hailed as evidence that man did somehow arrive in America before the Canadian glaciers opened up.

The Laguna bones, says Dr. Stewart, "pretty much answer our questions. At

this point, I doubt whether it's worthwhile spending the money to dig up the Marmes site again."

**Not all scientists** agree that the Laguna bones are older than Marmes Man. Dr. Meyer Rubin of the U.S. Geological Survey points out the age of the Laguna bones was obtained by dating their collagen content, a method he considers unreliable. "I don't believe the 17,000 date," he says. "As a matter of fact, there isn't any really reliable way to date bones."

In any event, the scientists who discovered Marmes Man still hope to return to their site. Dr. Fryxell believes that, aside from the age of the bones, the Marmes area offers an unusually good picture of living habits and geological conditions at an early date in man's settlement of this continent.

"I think the Army Corps of Engineers' estimate for salvaging the site may be on the high side," he says hopefully. "We're not giving up on it." □

alternative is that the electrons are doing it by means of chemical bonds. And, says the Purdue team, the likeliest locus is the electron-rich F center.

Up to now neutrons have been studied either on the fly or as constituents of deuterium nuclei. Either the motion or the presence of a proton in the deuterium nucleus can cause severe complications in the interpretation of the data. For investigators of neutron physics, chemically bound neutrons would provide a supply of fairly stationary neutrons far away from the influence of protons.

**But first** the case must be proved, and so far it hasn't. In one experiment at Argonne National Laboratory, Drs. V. E. Krohn, G. J. Perlow, G. R. Ringo and S. L. Ruby irradiated lithium fluoride with a neutron flux that should have led to an even higher count of trapped neutrons than the experiment of Drs. Grant and Cobble. The Argonne experiment did not find that result.

The Argonne group suggests that the estimate of the binding strength used by Drs. Grant and Cobble may be much larger than is actually the case. "It was one of the few mistakes in style that (Enrico) Fermi made," says Dr. Ruby.

Fermi was the one who first calculated the binding potential between a neutron and an electron. In doing so it was necessary to choose whether an electron should be treated according to particle physics or chemistry. In particle physics an electron is regarded as a very small body; chemists usually consider valence electrons as ranging over the volume of an atom.

Fermi chose the particle physics treatment which made the electron small, concentrating its influence so that the bond to the neutron ought to be fairly strong, and this estimate was followed by Drs. Grant and Cobble. Dr. Ruby thinks the electron should be treated as if it ranges over the volume of an atom, which dilutes its influence and makes the potential bond much weaker.

Other experiments tend to confirm Dr. Ruby's judgment.

If neutron trapping reported by Drs. Grant and Cobble existed, says Dr. Donald W. Connor of Argonne, "something would really have to give. It would have to revolutionize some aspect of neutron physics." But experiments that he did at the National Bureau of Standards with Drs. Ivan Schroder, Robert S. Carter and Bert Mozer don't show the trapping effect.

This group did three experiments with lithium fluoride specially depleted of neutron-absorbing lithium 6 nuclei. They found no evidence for chemical trapping of neutrons when they irradi-

## CHEMICAL NEUTRONS

### Controversial bond in the F shell

A neutron is, on the whole, an electrically neutral body. But within itself it has both negative and positive charges and these do not seem to be evenly mixed. At times a neutron behaves as if it consisted of a positively charged proton core surrounded by a cloud of negative mesons.

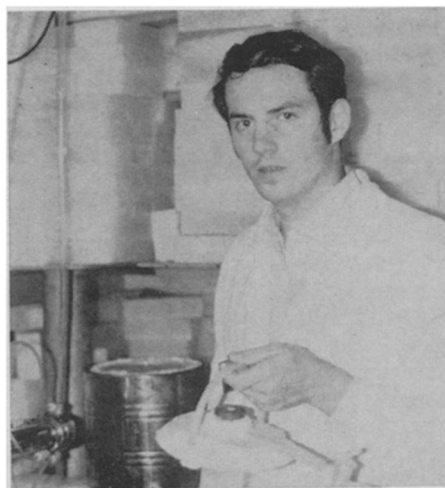
This separation of charges in the neutron produces a minute electric field. Combined with the spin of the neutron it also produces a small magnetic field. Either of these fields could in principle interact with the electric or magnetic field of another particle and produce a chemical bond between the two. In either case the force would be small.

In October two Purdue University scientists announced that they had evidence of chemical bonding between neutrons and electrons in lithium fluoride crystals.

**The report** sent scientists in various parts of the United States and Great Britain to their laboratories to see if they could confirm the findings. Some of the experiments are still going on. But those that are finished have so far failed to confirm the discovery.

Nevertheless, the original experimenters, Drs. T. J. Grant and J. W. Cobble, are sticking to their guns. They found that when lithium fluoride was cooled to temperatures around 4 degrees above absolute zero and irradiated with slow moving neutrons from a reactor, some of the neutrons remained in the crystal for as long as 40 seconds. They were released as the crystal warmed.

Drs. Grant and Cobble varied the ex-



Purdue

*Dr. Grant: Neutrons for electrons.*

periment in a number of ways so as to rule out, to their satisfaction, the more likely causes of such retention, particularly capture by atomic nuclei. They concluded that the neutrons were being captured by electrons in the so-called F centers of the crystal.

The F centers are formed by electrons that have taken the place of negative ions in the crystal structure. They are thus in a position that is fairly free of the surrounding atoms and able to make chemical bonds to things, such as neutrons, that come drifting in. Heating destroys the F centers.

Matter is composed overwhelmingly of nuclei and electrons, and if the nuclei are not doing the capturing by means of nuclear forces, the most likely

ated the lithium fluoride at 90 degrees K.

They tried again at about 4 degrees K. and still found nothing. Finally they applied a magnetic field to see whether bonding by magnetic forces could be induced, and again found nothing.

Dr. Connor believes the effect reported by Drs. Grant and Cobble may be due to capture by atomic nuclei, even though they say they have ruled it out. It is implausible, he says, that a neutron should avoid capture by a nucleus in a lithium fluoride crystal for long enough to be captured by an electron.

The third negative report comes from Los Alamos Scientific Laboratory, where Drs. Robert Wenzel, George Arnold and John Warren subjected a lithium fluoride crystal at 4 degrees K. to a flux 1,000 times that used by Drs. Grant and Cobble, and found nothing like the flux of trapped neutrons that the Purdue results led them to expect. □

## ORAL CONTRACEPTIVES

### Minipill in limbo

Birth control pills have been under fire by some segments of the scientific community ever since they were first marketed in 1960. Since then, the anti-pill faction has grown as researchers have linked the contraceptives to an increased risk of blood clotting, to hypertension, diabetes, neurological disorders and cancer.

Throughout the decade the Food and Drug Administration has monitored these research reports, growing more cautious about unqualified support of the hormone pills. Yet there is no sign it will move to ban them. Indeed, its last official statement, issued in September (SN: 9/13, p. 198) called them safe while urging increased research efforts directed at suspected problems.

Faced with mounting concern and confusion about the safety of birth control drugs in the public mind, Sen. Gaylord Nelson (D-Wis.) is holding hearings to provide a forum for discussion of risks and advantages. His avowed intention is to bring to public notice the controversy surrounding the birth control drugs being consumed regularly by eight million women at one time or another and to encourage physicians to inform their patients of the pills' known and suspected risks.

**This week** in the wake of the opening of the Nelson hearings, Dr. Charles C. Edwards, the new commissioner of the Food and Drug Administration, wrote to 381,000 doctors and hospital administrators to notify them of the latest data regarding blood clots among women taking oral contraceptives. "In

most cases," he said, "a full disclosure of the potential adverse effects of these products would seem advisable."

The connection between the pill and clotting is well documented compared to other possible adverse effects, including cancer. At the Nelson hearings, Dr. Roy Hertz of Rockefeller University testified that birth control pills are to cancer what fertilizers are to weeds. But not every researcher in the field would take so strong a view, even though the combination estrogen-progestin hormone drugs have been shown to produce malignancies in at least five species of laboratory animals.

**One alternative** to the suspect first generation products now on the market is a low-dose progestinal pill, free of the estrogen that has been accused of being the dangerous member of the combination (SN: 6/7, p. 556). The minipill, which has been in clinical testing for six years, exerts its contraceptive effect by some unclear mechanism, but most certainly it does not block ovulation as the prevalent combination products do. For this reason, it has been hailed as a more sophisticated agent than the combinations, which are something of a sledge-hammer approach to contraception.

The minipill too has its risks, however. One may be cancer. The evidence is circumstantial, less convincing than even the vague ties between the estrogen-progestin pills and malignancy. Nevertheless, in a surprising move, Syntex Laboratories, after consultation with the FDA, has suspended all human trials of its minipill because breast tumors developed in five dogs.

In experiments ranging over 18 months, the animals received large daily doses of chlormadinone acetate—the synthetic progestin—2, 10 and 25 times the daily one-half-milligram dose taken by women. Among the dogs, seven tumors appeared. One was malignant. Four were benign. Researchers are uncertain of the character of the other two.

Explaining the unexpected withdrawal of the progestin-only pill from testing, a spokesman for the Palo Alto, Calif., company said, "These are very conservative times. We felt we had to do this."

Following further animal tests and evaluation of the tumors already identified, the minipill may be restored to tests in women. As a contraceptive, the low-dose drug, taken 365 days a year, is about 97 percent effective—the combinations are 100 percent effective if properly used. To date, the most apparent side effect of the minipill has been breakthrough bleeding, which is more significant for its inconvenience to women than for any medical reason known so far.

Two other drug houses, G. D. Searle & Co., in Chicago and Wyeth Laboratories in Philadelphia, are also investigating low-dose progestin-only contraceptives. Neither company is as far along in its research as is Syntex. All three use synthetic progestins that vary slightly from one another. All three are conducting dog studies for possible cancer-causing effects, at the request of the FDA. Both Searle and Wyeth are continuing their human studies of their minipills. Neither reports either malignant or benign tumors in experimental animals.

**Whether dogs** are a reliable animal model for studies of contraceptives and their link to cancer is moot. A number of investigators in the field, both in and outside of the drug industry, find the dog a particularly poor species for reproductive studies of any sort because so little is known about the endocrine systems that regulate hormones in these animals.

**Rats, rabbits** and monkeys are considered more valuable species for studies in this field, but as one scientist said, "The FDA wants dogs regardless. So you give them dogs." Syntex investigators also conducted chlormadinone trials in monkeys but found no evidence of tumors.

Though chlormadinone acetate is not yet marketed as a progestin-only contraceptive in the United States, the synthetic hormone is available in C-Quens, a sequential birth control pill sold by Eli Lilly and Co. of Indianapolis. Women taking their product take estrogen alone for 15 days and a combination tablet of estrogen and two milligrams of chlormadinone acetate for five days. Lilly scientists have observed no breast changes in either women or dogs.

Syntex also is marketing the minipill in England, France and Mexico. Recently, however, the British dropped it from their list of recommended drugs because of its high failure rate and its consistent record of causing intermittent or breakthrough bleeding. □

## JETPORT

### Everglades reprieve

The possibility of a commercial jetport being located near Everglades National Park in Florida has been part of the running battle between developers and protectors of the environment (SN: 10/4, p. 296). Last week the environmentalists won. Dade County, Fla., agreed to seek an alternate site for the controversial airport.

The existing flight training operations at the present one-runway site will continue temporarily under strict environmental safeguards. □