traditional fishing industry concentrating on high-fat fish like salmon and herring.

A number of FPC processing methods have been developed in recent years, but in all of them the fish is processed without removal of heads, fins, tail, viscera or intestinal contents. In order to obtain a bland-tasting, stable and yet nutritional concentrate, it is necessary to extract water, water-soluble odor-bearing compounds and fats from the raw material. There can be a number of difficulties at this stage since certain of the fats are firmly attached to the proteins.

Most fat extraction processes use only a single solvent to dissolve the fats, in order to minimize the problems of removing the solvent. But since many single solvents are generally inefficient, several FPC production methods use solvent mixtures or solvent sequences.

The process used by Alpine was one of these. Actually Alpine used the technique of the VioBin Corp. of New Bedford, Mass., since it had arranged to use VioBin's processing plant to fulfill the AID contract. In this method ethylene dichloride is used as a first solvent, followed by successive baths of isopropyl alcohol.

The technique perfected by the Bureau of Commercial Fisheries as part of its research effort, in contrast, uses only isopropyl alcohol as a solvent. Both processes were approved in 1967 by the FDA for manufacture and sale of FPC in the United States.

The dissimilarity is one difficulty the bureau is having in trying to help Alpine decide what went wrong. "We are just not as familiar with their process as with ours," says Roland Finch, director of the bureau's National Center for Fish Protein Concentrate. The problem of protein deficiencies had not been encountered in the bureau's method.

It may turn out that the problem with Alpine's product is a result of a still-undiscovered operational factor, rather than of the process itself, although Finch tends to consider that wishful thinking. Evidence seems to point to something about the two-solvent process. Another possibility is that the protein is being damaged by heat during the processing, although the temperatures used seem to be within acceptable constraints. A number of other possibilities are being studied.

"It's an unresolved problem," says Finch, "but I think a systematic attack on it will find the cause."

Alpine plans to reopen the plant at New Bedford on Feb. 1, partly in an effort to help track down the defect in the process. "We are going to try to solve our problems," says Bourdon. He hopes that if the difficulty can be found and corrected a new contract might be negotiated with AID this spring.

Hope for FPC's future also lies with the petition put before FDA by the Bureau of Commercial Fisheries to allow the concentrate to be made from additional orders of fish, including the families of herring, anchovy, eelpout, right-eye flounder and codfish.

This would help greatly to improve the economic situation for Alpine and future FPC manufacturers. Alpine was hurt by a smaller-than-expected catch of hake in 1968 and 1969 by the New England fishermen who had sub-contracted to supply the necessary tonnage to the company.

Granting of the petition would mean that the processor would no longer have to sort out the hake from other varieties that can constitute up to 30 percent of a catch. It would also allow the fishermen to go after more common varieties of fish during the months that hake disappears.

The FDA has until March 15 to take action on the petition, although it can then request another 90 days for additional study.

For the long-run future of FPC, assuming the protein deficiency problem is surmounted, the most important factor is economics. "FPC, to be successful, has to be lower in cost," says Finch. "I think this is feasible with time and experience."

MARMES MAN

Drying out a discovery

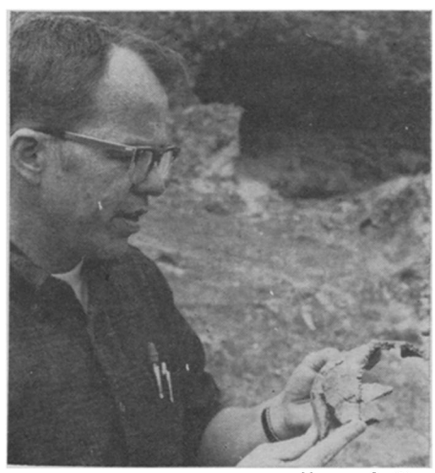
Buried under a few sheets of plastic, some gravel and a lot of water, is one of the best-known archaeological sites in America. Reclaiming it depends on someone coming up with $7 million.

The small canyon in southeast Washington State, where the 10,000-year-old remains of Marmes Man have been unearthed in the past five years, happens to lie in the path of a man-made lake created recently by construction of a dam on the Snake River. In spite of a protective levee that the U.S. Army Corps of Engineers thought would avert flooding, lower parts of the archaeological site have been under 30 feet of water since early last year. It has been inundated, but not destroyed.

Dr. Roald Fryxell, a Washington State University geologist who took part in the first Marmes discoveries. has been visiting the site periodically and reports that the highly sloped terrain still seems to be in good shape. "So far," he says, "there has been no evident slumping." Whether the Government, educational institutions and foundations will finally scrape together funds to retrieve the land, however, is anybody's guess.

Shortly after the flooding began, anthropologists and geologists from Washington State University met with hydraulic engineers and with Sen. Warren G. Magnuson (D-Wash.). The conferees were enthusiastic about the sheer technical feasibility of removing the water. On the other hand, they agreed that the price tag of $3 million to $7 million estimated by the Corps of Engineers meant pumping operations could not possibly begin so long as the Government is trying to restrict its support for scientific projects.

"In effect," says a scientist who was present at the conference, "we decided we'd have to wait until after Vietham."



Harvey S. Rice

Dr. Roald Fryxell and Marmes skull.

Marmes may also lose out to recent archaeological discoveries, which have begun to overshadow the more spectacular aspects of the Marmes Man site. When the skeletal remains of Marmes Man, consisting mostly of parietal skull bones, rib pieces and vertebrae, were dated in 1968 (SN: 5/11/68, p. 445) they attracted international attention. The age of 11,000 to 13,000, assigned to the remains by analysis of the overlying strata of mussel shells, was the oldest definite age that had been obtained for human remains in America. Dr. H. Marie Wormington, then president-elect of the Society for American Archaeology, called the Marmes discovery "the most significant development in American archaeology in the last 25 years."

But other human remains that have been analyzed in the last year may be older than Marmes Man. According to Dr. T. Dale Stewart, retired director of the Smithsonian Institution's Museum of Natural History, bones found at Laguna Beach, Calif., "have a good

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." □

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 experiment 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.

Purdue

Dr. Grant: Neutrons for electrons.

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 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-