

protein concentrate from petroleum hydrocarbons. The pioneer work in this field was done at Lavera, France, and for the last five years the Shell BP group has been engaged in a research and industrial programme aimed at protein production on an industrial scale, chiefly at Grangemouth, Scotland.

Protein concentrates can be made by two processes: the product is an off-white, free flowing, tasteless powder which has a relatively high lysine content but which is low in methionine. One process starts with refined petroleum hydrocarbons and the other with gas or diesel oil. These unusual substrates are fermented by yeast cells grown in conditions of favourable pH and temperature and provided with adequate substrate and minerals. The fermented product is centrifuged and treated to produce a cream suitable for the drying stage. From each ton of hydrocarbon, a ton of protein concentrate is produced. This is suitable for use in animal foodstuffs and will possibly compete in food value and cost with more familiar protein concentrates such as fish meal and soya. Laboratory and early field-scale testing of the nutritional value of the product is being supplemented by toxicological studies using albino rats. Stringent safeguards have to be satisfied before the protein can be used for human consumption, but it has been suggested that it could be included in bread and biscuits. Furthermore, the protein can be extracted and coagulated to form a material with a structure resembling meat such as veal or chicken.

These results are shortly to be published in detail in the *Journal of General Petroleum*.

A Ship from the Bottom

THE raising and restoration of the seventeenth century Swedish warship the *Wasa* is a strikingly brilliant piece of marine archaeology, and the small but informative *Wasa* Exhibition at the Science Museum in London does it justice. The exhibition, organized by the *Wasa* Museum and the Swedish National Maritime Museum under the auspices of the Swedish Institute, traces the history of the ship from its construction and sinking on its maiden voyage in 1628 to the location of the hull in 1956 and its recovery in 1961.

The *Wasa*, for some unknown reason, capsized and sank before it had left Stockholm harbour. Most of the heavy cannons were recovered in the seventeenth century by divers using the most primitive of diving bells and the ship was then forgotten. In 1956, however, it was relocated at a depth of 100 feet, completely silted up with mud, and the Swedish Government decided to raise it. This posed enormous technical difficulties which have been brilliantly overcome. The exhibition shows with models and photographs how the hull was lifted in seventeen stages until it was at a depth of 60 feet and finally raised to the surface in April 1961.

Once on the surface, 1,000 cubic metres of mud was removed and sifted, yielding about 24,000 objects including clothing (see illustration), food, coins, sails and utensils. From these an authentic picture of life aboard a seventeenth century warship can be reconstructed. The woodwork of the hull was remarkably well preserved as several photographs and replicas show. Fortunately, the salinity in the Baltic is too low for wood boring animals such as *Teredo* and this

more than anything else accounts for the good state of the woodwork.

Preservation of the hull is an enormous task which is still going on. It is the largest water-logged object ever to be preserved and the Swedish authorities are sparing neither time nor expense to make sure it is done properly. To prevent the wood from shrinking as it dries out it is being impregnated with polyethylene glycol. All the movable parts are being stewed in a 60 per cent solution at 60° C and then carefully dried. The main bulk of the hull—190 feet long—is being continuously sprayed with polyethylene glycol solution and this operation will not be completed until 1971. It will then be dried out under carefully controlled humidity and eventually all the pieces reassembled.

Sorry, for copyright reasons some images on this page may not be available online

The seaman's clothing on this model was recovered from the hull of the *Wasa*. (*Science Museum photograph*.)

The exhibition, which whets the appetite for the real thing, will stay in England until 1969 during which time it will be shown at most provincial museums. Similar exhibitions are touring North America, Australasia and the continent of Europe.

Irradiating Food

SOME estimates indicate that as much as 20 per cent of the world food supply is wasted by spoilage—in some areas this figure may reach 50 per cent. Clearly any technique for reducing this waste would be welcome, which explains the considerable interest in food preservation by irradiation. One investigation of this sort is being carried out under an agreement between the Austrian Atomic Energy Agency, the European Nuclear Energy Agency and the International Atomic Energy Agency. The work is done at the Reactor Centre at Seibersdorf in Austria, and the project has just published details of progress up to the end of 1966.