Gesellschaft of Berlin and the Royal Society, London, was continued on June 22 with a lecture by Professor F. Wever, of Düsseldorf, entitled "A Review of the Development and Present State of Metallurgical Research"; and on June 23 with a lecture by Professor Otto Hahn, of Berlin-Dahlem, who spoke on "The Fission of Uranium Nuclei by Neutrons."

THE Puerto Rico chapter of the honor society of agriculture, Gamma Sigma Delta, held its initiation banquet on May 20. The guest speaker was Dr. Harry H. Love, professor of plant genetics of Cornell University. Rafael Menéndez Ramos, dean of the College of Agriculture and Mechanic Arts, introduced the speaker. The eight initiates included five graduating seniors of the College of Agriculture, two members of the Puerto Rico Experiment Station, and one from the Insular Department of Agriculture. Following the initiation election of officers was held and the following were elected for the coming year: *President,* Professor Rafael A. Toro; *Vice-President,* Dr. Arthur G. Kevorkian; *Secretary,* Professor José A. Ramos; *Treasurer,* Professor Jorge H. Rodríguez; *Historian,* Professor Rivera Valiente.

THE Louisiana State University has completed the equipment of its new astronomical observatory by the installation of a Clark refractor of eleven and a half inches aperture. The principal address at the dedication ceremonies was given by Professor W. L. Kennon, of the University of Mississippi, who spoke on "Astronomy in America." The director of the observatory is Dr. David Vance Guthrie, professor of physics and astronomy at the Louisiana State University.

THERE has been organized at Youngstown, Ohio, the Mahoning Valley Academy of Science with about sixty members, most of whom are engaged as instructors in the Youngstown College or as teachers in the local high schools.

ACCORDING to the *Journal* of the American Medical Association, a new National Institute of Hygiene and Public Health in Lima, Peru, has been opened officially by the president of the republic. The institute, created by a government decree on July 23, 1937, is under the supervision of the ministry of public health, labor and social welfare. Dr. Telemaco Battistini is the director. It has three departments: bacteriology and immunology, entomology and experimental medicine. The department of bacteriology and immunology, which are directed by Dr. Battistini, will engage in the manufacture of serums, vaccines and glandular extracts, which will be sold to government controlled hospitals, municipalities and certain other public agencies at cost. The department of entomology, under the direction of Dr. Marshall Hertig, formerly of the Harvard Medical School, will for the present work exclusively on Carrion's disease, or "verrugas," which is endemic in certain areas of Peru, notably in Verrugas, about 99 kilometers from Lima. Later it is expected that research will be instituted on malaria, which causes the greatest morbidity of any disease in Peru. The department of experimental medicine, which is directed by Dr. Alberto Hurtado, professor of medicine in San Marcos University, will cooperate with the department of entomology in its study of Carrion's disease.

DISCUSSION

PLANKTON AS A FOOD SOURCE FOR MAN

ACCORDING to a recent news report the German State Biological Institute at Helgoland is investigating the possibility of harvesting the plankton of the sea as a new food source for the German market to make Germany still more independent of foreign imports. Zooplankton was reported to have a nutritive value equivalent to the best meat and phytoplankton to be equal to rye flour. Since the nature and abundance of the marine plankton has been the subject of several recent investigations at the Woods Hole Oceanographic Institution, it is of interest to examine the feasibility of the German proposal from the quantitative point of view.

There is no question that plankton is rich in food materials. A typical zooplankton catch, consisting chiefly of copepods, yielded the following analysis when dried:[1] fat 7 per cent., protein 59 per cent., carbohydrate 20 per cent. and chitin and ash 14 per cent. In fact, the fat content of crustacean plankton sometimes exceeds 30 per cent. Certain whales, sharks and many kinds of fish feed on plankton almost exclusively.[2] Plankton has been claimed to be palatable by biologists who have eaten catches of it on occasion, and shipwrecked crews "are said" to have subsisted on plankton strained through handkerchiefs.

There is plenty of plankton in the ocean, but the essential problem in the practical application of the scheme is the difficulty of separating such small organisms from the water in sufficiently large quantities. Considering first the phytoplankton (including nannoplankton), we know that for the ocean as a whole it must bulk larger than the zooplankton since the latter subsists upon it, but the extremely small size of the individual cells presents a very serious obstacle to mass collection. The most efficient method which has

[1] J. Johnstone, "Conditions of Life in the Sea." Cambridge, 1908.

[2] G. L. Clarke, Fifth Pacific Science Congress, Vancouver, B. C. A5. 5 p. 2017, 1934.

been developed has proven successful for obtaining diatoms in quantities large enough for chemical analysis (*i.e.,* by the kilogram),[3] but since the maximum rate at which the diatom sludge could be accumulated during periods of abundant flowering was a liter in about six hours and since the work involved the services of three men and a forty-foot power boat, the method obviously would not be practical for obtaining a food supply for man.

Zooplankton can be procured much more readily because its larger size makes possible the use of coarser nets which, due to their stronger mesh, can have larger filtering surfaces and can be towed at faster speeds. The abundance of zooplankton is extremely variable both in time and in place. But even in the relatively rich Atlantic coastal area between Cape Cod and Chesapeake Bay catches greater than 2 liters in volume (per 20 minute haul at 1.2 knots with net 1 m in diameter) were rarely encountered in a four-year survey reported by Bigelow and Sears.[4] These authors concluded that the average concentration of zooplankton in this area during the season of maximum production was about 0.5–0.8 cc per cubic meter of sea water. Plankton was much scarcer during the winter. Comparison with other investigations showed that the plankton of European waters was little, if any, richer. Since plankton is at least 90 per cent. water, we may take as an outside figure a value of 0.1 g dry weight of plankton per m^3 of sea water. Even though the plankton may actually be richer, this figure gives the order of magnitude of the amount *which can be caught* using the most efficient methods yet devised.

Since the foregoing data are available one is tempted to make a rough calculation of the amount of ocean which would be required to sustain a man. Assuming an energy yield of 9 cal/g for fat, and 4 cal/g for protein and carbohydrate, we find that the combustion of 1 gram of dried plankton would yield about 4 cal. If a value of 3,000 cal per individual be taken as the average daily requirement of the population,[5] about 750 g of plankton would be needed per man per day, *assuming all the organic matter in the plankton to be assimilable.* On the basis of 0.1 g plankton/m^3 each member of the population would require all the zooplankton from *at least* 7,500 m^3 each day (approximately equal to the volume of a football field filled 1.5 m deep). Using the largest net generally found practical (2 m in diameter)[6] at a fast towing speed (2 knots) and assuming a 20 per cent. straining efficiency for a coarse net,[7] a period of 2½ hours would be necessary to filter this volume of water. If several nets were used simultaneously, more men and larger boats entailing greater operating costs would be required.[8] Even though plankton be considered only as a subsidiary food source, it must be obtained economically in order to form an efficient part of the whole dietary scheme. We are forced to conclude, therefore, that if the marketing of plankton on a commercial scale is to become a practical reality, either areas of greatly increased richness must be located or some method must be found for making the above rate of procuring plankton economically feasible.

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[3] G. L. Clarke, SCIENCE, 86: 593, 1937.

[4] Memoirs of the Museum of Comparative Zoology, 1939 (in press).

[5] G. Lusk, "The Elements of the Science of Nutrition." Philadelphia, 1928.

[6] A net 4½ m in diameter but with relatively coarse mesh was used by the *Discovery* (J. W. S. Marr, *Discovery Reports,* 18: 105, 1938).

[7] Reported by G. L. Clarke and D. J. Zinn (*Biol. Bull.,* 73: 464, 1937) and confirmed by tests with the plankton sampler—a recently developed device equipped with volume meter.

[8] There might be some possibility of operating economically a filtering plant in the tidal flow between suitably located islands or in the entrance of an estuary.

IMMUNITY TO FUSARIUM WILT IN THE TOMATO

GREENHOUSE and field tests of the resistance of several wilt-resistant tomato varieties to *Fusarium lycopersici* Sacc. (F. *bulbigenum* var. *lycopersici* Woll.) showed that infection was almost universal when environmental conditions were very favorable for the development of the disease. The resistant varieties survived for longer periods than susceptible varieties, but usually died before the growing season ended.

In a search for more effective resistance to *Fusarium lycopersici* in a plant cross-fertile with the tomato, numerous accessions of Lycopersicum and related genera were exposed to infection by virulent isolates of the parasite. All accessions of species in genera other than Lycopersicum proved immune. A few attempts to produce intergeneric hybrids were not successful. Accessions of *L. esculentum* Mill. exhibited various degrees of resistance and development of external symptoms, but all were susceptible to infection. Accessions of *L. pimpinellifolium* Mill. from several sources varied greatly in reaction to *F. lycopersici;* one proved very susceptible; several were somewhat resistant; one, Accession 160, remained free from infection and apparently possessed immunity.

The immune accession of *L. pimpinellifolium* was received from Dr. W. S. Porte, U. S. Department of Agriculture, Washington, D. C., who wrote of it, ". . . our No. 2116 was obtained by F. P. I. from Dr. Wolcott, who picked it up near Trujillo, Peru."

In contrast to the resistance or tolerance of commercial varieties of tomatoes to *Fusarium lycopersici,* immunity in Accession 160 was effective under con-