J. W. Brown of Camp Detrick (right) receives the prize for the outstanding paper delivered at the conference from C. E. Minarik, chairman of the award committee

benzoic acid type have been used experimentally to control the direction of transport of 2,4-D. Although the accumulation of 2,4-D in different parts of the stems of bean plants has been controlled in this way, the total amount translocated from leaves or stems to roots has not been greatly increased.

In this connection, considerable interest has been shown recently in the new growth-modifying compound, α-methoxyphenylacetic acid (MOPA). Not only is this compound absorbed by the leaves and translocated from them to distant parts of the plant, but it moves out of the roots of some plants and into the roots of untreated plants growing nearby. It then travels up the stems of these untreated plants, where it induces significant growth responses.

Entry of 2,4-D. In the application of 2,4-D to the foliage of plants, the rate and extent of entry of the material into the leaf may be of great importance in determining the ultimate effectiveness of the herbicide, according to a report by R. L. Weintraub, J. N. Yeatman, J. W. Brown, and coworkers at Camp Detrick. At present, however, there is virtually no information available concerning either the mechanism of entry or the factors that influence its rate and amount. This neglect has doubtless resulted from the lack of convenient experimental techniques.

Three methods, each with its limitations, are available for measuring the entry of 2,4-D into the leaves. Use can be made of the plant response as a criterion of entry. Even with the best techniques available, however, this method has relatively low precision and does not always distinguish entry by other processes, such as translocation.

In entry studies, use can also be made of nonabsorbed 2,4-D recovered from the leaf and its determination spectrophotometrically. This method is subject to interference by other materials that are also washed from the leaf and is suitable for only relatively high doses of 2,4-D. Finally, use can be made of radioactive 2,4-D, followed by removal of the nonabsorbed portion and determination of either the absorbed or nonabsorbed radioactivity. This appears to be the most useful method available at the present time.

The report by the Camp Detrick researchers indicates that, although some insight has been gained into the influence of a number of biological and environmental factors on 2,4-D entry, uncertainty still exists as to the exact mechanism of entry. The bulk of the evidence suggests that absorption into the leaf is primarily by penetration of the cuticle. The stomates may also serve as points of entry.

Soil Organic Matter. Herbicide researchers are well acquainted with the variability of results often obtained, said Stewart Dallyn of the Long Island Vegetable Research Farm. In many cases, this variability is limited to unsatisfactory weed control. On the other hand, all too often the effect is in the opposite direction, with the much more serious consequence of crop injury. A great deal of work has been conducted in the past on this problem, and numerous environmental factors have been found to play important roles, particularly in the case of some chemicals. Among the more important of these factors is the organic matter content of the soil.

A marked relationship has been found between the response of sweet corn and red beets to CMU (3-*p*-chlorophenyl-1,1-dimethylurea) and the organic matter level of the soil involved. The interaction indicates that the organic matter content should definitely be considered when making recommendations concerning the use of CMU on such crops. Each increment of CMU consistently reduces the weed population, regardless of the organic matter level of the soil. Any given amount of the chemical, however, gives better weed control at the lower levels of organic matter.

Demand, Not Supply, Seen as Determinant of Food from Sea

BOSTON.—Although the ocean is by far the greatest factory of living substance on the earth, the harvest of this potential food by man is statistically negligible, according to Harden F. Taylor.

Dr. Taylor discussed the determinants of food production from the sea at the recent meeting here of the American Association for the Advancement of Science. Any discussion of potential food harvests from the sea must be predicated on a discussion of the potential production or how much can be taken. According to Dr. Taylor this question is difficult to answer. He says we do not know how much fish the ocean can produce, although present public policy and conventional belief seems to be that the amount of fish produced is determined by the abundance of the fish in the water. The basic fallacy of this reasoning as he sees it is explained by the fact that the people of the world are not where the fish happen to be. Some of the great concentrations of fish seem to be far removed from dense human populations, the polar regions for example.

However, the supply of fish does not determine fishery production according to Dr. Taylor. The chief determinant of this production is the demand for the product, or the lack of demand.

Indications are that generally fisherman catch all the fish they can sell, and according to Dr. Taylor, they have done so in the past and will continue to do so in the future. An examination of statistical data on the yearly catch of fish in the U.S. leads to the conclusion that

production of food fish "is governed solely by economic rather than biological determinants."

He told the participants in the symposium that, "exploitation of the world fisheries resources is nowhere near its potential, but what that potential is we now have no means of estimating with any degree of accuracy."

The Sea Frontier. Two symposia sponsored by the AAAS were concerned with the general problem of food production. One of these was entitled "Species Which Feed Mankind" the other was "The Sea Frontier."

Alfred C. Redfield of Woods Hole Oceanographic Institution presented a discussion of the general productivity of the seas. Dr. Redfield said that estimates of the total productivity of the seas may have been somewhat overenthusiastic. He doubts that the oceans are 10 times as productive as the land and says that there is a need for a downward revision of estimates of this productive capacity. He explained that the bottleneck in the food chain is the rate of formation of organic matter by living plants. This rate is commonly referred to as productivity. The productive agents of the sea are the phytoplankton, microscopic foliating plants.

As a physical environment the sea is, in many ways, ideal for plant growth. The physical and chemical properties of the sea are practically the same everywhere and much more uniform than soil. However because of the great dilution of these small floating plants in the sea they cannot now be harvested economically as a source of food.

The larger animals, fish, can only be harvested in areas where they accumulate in unusual concentrations. As an example of the relatively small harvest of the sea by man Dr. Redfield pointed out that probably less than 1% of the total organic matter produced in the ocean is available for the growth of fish, and of this only about one third is harvested even in heavily fished areas.

Dr. Redfield believes that in attempting to foretell the potentials of the sea it would be realistic to assess the extent of unexploited areas of unusual productivity rather than to rely on estimates of the total productivity of the oceans.

Fishery Management. The chief hope of increasing the harvest of the sea lies in developing a science of dynamic fishery management, according to Lionel A. Wolford. In the symposium on the sea frontier, Dr. Wolford presented a discussion on the biological resources of the sea in relation to man.

He agreed with Dr. Redfield that there seems to be little hope of ever economically fishing up the plankton from the open sea as a source of food. However, he believes that a vigorous research program aimed at an extension of knowledge about marine fishery stocks and management would pay off by vastly increasing world food production.

Dr. Redfield does not conceive of the sea frontier as a physical entity but rather it is his contention that the real frontier here is the boundary between knowledge and ignorance. He believes that we are not making enough progress in pushing this frontier back, and we must find some means to accelerate this progress.

DDT Residue Persistence High in Some Soils

BOSTON.—Organic insecticide residues in soils are presenting an important new phase of an old problem, according to Arthur Foster, USDA. Dr. Foster told the recent meeting of the American Association for the Advancement of Science here recently that while the effects of insecticide residues, such as arsenicals, on crops has been under study 45 years, some of the new organic products are presenting new aspects of the problem. DDT, apparently the most persistent, was recovered from certain soils seven years after application in more than 80% of the amount applied.

Describing work done at the plant industry station at Beltsville, Dr. Foster said that Greenhouse, cold frame, and field experiments all were used as bases for his conclusions. DDT in cold frame experiments varied from 70% recovery after seven years where 25 pounds per acre was applied to 88% where 1000 pounds per acre was applied.

The effect on plants was demonstrated most strikingly with beans, which are particularly sensitive to DDT. The presence of 100 pounds or more per acre of DDT in mineral soils showed toxic effects.

The impurity *o-p'*DDT in technical DDT was much more toxic than was the *p-p'*DDT. Alkaline soils high in iron oxide were less retentive of DDT.

Great Variation and Specificity of Plants. Where peach trees were sprayed with 25 pounds of DDT per acre annually during three consecutive years, accumulations in the soil apparently interfered with the growth of rye used as winter cover. Wheat was tolerant of DDT and showed little effect. Many other crops were highly tolerant, while some were retarded by as little as 25 pounds per acre. There was even striking variation of tolerance among varieties of a given crop.

DDT and the related compounds rhothane and methoxychlor were the most persistent of compounds tested, dieldrin and toxaphene were intermediate, and chlordane and lindane were the least stable. The beta and delta isomers of BHC were more stable than other components of technical BHC.

In greenhouse studies, aldrin, dieldrin, BHC, and lindane were most generally toxic to a diversity of crop plants during one to three years following single massive doses.

Optimism for Future. George McNew, Boyce Thompson Institute, offered an optimistic note. The upsurge of organic chemicals, he pointed out, has provided chemists and biologists an opportunity to develop compounds more or less tailored to specification. Very encouraging results are being obtained in avoiding hazardous residues. Among examples he noted: New chemicals that are so selectively potent against crop pests that they can be used in very light applications; insecticides such as allethrin and malathion that are much safer for animal life than their predecessors; chemicals that volatilize, hydrolyze, or decompose shortly after application and before harvest. More data are needed on formulation of active compounds, he said, and also on interaction between various types of soil bacteria and artificially introduced molecules.

Soil Conditioners. The relatively high cost of soil conditioners excludes their use over large acreages at present according to S. J. Toth, Rutgers University, who reported on the present status of these compounds. However, he recognized the importance of soil conditioning chemicals in agriculture, especially on heavy-textured soils with poor structural characteristics. While crop returns do not justify their use unless effects are relatively long lasting, they may be used economically in greenhouses, plant beds, and home gardens.

Industry

IM&C Splits Phosphate Division

Establishment of a phosphate chemicals division has been announced by International Minerals & Chemical Corp.

The new division is expected to provide for continued growth of international's phosphate chemicals operations,