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## WORLD PROTEIN SHORTAGE

For the past several years it has been obvious to international nutritionists that the world is short of food, especially protein. This shortage is becoming more acute in the face of an exploding world population. The problem is intensified by the fact that the protein shortage is most serious in the developing countries which are least able to increase their food supplies by production or importation. This complex problem has been completely reviewed in the book "World Protein Resources" published by the American Chemical Society in 1966. The following information has been abstracted from this book.

Protein Sources. On a worldwide basis grains furnish almost 50% of the protein in the human diet; pulses, oilseeds and nuts contribute 13%, starchy roots 5%, fruits and vegetables 3%, meat 13%, dairy products 11%, eggs 2% and fish 3%. However, the proportion of these various proteins in the diet vary widely from country to country and indeed within countries. For example, grains contribute 72% of the dietary protein in Pakistan but only 16% in the United States; meat supplies 44% of the dietary protein in Argentina but only 2% in Ceylon, India and Pakistan. In general high income populations throughout the world tend to consume large amounts of high quality animal protein (meat, milk, eggs) while low income populations in developing countries eat inadequate amounts of cereal protein which is usually deficient in one or more of the essential amino acids. Immediate food protein deficiencies could be satisfied by correcting distributional discrepancies, but future requirements can be met only by massive increases in protein food production. It is estimated that the current world food protein supply of about 135 million metric tons must be doubled by the year 2000 just to maintain the current nutritional level of the world population.

Expanded Food Protein Supplies. Where is this vast amount of food protein coming from? No single traditional or novel resource, whether increased through agricultural productivity

or by new technology, will solve the problem. But the combined application of technology, the development of new knowledge and improved distribution can all contribute to the solution of the problem. Improved grain varieties with less pronounced amino acid deficiencies will help greatly. We know already that corn with higher amounts of lysine (one of the essential amino acids) can be produced. With proper processing, oilseeds yield meals that can be utilized as human food. Of course there are problems here -- aflatoxin in all of these, especially peanuts, the anti-trypsin factor in soybean, gossypol in cottonseed, etc. However, the necessary technological knowledge is available to solve these problems. We may of course turn to the sea for some of the extra protein needed. However it is debatable how far present fish and other seafood supplies can be increased using the traditional approach of "hunting" rather than by "husbandry" as for farm animals. Even the present enthusiasm over fish protein concentrate (FPC) for human food is not entirely justified since the current plans really include only the diversion of some of the fish meal from livestock feed to human food. This would amount to only about 2.5 million tons of fish protein. If the total current fish harvest were tripled and all was used as human food this would total about 30 million tons of fish protein. Although the animal is not an efficient converter of feed protein to food protein there is a real opportunity to develop animal culture with increased efficiencies and to utilize feed materials now considered unsatisfactory. Also a more complete utilization of animal protein as human food is possible using some of the same technology applied for the preparation of fish protein concentrate. The dairy cow and other ruminants can convert non-protein nitrogenous materials to protein if supplied sufficient carbohydrate material. This might offer a greatly expanded source of protein for vast numbers of undernourished people. Just one step removed from this is the recent development of protein from petroleum or coal. In this process, appropriate microorganisms use the petroleum or coal derivative as an energy and carbon source and the nitrogen from the air or from inorganic nitrogen salts to build protein in their cells. Almost unlimited supplies of protein could be produced in this way.

Economic and Social Problems. The basic technical knowledge necessary to overcome our world protein shortage is available. The technological development, the problem of cost and the incorporation of new types of protein into native foods are problems that will tax the ingenuity of the best brains in this country and abroad. A protein concentrate with an intense flavor, costing $0.35 per pound of protein, that cannot be incorporated readily into his normal foods, is of no value to a poor, starving Indian or Peruvian no matter how nutritious the concentrate may be!