tivity of murexine is reported to resemble that of nicotine and curare, activities which are not shared by pahutoxin (*32*). The biological activity of pahutoxin is, however, analogous to the activities of the steroidal saponins isolated from echinoderms (*5, 6*).

To our knowledge this is the first chemical identification of an alarming or repellent substance of a marine organism. Marine biologists have postulated that such substances are of common occurrence in that they constitute a logical defense of slow-moving unprotected species against predators. Our finding that crude solutions of pahutoxin lose their toxicity rapidly may well be the result of an unknown biological (enzymatic?) mechanism which is designed to protect the boxfish from its own toxin. Since pahutoxin is a compound of simple chemical structure and is readily synthesized, it will be an excellent vehicle for further biological research of the mechanism of fish repellents.

Pahutoxin, the toxic secretion of the boxfish, *Ostracion lentiginosus*, has been isolated in crystalline form and identified as the choline chloride ester of 3-acetoxyhexadecanoic acid. It and its C_{14} and C_{12} homologs have been synthesized as the racemates. Their lethalities toward fish and their hemolytic activities have been compared. Of the compounds studied, pahutoxin, the C_{16} compound, has the highest activity. This work constitutes the first chemical identification of an alarming substance secreted by a marine organism.

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NEWS AND COMMENT

World Food Supply: Problems and Prospects

The critical problems of food production and population control were discussed, provocatively at times, by several panels at the AAAS's annual meeting in Washington last week. Although in most cases the two problems were treated separately, few people these days, when many are predicting a doubling of the present world population of 3.2 billion by the year 2000, overlook the Malthusian prophecy that ultimately population growth will outstrip food supplies, with apocalyptic results.

Provided the widely held concept of a "population explosion" is valid, which not everyone concedes, the outlook seems gloomy indeed. One AAAS panelist, Lester R. Brown, administrator of the U.S. Department of Agriculture's International Agricultural Development Service, held out little hope that increases in food supplies through the expansion and improvement of conventional farming will be sufficient. The prospects, he said, for significantly increasing cultivated acreage in the hungry and potentially hungry nations are not bright unless there should be technological breakthroughs, such as the development of a desalination process cheap enough to permit the irrigation of vast desert areas.

As for increasing the yield of existing farm land through more extensive use of improved seed varieties, fertilizers, modern farm equipment, and the like, Brown spoke more encouragingly. He made it clear, however, that widespread use of advanced agricultural practices in the developing nations will not come easily, despite the new emphasis on "self-help" in U.S. aid programs (*Science*, 6 May 1966). Thoroughgoing social and economic changes will be necessary, Brown indicated. As others have noted, for example, the subsistence farmers of traditional societies are largely outside the cash economy, and, even when shown the advantages of modern farming methods, they have no money to invest in them.

At best, adoption of such methods will not, if the experience of the advanced nations is indicative, lead to an indefinitely increasing food supply. When first used, Brown observed, such things as hybrid seeds and weed control agents lead to major gains in crop yields, but ultimately the yields tend to level off. "A one-time phenomenon—this simple phrase has ominous overtones for the long-run food production capacity of conventional agriculture," Brown said.

However, if the outlook for an adequate food supply in the face of an expanding world population is highly uncertain, some AAAS panelists seemed to believe that the means may be at hand to enhance the protein value of cereal grains and to produce protein-rich dietary supplements to whatever food is available. Increasing the protein intake of people in the developing nations is seen as a vital need, though the more urgent need in many countries is, and will continue to be, the need to increase caloric intake. Protein malnutrition, of course, contributes to the high death rate among infants and children of the developing countries and, among many of the survivors, causes debilitating weaknesses that interfere with programs of education and economic advance.

Aaron M. Altschul, a USDA research chemist and adviser to Secretary Orville L. Freeman, discussed several ways of increasing the supply of protein-rich foods and of improving the protein value of grains. Through research in genetics an effort is being made to improve the amino acid compositions in corn, wheat, and grain sorghums. For example, the recent development by two Purdue scientists of a new variety of corn having approximately twice the lysine content of other varieties (*Science,* 17 July 1964) is considered something of a breakthrough. The Rockefeller Foundation has undertaken a program to breed a high-lysine wheat.

Another approach to improving the biological value of protein is fortification of cereal grains with amino acids produced by chemical synthesis or by fermentation of such carbohydrates as sugar or corn syrup. A fermentation process is now being used commercially in Japan and, on a small scale, by an American firm (Merck). Chemical synthesis, though not yet important, may take the lead in the future. Dutch State Mines, of The Netherlands, is setting up a chemical synthesis plant which will have a capacity of up to 6 million pounds a year.

Altschul has observed that, while amino acids formerly were expensive and largely unavailable, they are now becoming available in commercial quantities at prices by no means prohibitive. "It has been estimated that at a cost of $1 a pound for lysine it would cost $1 per person per year to upgrade the protein value of wheat in a country like India," Altschul said in a talk at Harvard last spring.

To use the Indian example, it would not be difficult for the United States to fortify wheat sent to India under the Food for Peace program, but for the Indians to fortify their own nationally produced cereals, much of which never move in commercial channels, is another matter. Moreover, the nutritional value of fortification has not been determined to the satisfaction of the U.S. and Indian agricultural experts, who are now considering undertaking some test projects.

The Indians are expected to complete plans for the tests by early next year. One type of test might be "controlled" feeding experiments in institutions, such as orphanages, schools, or hospitals, where the diets of 100 to 200 children of various ages could be controlled and their nutritional status could be determined. A second type of test might be one involving four or five large villages with as many as 25,000 inhabitants each. Wheat supplied to those villages would be fortified with lysine. Nearby villages with similar diets would serve as controls. This test would seek to illuminate certain aspects of the technical feasibility of lysine fortification. Also, statistics might be collected on comparative death rates among children, the growth rate of children, and the incidence of disease. The major U.S. contributions to these test projects could be to provide some of the wheat and help finance the tests with rupees available from sales under the Food for Peace program.

Protein from Oil Seeds

A third approach to improving the diet of people in the developing nations is to have them use the protein from oil seeds, principally soybeans, cotton seeds, and peanuts. Meal produced from these seeds after the oil has been extracted usually has a protein content of about 50 percent, as compared to 11 or 12 percent for winter wheat and 8 or 9 percent for corn. Seed-oil meal is now used mostly as livestock feed or fertilizer. Each year India produces well over half a million tons of cotton-seed meal and 2 million tons of peanut meal, but India's millions of undernourished children are not benefiting from this potential source of protein-rich food.

On the other hand, as Altschul and others have pointed out, considerable progress is being made toward developing food products containing protein obtained from oil seeds. For example, the Institute for Nutrition for Central America and Panama (INCAP) some time ago developed a high-protein formulated food for small children. Called Incaparina, it is made (to cite one formula) of cotton-seed flour (38 percent), corn and sorghum flour (56 percent), yeast (3 percent) and dehydrated leaf meal (3 percent). Through experiments with Incaparina it has been demonstrated that children with kwashiorkor can be cured by a protein concentrate containing no animal protein.

But commercial sales of Incaparina have not been particularly encouraging in most countries where it has been introduced (Guatemala is a notable exception). This market resistance is not surprising to nutrition specialists, who are well aware of the difficulties to be expected in trying to improve dietary habits, especially among the uneducated.

Such difficulties are compounded in the case of villagers remote from the normal channels of trade. To encourage use of soybean flour by such people, USDA has developed a simple five-step milling process requiring equipment costing less than $125 if the climate permits air-drying of the beans after boiling. The flour can be used in soy beverages, and as a component of breads, soups, curries, and other cooked dishes.

As incomes increase in the developing nations and more people become prosperous, the demand for meat products will inevitably rise. If an increasing proportion of grains and oilseed meals should be diverted to the raising of livestock and poultry, the caloric and protein intake of the poor could be reduced. The eating of fresh meat, even for those who can afford it, is a notoriously inefficient way for human beings to get the calories and protein they need. These considerations, as well as the desire to turn a profit, have encouraged companies such as General Mills, Swift, and Worthington Foods to develop "texturized" products from soybeans.

Products such as Worthington's "White-Chik" and General Mills's "Becos" (simulated bacon bits) are intended to have the esthetic appeal necessary to satisfy meat fanciers. Some of the simulated meat products are made by a complicated soy-fiber-spinning process and are expensive.

Others, not requiring spinning, are cheaper—some of them may be marketed for as little as 20 cents a pound. Altschul and other scientists at Agriculture hope to see such protein-rich simulated meat products gain acceptance in the developing nations.

Some exotic means of producing new high-protein foods are being found, including a process for producing quality protein from high-purity hydrocarbons, reportedly being developed jointly by Esso Research and Engineering Company and Nestlé Alimentana, S.A. The new process was discussed at the AAAS meeting by John G. McNab, an organic chemist at Esso. McNab said that, while a number of technical and economic problems remain to be solved, the process could result in a major new source of food within the next decade.

Efforts to expand and improve world food supplies are clearly in order, whether Malthus and latter-day prophets of a catastrophic food shortage are right or not. If the present world population should, by some miraculous event, immediately be stabilized, many years would pass before all people of the developing nations were provided an adequate diet. No one predicted any miracles, but a few AAAS panelists suggested, by way of hypotheses developed in their research, that the rate of population increase will decline in the years ahead. Ulla H. Olin, a Swedish demographer with the United Nations and the Institute of Theoretical Medicine in New York, observed that the growing urban concentrations occurring throughout the world produce increasing social competition. The universally observed tendency for fertility to be less in urban than in rural areas may be assumed to reflect, she said, the presence in urban areas of a relatively higher degree of nervous tension. She suggested that interdisciplinary teams of researchers should follow up her hypothesis.

David M. Heer, assistant professor of biostatistics and demography at Harvard, reported on some model studies suggesting that the decline in death rates which accounts for the rapid population increases leads ultimately to a reduction in birth rates. He speculated that, if this should prove to be true, part of the explanation will be that, because of the lower mortality rate, parents could have fewer children and still expect to have a son survive to look after them in their old age.

These theories no doubt will be received skeptically. Whatever their validity, however, they are noteworthy as evidence that some researchers are taking a critical look at the prevalent idea of a population explosion. But for the people concerned with the production of more and better food for the millions of ill-fed people now on earth, hopeful speculations about future population trends could not be more academic.—LUTHER J. CARTER

Machine Translation: Committee Skeptical over Research Support

Man, plain untransistorized man, has scored a victory in his continuing effort to demonstrate intellectual superiority over the computer. In the judgment of the Automatic Language Processing Advisory Committee of the National Academy of Sciences–National Research Council, skilled human translators produce much better translations than machines do. In fact, the committee is so skeptical of the possibility of achieving machine translation equivalent to translation done by human beings that it does not advocate spending for further machine-translation research.

The committee's conclusions are contained in a recently issued report entitled "Language and Machines: Computers in Translation and Linguistics," which is based on a 2-year study.* The committee was formed in 1964 by Frederick Seitz, president of the National Academy of Sciences, at the request of National Science Foundation director Leland Haworth to advise the NSF, the Department of Defense, and the Central Intelligence Agency concerning mechanical translation of foreign languages.

The creation of the committee and its report mark significant steps in the decline of the reputation of machine translation. A decade ago there was considerable support for the idea of trying to achieve machine translation, and considerable interest in the efforts of the Soviet Union in this field. However, in the last 4 or 5 years, sponsoring agencies have become increasingly pessimistic about the possibility of translating by machine and have reduced the funds they are willing to spend for such research. At present, only a small number of U.S. institutions have projects in machine translation; these include the University of Texas, Georgetown University, and the CIA. The bloom is now off the rose; the committee's report may help give mechanical translation the wilted elegance of a pressed flower.

"There has been no machine translation of general scientific text and none is in immediate prospect," the committee reported. It defined machine translation as that which was done without recourse to human translators or editing. The members found unedited machine output to be "decipherable for the most part" but "sometimes misleading and sometimes wrong," and "slow and painful reading."

Lesser Need for Translations

In addition, the committee questioned whether there was any need for developing more extensive translation facilities. Since English is the leading scientific language of the world, the report noted the English-speaking scientist has less need for translations than does a scientist whose native language is not English. The committee maintained that it would be relatively easy to teach heavy users of Russian translations enough Russian for reading Soviet journals in their own field. The report cited the 6-

*"Language and Machines: Computers in Translation and Linguistics" (Publication No. 1416) is available from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, D.C. 20418, for $4.