NEW GUINEA NATIVES

More on nitrogen fixing

A prime characteristic of much of the world's malnutrition is a shortage of proteins; high-carbohydrate, low-protein diets are the affliction of much of the third world. The first step in the manufacture of amino acids, the building blocks of proteins, is nitrogen fixation, a key process in nature, perhaps second in importance only to photosynthesis. Leguminous plants, in symbiotic cooperation with nitrogen-fixing bacteria, are important producers of protein.

If it were possible for human beings to form such symbiotic relationships with bacteria, the symbiosis could be of immense importance for human nutrition. Australian scientists believe that there is evidence that certain New Guinea natives are able to accomplish it (SN: 6/27, p. 620).

Dr. F. J. Bergersen of the Australian Commonwealth Scientific and Industrial Research Organization was in Washington last week to discuss the Australian findings with U.S. Department of Agriculture scientists. The latter, although cautious, believe the discovery could be of great importance. "It certainly should be further pursued," says USDA's Dr. Charles Sloger, a plant physiologist and specialist in nitrogen fixation.

Scientists had observed several times in the past decade that certain sweet-potato-eating people in the New Guinea highlands were far healthier than they should be, given their high-carbohydrate diet. The natives subsist almost wholly on sweet potatoes and leafy greens, with a pig feast every two or three years the only apparent source of major protein intake. Estimates indicated the natives took only about two grams daily of nitrogen—as contrasted with the 16 to 18 grams in the usual European diet. Yet the natives are muscular and certainly not unhealthy. Their body height and growth rates are less than those of the average European, but this could be due to the high altitudes at which they live. There is little evidence of severe nutritional stress.

Several recent studies seemed to establish a negative nitrogen balance in the natives; that is, they excreted about twice as much nitrogen as they took in. The studies were performed under somewhat crude conditions in a mission hospital, and the fact that food had to be sampled on a wet rather than a dry weight basis was a possible source of error because it is difficult to determine the exact moisture content. But control work with potassium and calcium balances indicates a much smaller negative balance of these elements than that found for nitrogen; and work by Dr. Bergersen and Dr. E. H. Hipsley clearly establishes the existence of nitrogen-fixing bacteria in the guts of the natives. Dr. Bergersen is not yet prepared to say absolutely that the bacteria account for the negative nitrogen balance, but he thinks it is a reasonable hypothesis.

Two methods were used to establish nitrogen-fixation by bacterial cultures taken from the natives' intestines (where, incidentally, Dr. Bergersen, a specialist in nitrogen fixation, believes that anaerobic conditions are such as to be conducive to this process). So far, all nitrogen fixing bacteria discovered by man have also been able to reduce acetylene to ethylene, and acetylene reduction has become a standard test for nitrogen-fixation by bacteria. The New Guinea cultures were acetylene-reducing. The team also measured nitrogen fixation more directly with nitrogen 15; this established beyond doubt that the bacteria were nitrogen-fixing.

A provisional identification of the bacteria indicates four species involved: *Klebsiella aerogenes, K. pneumoniae, Enterobacter cloacae* and *Escherichia coli.* If the last two identifications are correct, it is the first time these species have been recognized as nitrogen fixers. *K. aerogenes* appears to be the most efficient nitrogen-fixer.

An interesting sidelight to the experiment is that the Australian researchers, working with European control subjects, discovered the nitrogen-fixing bacteria also to exist in European intestines (*E. coli*, of course, being one of the most common inhabitants of human intestines). But they exist in lower quantities than in the natives, and the hypothesis is that there is a direct correlation between the amount of protein in the diet and the numbers of the bacteria.

But if the bacteria exist in all human intestines, standing ready to begin multiplying when protein intake is low, this does not explain why in fact most human beings on a low-protein diet begin to suffer malnutrition. For example, neighbors of the sweet-potato-eating natives eat sago, a root which is high in carbohydrates just as are the sweet potatoes. But the sago-eating natives suffer from poor nutrition.

"It could be," says Dr. Bergersen, "that there is something magic about the sweet potatoes." That is, they may contain some substance that is vital to multiplication and nitrogen fixation by the bacteria.

The source of the nitrogen for the fixation is most probably blood plasma, in which it has long been clearly established that nitrogen from the atmosphere is dissolved in the lungs.

Dr. Bergersen concedes that a great deal more work must be done with the New Guinea natives. He and his associates are now trying to interest the International Biological Program and the Royal Society of London in supporting further research.

"The work has to be continued," he says. "If what we think happens is real, it is very, very important." □

TEST RESULTS

Gout and achievement

Does body chemistry reflect or even shape human personality? Uric acid has been one of the most explored coefficients of this intriguing question. A recent study finds new evidence that uric acid may be a chemical signal of high achievement and suggests that cholesterol may be a signal of the reverse.

Debates about uric acid and genius have been a kind of British pastime. In his "Study of British Genius," Havelock Ellis assembled evidence that "gout is the one disease characteristically attacking great minds." A. B. Garrod, the long unacknowledged father of a field now at the leading edge of medical research—the genetic basis of many molecular diseases—showed in 1863 that gouty patients have a high level of serum uric acid.

The dreadful pain of gout is now known to be caused by deposit of urate crystals in the joints. Many researchers believe that primary gout is the result of an inherited flaw in the chemical machinery that breaks down the nitrogeneous base, purine, leaving an excess of uric acid in the blood serum. A building block of the nucleic acids, the materials of heredity, purine is synthesized in the body from small molecules and is ultimately, like other

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Gout and personality: More evidence.