50,000, 60,000, and 65,000. Using data available from other laboratories before the monoclonal antibody work got under way, Lindstrom constructed a hypothetical model of the receptor. It is a cylindrical molecule that protrudes through the postsynaptic membrane, having an ion channel running through the center, with two acetylcholine binding sites probably located on the α-subunit (see diagram).

Michael Raftery and his colleagues at the California Institute of Technology have analyzed part of the amino acid sequence of each of the four subunits and report a high degree of homology between them. "At 11 of the first 54 amino acid positions all four subunits have the same residue," says Raftery. "These data suggest that the genes encoding the four subunits descended from a single ancestral coding sequence. . . . We assume that the subunits evolved to perform discrete functions in the receptor complex."

"Apart from the obvious functions such as the site for binding with acetylcholine and the structures that make up the ion channel, there are other features on the receptor we need to know about," says Lindstrom. "There's the functional link between the binding site and the channel, for instance; and the molecule probably interacts specifically in some way with the basement membrane outside the postsynaptic membrane and with structural proteins inside it. We expect to be able to probe these functions using our library of monoclonal antibodies."

So far Lindstrom and his colleagues have isolated 70 monoclonal antibodies from rats, 17 of which came from immunization with torpedo receptor, 40 with electric eel, and 13 with fetal calf muscle. By testing with whole receptor, separate subunits, and individual subunits fragmented by proteolysis, the Salk group has begun the process of mapping the regions on the receptor to which the antibodies bind.

"Many of the antibodies are species-specific: they bind only to receptors against which they were produced," reports Lindstrom. "But about half of them cross-react with receptors of other species. It is interesting that many of these cross-reacting antibodies bind with the α-subunit. There's an area on the α-subunit that provokes a powerful immune response: many antibodies react with determinants here. We call it the Main Immunogenic Region, and it is not the acetylcholine binding site." Similar regions are found in torpedo, eel, and

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Biology and Culture Meet in Milk

William Durham, an anthropologist from Stanford University, is concerned about a gap he sees between biological and cultural anthropology. "A major goal of anthropology has been to explain and interpret the diversity of human attributes around the world, past and present," says Durham. And yet, he complains, "there have been relatively few attempts to interrelate or integrate the dichotomous schools of thought." Speaking at one of the few sessions on sociobiology at this year's meeting, Durham offered to bridge that gap with a case study on the biological and cultural aspects of dairying.

"The interaction of biology and culture proceeds through the influence that culture can have on the fitness of individuals and genotypes, and through the influence biology can have on the fitness of cultural practices," he stated. Calling on the data of cultural geographer Frederick J. Simoons, Durham claimed that the distribution of certain dairying practices and the physiological ability to metabolize lactose "proves in this instance that cultural changes directly affected human survival and reproduction."

Some populations rely heavily on milk products as part of their diet; others do not. This is the cultural diversity on the equation. In addition, some of the "dairying populations" consume their dairy products as milk, others as cheese, yoghurt, and similar derivatives, thus extending the cultural diversity. Durham adduced archeological data for an indication of the importance of dairying in different cultures' history.

The biological variable in the equation is the possession, or not, of lactase, the enzyme required for the absorption of lactose from the intestine. Although all infants have lactase in their gut juices, for obvious reasons, levels of the enzyme plummet to near zero in many populations of adults. This state of zero lactase in adults was the norm in humans until animal domestication became important after the Agricultural Revolution some 15,000 years ago, Durham hypothesized. The recently evolved high levels of lactase in some adult populations provides the biological diversity.

Durham analyzed biological and cultural data on 32 populations living between 60°W and 60°E (that is, roughly between Greenland and Saudi Arabia) and classified people into dairying and nondairying populations. Imposed on this cultural split was the finding, not surprisingly, that the lactase levels in nondairying people were low. The dairying people, however, were divided into low-lactase and high-lactase groups. This biological difference was explained by the discovery that these low lactase absorbers, who had a long history of dairying, consumed their milk produce mainly as cheese and other derivatives (the most extreme example is Jordan, where 86 percent of its milk is converted into cheese).

The question to be answered, says Durham, is "why in the milk-consuming populations there was a biological rather than a cultural solution to the problem of lactose absorption." The answer, he suggests, has to do with the diminishing amount of natural synthesis of vitamin D in the skin with increasing distance from the equator. "Clinical studies have shown that lactose behaves biochemically like vitamin D, facilitating the absorption of calcium from the small intestine, but only for absorbers," explains Durham. "The frequency of lactose absorption in dairying populations would therefore be expected to increase directly with increasing distance from the equator. . . . This prediction is precisely what one finds."

This pattern of lactose absorption among dairying people is mirrored directly by the cultural pattern of milk consumption and inversely by cheese consumption. "Dairying is thus a good case of what I have called coevolution—the idea that through both biological and cultural evolution attributes tend to facilitate human survival and reproduction," claims Durham, making the assumption that the ability to assimilate dairy products significantly widened people's base of food resources. Coevolution—or coincidence? Some biologists are certain to offer the latter as an equally valid interpretation.

The American Anthropological Association held its 79th annual meeting in Washington, D.C., 3 to 7 December.

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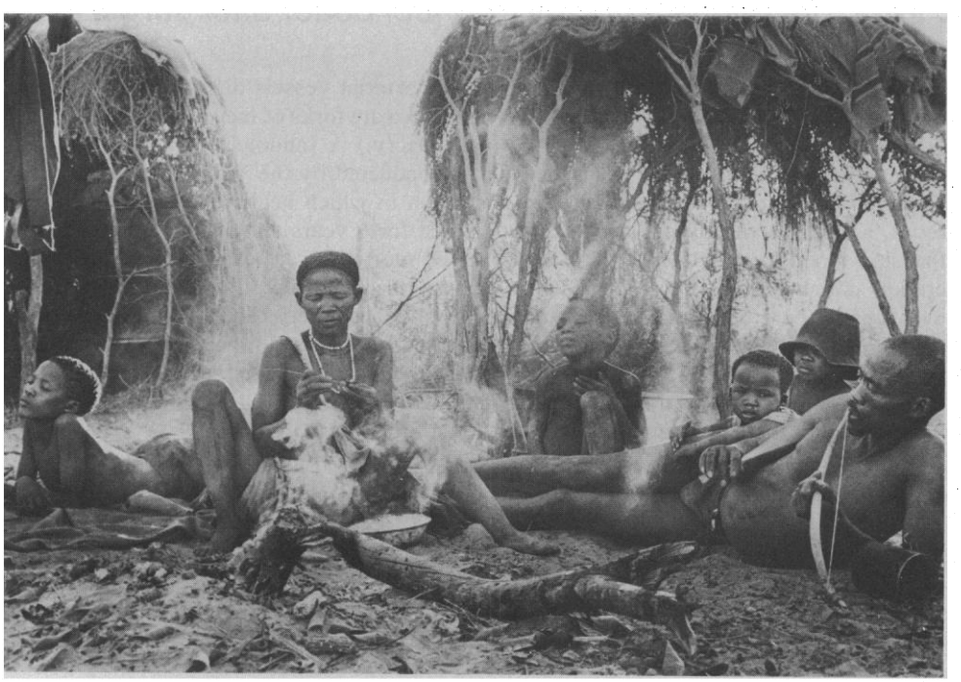
Disease Clue to Dawn of Agriculture

"It is a striking fact that largely irreversible sedentism emerges in a remarkably parallel manner in various parts of the world over the past 15,000 years. . . . Our job is to look for commonalities that can explain this major cultural change while accommodating the wide diversity of detailed differences." This was how Mark Cohen of the State University of New York at Plattsburgh spelled out the intellectual challenge of explaining why our ancestors switched from long-established hunting and gathering to agriculture on a global scale over a very short period of time. Cohen's commonality is population pressure.

In an area of archeological discussion that has been dominated more by speculation than by fact, the notion of population pressure as a "trigger" for the relatively dramatic adoption of agriculture and other sedentary economies has been a recurrent theme over the past decade and a half. But the proposition has by no means been proved. Now, however, Cohen has drawn together the data of many workers which, he cautiously claims, "are at least consistent with the hypothesis that high population density was a causal factor in the relatively rapid global shift to sedentism." Those data come from paleopathology studies that reveal the tell-tale signs of stress-related disease in ancient bones and teeth.

"I have suggested," explained Cohen, "that as one index of population pressure we might expect to find paleopathological evidence of increasing biological stresses on populations just before and during the transition from hunting and gathering to farming." Such evidence appears to come particularly cogently from central Illinois where the transition from a mobile to a sedentary population occurred about 3000 years ago.



Marjorie Shostak/Anthro

Kung San in Botswana

Hunting and gathering has dominated most of human history. It was a way of life that provided a surprising degree of security and leisure. For this reason the almost universal switch to agriculture over a relatively short period is particularly puzzling.

Archeological evidence for a rise in population (such as a higher density of camp sites, exploitation of more marginal habitats, and the consumption of a broader range of foods) is accompanied in this region by indications of chronic poor health in the people of the time. Citing the data of Della Cook, Cohen notes an increase in the incidence of infectious lesions of the bone (periostitis) and abnormally thin cortical bone layers of the femur. And children in the early agricultural communities faced a higher mortality rate than their hunting and gathering predecessors. "The diet," said Cohen, "shifted from one relatively rich in protein to one higher in carbohydrates during this period."

An equally grim picture of hardship comes from the lower Illinois valley, the work here of Jane Buikstra. According to Cohen, "She noted that the number and density of sites increased; that more upland areas away from the rivers were exploited; that each site suggested more intense exploitation and storage of wild produce of a more limited territory; that gene pools became more localized; and that there was evidence of a significant increase in the frequency of violent deaths, suggesting increased intergroup strife and competition." A high incidence of weanling deaths and a lowered life expectancy was also apparent in these maize-farming groups.

Cohen's extensive survey of New and Old World archeology of the Neolithic period has the air of a particularly grim medical case book. The prominence of nutritionally related pathologies at the transition from hunting and gathering to more settled economies is impressive. And one set of data from Kentucky and Illinois indicates a fall in life expectancy from 24.3 years in the early hunter-gatherers, to 22.5 years in the first farmers. The decline continued over many centuries to 19.0 years, recovering only when agricultural techniques had become well developed and productive. Cohen acknowledges that there are counter-examples, where hard-pressed hunters had their plight relieved by adopting agriculture, "but they are surprisingly in the minority," he comments.

In some areas the archeological evidence is abundant enough to reveal in detail that some early farmers suffered deprivations over periods of many hundreds of years. "This pattern conforms well to a population-pressure model," claims Cohen, "and does not fit the alternative suggestion that poor health may simply have been an unanticipated result of the adoption of a new economy." In other words, why persist with a new economic system that is demonstrably inferior to the old one—unless there is no choice?

Roger Lewin