Homogenized Milk and Atherosclerosis

In the article "Atherosclerosis and the arterial smooth muscle cell" (29 June 1973, p. 1332) Russell Ross and John A. Glomset give an excellent presentation of the role the arterial smooth muscle cell plays in the genesis of lesions of atherosclerosis. In addition, they discuss such factors as lipids and cholesterol being important in the development of atherosclerosis in experiments with various laboratory animals.

Although they make it clear that "relatively little is known about the genesis of the disease," they do not mention other, less popular, hypotheses about the genesis of atherosclerosis. For instance, the hypothesis presented by K. Oster (*1*) offers a fresh approach to the cause and prevention of this disease. Oster proposed that the enzyme xanthine oxidase (XO) in homogenized milk may be involved in atherosclerosis and other cardiovascular diseases in humans.

Briefly, XO is an oxidizing enzyme in milk and is synthesized in liver and mammary gland. Besides being present in relatively large amounts in bovine milk, XO is also present in the milk of other ruminants, such as sheep and goats, but is not present in human, sow, and mare milk (*2*). This enzyme controls the last stages of purine catabolism by removing hypoxanthine and xanthine in the form of uric acid from the general pool of purines. Because of its low substrate specificity, XO also oxidizes several other purines (*3*) and many aldehydes (*4*) to their respective acids. Pasteurization of milk as is done in the United States (a holding time of 62°C for 30 minutes or 71°C for 15 seconds) leaves approximately 42 percent of the enzyme in its active state (*5*). This is understandable, as heat sensitivity studies of milk indicate that XO is completely inactivated at about 82° to 84°C (*6*). This enzyme in milk is closely associated with the fat globule (*7*). The fat globules in nonhomogenized cow's milk vary in size from about 0.1 to 15 micrometers. They average about 3.5 μm, with 80 percent in the range of 2.0 to 5.0 μm. During homogenization, the fat globules are reduced in size from an average diameter of about 3.5 μm to about 1 μm (*8*). As a result of this unnatural micronization, the following alterations occur in homogenized milk: (i) a large increase in the number of fat globules; (ii) a large

expansion of the fat globule surface area; (iii) as a consequence of (i) and (ii), an increase in the biological availability of XO by a factor of at least 3.5; and (iv) an increase in the potential of XO to pass undigested through the intestinal mucosa. Once it passes through the intestinal mucosa, it eventually reaches the bloodstream (via the lymph system) and is deposited ectopically, first in the heart muscle and then in the arterial wall.

Oster proposed that, inside the body, XO (on the fat globule) finds large quantities of the substrate, plasmal [the aldehydic moiety of plasmologens which is essential in maintaining the elasticity in the arterial wall (*9*)] in situ in the outline of the arterial wall and in the myocardium. The enzyme would then, by oxidizing these aldehydes, create a histochemical change in the site, which could be overcome either by the formation of more substrate or by scar formation. This healing process in the vessel wall would be the initiation of atherosclerosis. It is at the site of such tissue destruction that cholesterol deposition begins.

This hypothesis is in sharp contrast to the prevailing ideas about avoidance of saturated fat and cholesterol in the diet to reduce atherosclerotic lesions and the incidence of myocardial infarction. The Masai, an East African tribe with an extremely large intake of nonhomogenized milk (about 7 liters per day) and saturated fatty acids (about 60 percent of their diet), rarely develop atherosclerosis (*10*). Also, epidemiological data on the consumption of fluid milk, cream, butter, and cheese in selected countries indicate a high correlation between the death rate from heart disease and the consumption of homogenized milk (*10, 11*).

Oster's hypothesis and the accumulated evidence supporting it should be carefully examined before being rejected.

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The "Relevance" of Basic Science

Herbert Simon's editorial "Relevance—there and here" (17 Aug. 1973, p. 163) comes at a very interesting time —not so much because of the current political détente, but because we are at the end of the relevance dogma which was prevalent in certain academic circles, say 5 years ago.

There has never been purely basic science, science predicated solely on "a thirst for knowledge," just as there is no completely relevant endeavor (whatever that would mean). Science, per se, is a question-answering process; and questions, whether aimed at descriptive or prescriptive issues, arise from a combination of interests, abstract and pragmatic. The advances in computer science are responses not solely to developments in automata theory, but to some very real questions about information storage and processing. Similarly, the investigation of human learning is not simply an inquiry into the properties of memory, but a desire to understand how knowledge can be acquired and used. Of course, knowledge can be integrated into theories, but this is not what makes "us" scientists; it is the desire to deal with questions in a structured way.

Questions, then, are relevant because that is what questions are—issues of interest. Societal funds may be allocated so as to promote certain interests; but not so much to exclude "nonrelevant" concerns as to focus on immediate problems. And even here, there is always at least a little left over for long-range problems.

The issue of cross-cultural neglect of basic sciences thus appears to me to be a straw man. The danger is that such an argument will lead to a form of elitism and intellectual isolationism in science.

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