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New Research on the Relationship of Fats, Blood Cholesterol and Heart Disease

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IN THE PAST FEW YEARS we have witnessed two rather extraordinary developments which have commanded much more than usual attention because of their possible significance in the health and well-being of major populations. The first was occasioned by reports of numerous investigators that cigarette smoking and lung cancer are closely associated. Despite all warnings—some quite strongly and even harshly worded—cigarette sales have continued to zoom upward, many, however, with assists from sundry filters.

The second began through the association of blood cholesterol with atherosclerosis. Our citizens have not shrugged off this latest warning. Instead, heart associations, doctors, and scientists have been deluged with inquiries as to the facts concerning diets. The reason for these distinctly opposed attitudes is not hard to find. In the first place, heart disease is the number one killer in this country and accounts for more than three and a half times as many deaths annually as all forms of cancer combined, while lung cancer is only one of these many forms. Thus, most American families have had some experience with coronary problems and, of course, the illness of the President two years ago placed the entire subject in sharp focus.

A few newspaper headlines are adequate indications of the widespread interest in the subject and the very considerable differences of opinion among the experts as to the exact relationship between dietary fats and coronary heart disease. "Heart Ills in U. S. Tied to Fat Food;" "Fat Strongly Condemned;" "Saturated Fats—Newest Dietary Whipping Boy?" "Are You Eating Your Way to a Heart Attack?;" "Dairy Foods Not Main Coronary Troublespot;" "Less Heart Disease on Protein Foods;" "Blood Fat Tied to Job Stress." It is only necessary to glance at these headlines to see that opinions have shifted rapidly and that there is lack of unanimity among the experts as to relationship of fat nutrition to blood cholesterol and coronary heart disease. A small group firmly advocates sharply reduced fat consumption, especially saturated fats, but the great majority of scientists urge moderate use of all dietary ingredients and express doubt that final analyses will justify any substantial overhauling of the more or less standard American diet.

Until about 1925 fats were not recognized as having any diet functions beyond their high density caloric values. Then, at first, certain essential fatty acids were looked upon as the only added nutritive components; as the years passed many new activities were discovered, among them improved palatability, in-

fluence on other nutrients, protection against capillary fragility, and influence on liver and blood cholesterol.

This latter brings us to the core of the subject. When all the fuss over the effects of fat on coronary disease started, cholesterol was chosen as the "goat" because, so far, no population with a low level of blood cholesterol has been found with a high instance of coronary heart disease and because further population surveys supported the claim that cholesterol levels were usually higher in persons with coronary heart diseases than with unaffected persons of the same age groups. These observations would be of no great significance if it were not for the fact that atherogenic deposits consist of cholesterol, fatty acids, and protein. There are two schools of thought as to why these arteries build up in specific areas, but there is definite agreement in present medical practice that hypercholesteremia is undesirable and that a return to a normal level is to be sought by all reasonable means.

Nonetheless, there are those who unyieldingly refuse to follow this theory and claim that the cholesterol level has no effect upon the development of atherosclerosis. This theory is actually supported by an eighteen year experiment with rats at the University of Southern California. Unfortunately, animal results cannot necessarily be translated to humans, but some scientists feel that lipid metabolism in rats does approximate that of humans. So, while atherogenic buildups can be definitely determined by examining rats from time to time, it is still not possible to make the same determinations with living human patients. Let us hope that the new project of the Fish and Wildlife Service at Hormel Institute will give us some direct information. Here arterial depositions of cholesterol will be followed through the use of radioactive tracers.

Because of the prominence attributed to cholesterol in cardio-vascular cases, it has been assumed by the uninitiated that the intake of food containing cholesterol should be markedly reduced. Commonest and richest natural sources of cholesterol in the standard American diet are dairy products and eggs, so any revolt against their use could have serious effects upon the national economy. Fortunately, we do have considerable knowledge as to the effects of cholesterol ingestions and synthesis.

We know, for instance, that cholesterol is rapidly synthesized in the body, but synthesis is not increased by fat feeding, unless there is an extreme advance in fat intake. Controlled experiments show that additions of as much as 30 grams of cholesterol in daily diets result in trivial increases in serum cholesterol, unless its feeding is also accompanied by substantial additional fat intake. Since the human diet rarely includes more than one gram of cholesterol per day, it is largely accepted that dietary cholesterol can be disregarded for all practical purposes. Therefore, attention should be concentrated elsewhere on the diet.

Since Americans obtain approximately 40 per cent of their calories in the form of fat, it was only natural that attention should be turned to the effects of fat on the serum cholesterol levels. Is there a direct relationship between the incidence of atherosclerosis and fat consumption? Also, are there other population studies which can be compared to our own? There are some indications that the austerity diets of the British Isles were responsible for a definite drop in cardiac mortality during the war years, despite the added stresses and strains. However, some researchers discount this experience and claim that the decline actually started before the reduction of fats in the British diet.

Another population study applies to Norway, where there was a marked drop

in mortality from heart disease by 1941. Again, some specialists discount this history because they say that rationing actually began in 1939 and that the fat shortage became acute in 1940. Nonetheless, the decline increased steadily until 1945 and then the trend reversed until the prewar figure was again reached in 1949. There is evidence in these figures that in a total population, at least, the effects of major changes in diet are not immediately felt.

Another wartime population study covered the Finnish people, who are looked upon as the most physically fit in the world and who are accustomed to a great deal of hard physical work. On the other hand, the Finns probably are not subject to the same pressures as apply to more urban populations, as in the United States or Japan. Furthermore, the medical service in Finland is of the highest order. Despite all these conditions, this extremely active rural population has a level of coronary disease equal to that of the United States. Their diets contain a lot of fats, but physical exercise and cold climate require a high level of energy. A possible clue is the type of fat consumed, because Finland utilizes a higher level of butter fats than almost any other country in the world.

The Japanese, in Japan, have a low level of coronary disease. When they move to Hawaii and change their eating habits accordingly, their coronary problems increase; when they move to California, where they gradually acquire complete American eating habits, coronary deaths among them take the lead as with our own population.

Finally, it is argued that Eskimos consume very large quantities of fat, yet have a very low incidence of coronary disease. At best, the Eskimos are not a good subject population to compare with the Finnish, Norwegian, Japanese, Italian, or American people because they live an unusual and primitive kind of life, their total number is small and scattered over considerable areas, and by no stretch of the imagination could their normal diet be looked upon as comparable to ours. In passing, however, it is worth noting that Eskimos do consume considerable fats almost exclusively from fish and seals, and that the protein level of their diet is reported as extraordinarily high—45 per cent as against 14 per cent in the average American diet.

Where does this lead us? It appears that fat *per se* cannot be labeled as the culprit. Under strict dietary conditions, rather than with patients enjoying normal variety in their diets, cholesterol levels have been increased in the blood by the addition of animal fats and have been decreased by the addition of vegetable fats. Decreases in cholesterol levels have been induced by the replacement of animal fats by vegetable fats. So, it appears that the kind of fat may be of vital consequence. According to one group of workers the mean degree of unsaturation in the fat, rather than the content of any specific unsaturated fatty acid, determines the cholesterol level in the blood. In other words, a judicious blending of fats is undoubtedly desirable, especially for people who have hereditary or other inclinations toward atherosclerosis.

It is well established that the addition of highly unsaturated fats for the purpose of offsetting detrimental effects of saturated fats is inadvisable because of the high caloric value of such a diet. Also, experiments have shown that unsaturated fats must be added at levels of two to three times those of the saturated materials if they are to be at all effective.

At this point let us take a look at some of the fats and oils which appear most commonly in the human diet and explore briefly the fatty acids supplied by them (Table 1). Unsaturated fatty acids are shown as percentages of total fatty

UNSATURATED FATTY ACID COMPOSITION OF SOME MARINE, ANIMAL, AND VEGETABLE OILS*

	Per cent of Total Fatty Acid Composition																								
	Marine Oils						Animal and Vegetable Oils																		
FATTY ACIDS	Characteristics																								
	No. Carbon atoms	No. C=C double bonds	Acid number	Iodine value	Cod liver	Herring	Menhaden	Pilchard	Salmon	Sardine	Sperm-body	Butter fat	Coconut	Corn	Cottonseed	Lard	Linseed	Olive	Palm	Peanut	Safflower	Soyabean	Tallow-beef		
Lauroleic	12	1	285	128							0.4														
Myristoleic	14	1	248	112	0.2		0.1	0.1	0.1	0.1	4.0	1.6													
Palmitoleic	16	1	221	99.8	20.0	18.0	17.0	11.8	10.6	11.8	26.5	4.0													
Oleic	18	1	198	89.8	29.1	9.0	27.0	6.2	17.1	10.0	37.0	29.5	6.0	46.0	24.7	48.7	21.0	82.8	43.0	60.0	26.4	28.0	44.4		
Gadoleic	20	1	180	81.7							19.0														
Erucic	22	1	166	75.0							1.0														
Linoleic	18	2	200	181		13.0		11.5	11.5	15.0			3.6	2.5	42.3	49.7	12.2	17.4	7.2	9.5	21.0	67.3	52.6	2.2	
Linolenic	18	3	201	274																		0.2	8.0	0.4	
Arachidonic	20	4	185	334	25.4	20.0	20.0	17.9	23.5	22.0															
Clupanodonic	22	5	169	384	9.6	25.0	12.0	13.8	16.2	19.0												0.4	0.1	0.05	
Tetracosapolyenoic	24	?	—	—																					
TOTAL					84.3	85.0	76.0	76.5	79.0	77.9	87.5	39.1	8.5	88.3	74.4	62.0	89.1	90.0	52.5	81.0	93.9	88.7	47.1		

*Data taken from a chart prepared by the Technical Products Division of the E. F. Drew & Company, Inc., New York 10, New York.

acid composition. Coconut oil is at the bottom of the list, followed by butter fat, beef tallow, palm oil, and lard, and in each of these instances the level of polyunsaturated linoleic acid is extremely low, while oleic acid, which experimentally has had little effect on blood cholesterol levels, predominates. In general, the marine oils are much more highly fortified with polyunsaturates. In a six year controlled experiment, sardine oil showed no better advantage than the oils containing predominantly linoleic acid. Therefore, there was apparently no effect beyond the two double bonds. Nonetheless, there has recently been an increasing interest in arachidonic acid because there is considerable evidence that it is the biologically active form in which the unsaturated fatty acids influence cholesterol metabolism. There is still other evidence that arachidonic acid may be a component of an important enzyme system in the heart muscle. With this constantly expanding interest in the polyunsaturated fatty acids, which occur naturally in fish oils, we have reason to be highly pleased with the basic research supported by Fish and Wildlife Service under the Saltonstall-Kennedy program.

A word of warning is necessary here. It is not suggested that we should urge the replacement of any one kind of fat or oil for another at this stage of research. However, fish and fish oil producers should encourage every possible study towards greater enlightenment in the field of coronary disease. We are apparently keeping good pace with the field and we should surely maintain that position. Possibly more than ever before, fish should presently be sold on the basis of its established nutritive merits. We know that most of the more common fish contain a low level of fat and provide many of the essentials of an adequate, healthful diet, such as proteins, minerals, and vitamins. Because fish oils, when they are present, supply highly unsaturated fatty acids we can be confident that they do not contribute detrimentally towards atherosclerosis or other coronary diseases. Surely a nice fish fillet or steak is a more constructive addition to the diet than one of the several special products which have recently appeared on the market for the specific purpose of reducing blood cholesterol.

Another recent medical finding needs mention here. One of these has to do with thrombo-embolism. It has been noted that in Southeast Asia particularly, where diets have been relatively low in fats historically, clotting complications following surgery are rare occurrences by comparison with the experience here in the U.S.A. and in Europe. During the last war the relationship of fats in the diet to clotting following major surgery was clearly demonstrated in Norway. When the fat level of the Norwegian diet dropped to its lowest point the problem of thrombo-embolism declined to less than one-third of the pre-war level. It has now been shown that a heavy meal, containing considerable fat, often induces a state of hyper-coagulability for a period of some hours. Therefore, thrombosis surely should be explored in connection with all dietary fat studies as a parallel to atherosclerosis.

Thus, there are those who do not go along with the concept that a high level of serum cholesterol has anything to do with developments of atherosclerosis. There are others who believe that the problem is not so much one of high cholesterol level as it is a lack of essential fatty acids. However, it is safe to say, apparently, that the problem is a complex of relationships involving the body waste, obesity, hormonal balance, general composition of the diet (with special emphasis upon the quantity and quality of the proteins), age, sex, racial origin, and various kinds of physical and emotional stress.

Early in November, 1957, a report was presented to the American Heart

Association at Chicago by a San Francisco research laboratory. The findings of Drs. Rosenman and Friedman were based upon studies with 42 male tax accountants. Blood cholesterol samplings were taken during three periods of stress and three of relative inactivity. The results, which showed maximum blood cholesterol under stress in 83 per cent of the group and minimum counts during lulls for 75 per cent of the group, are looked upon as certain evidence of the importance of mental tension on coronary disease. "Even more striking was the highly significant acceleration of blood clotting time." Under stress the average time was five minutes as against 9.4 minutes when the accountants were under minimum stress. This report also bears out once again the close relationship between thrombo-embolism and blood cholesterol levels.

There are those who contend that fat consumption in this country has not gained in the past thirty to fifty years—the change is rather one of impossible calculations. It will also be argued that coronary disease has not increased—we simply have better statistics and more accurate knowledge as to causes of death. Whether gaining or not, atherosclerosis is still the long leader in the cause of death in this country and among other populations. It behooves all of us, therefore, to avoid creating public hysteria and to encourage continued orderly research now so well started.

Weather and Caribbean Fisheries Development

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THE WEATHER is one of the great controlling factors in marine fisheries commercial production. Weather is made up of a combination of conditions of air, temperature, moisture, wind, sky and cloud formations at any given time and place. For the purpose of this paper we will apply the term "weather" mainly to wind and its effect on sea conditions in fisheries development. Winds and choppy seas are assets under some circumstances in fishing gear operation. For fishing vessel operations such conditions are another matter. They can result in anything from a mere inconvenience to a genuine hazard for small vessels. In fact, it has been said that the sea is almost always rough for small ships. This axiom holds true in the Caribbean Sea as in other open waters for fishing vessels, which most generally fall into the class of small ships.

In recent years there has been considerable fishery developmental activity in the Caribbean, where small ships play a part. United States Government exploratory fishing vessels have been working with some success in the area to evaluate the potentials of tuna and other latent offshore fisheries. Japanese vessels, under various types of cooperative arrangements with some of the local Caribbean governments, are also exploring the Caribbean and adjacent waters. In addition to this, substantial local effort is being placed on pushing the historically inshore fisheries outward from Island shores. A large tuna cannery has been established at Ponce, Puerto Rico. Most of the raw material used at this cannery is derived at present from the Pacific. However, this installation has perhaps given greater confidence to a developing market for Caribbean produc-