

CAST

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**DIET, NUTRITION, AND CANCER:
A Critique**

Council for Agricultural Science and Technology

Special Publication No. 13
October 1982



The Science Source for Food,
Agricultural, and Environmental Issues

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FOREWORD

On June 15, 1982, the National Academy of Sciences—National Research Council issued a report called *Diet, Nutrition, and Cancer* that included recommendations for broad changes in the American diet to reduce the incidence of cancer. In letters dated June 24 and 25, Congressman William C. Wampler and Senator Charles E. Grassley requested comments from CAST on this report. Senator Grassley requested an analysis and critique of “this report to determine whether its conclusions and recommendations were premature, as well as justified.” In addition, he expressed concern about the fact that the “conclusions drawn from this study are in direct contradiction with those expressed by the National Academy of Sciences’ permanent Food and Nutrition Board which found that no causal relationship had been proved between nutrition and any type of cancer, and thus, that there was ‘no basis’ for recommending any modification of diets” (Senator Grassley was referring here to a report called *Toward Healthful Diets* issued by the Academy in 1980). Congressman Wampler was concerned about the impact of the report on American agriculture and the health of the American consumer.

Information about the requests was mailed promptly to members of the CAST Board of Directors, and a ballot on whether or not to respond to the requests was included in the mailing, along with a request for nominations of qualified persons to comment from the perspective of the various member societies for use, should the majority vote be in the affirmative. The vote was in the affirmative. Accordingly, the nominees were contacted and asked to prepare comments on the *Diet, Nutrition, and Cancer* report. Additionally, nominations were requested from the Presidents of the American Institute of Nutrition and the American Society for Clinical Nutrition, and these nominees also were asked to prepare comments. All nominees were asked to confine their comments to aspects of the subject matter within their expertise. The President of the American Agricultural Economics Association was contacted for recommendations of persons to comment upon the potential implications of the dietary recommendations for American agriculture to supply a part of the information requested by Congressman Wampler. The *Diet, Nutrition, and Cancer* report did not deal with the potential impacts, and so the economists were asked to concern themselves only with what might happen in agriculture if the dietary recommendations in the report were to be accepted and followed by the public. The economists regarded their analyses as preliminary because they did not undertake the expensive and time-consuming research studies involving the use of complex national economic models that would be required to

provide relatively precise estimates. Even the results of such studies would have to be considered tentative because they involve the use of assumptions about what people would do if they attempted to conform to the dietary guidelines, and no one knows just what they would do.

The decision was made to ask the participants to submit their comments individually, as opposed to asking them to prepare a statement under joint authorship. This procedure was considered advantageous because the controversy exemplified by the divergent recommendations in the reports on *Diet, Nutrition, and Cancer* and *Toward Healthful Diets* would make it unlikely that the participants could get together on a mutually acceptable statement within a reasonable length of time, and perhaps they never could agree. Accordingly, this special publication contains the comments made by the individual participants. The original submissions were edited by the headquarters office staff, and the galley proof prepared from the edited copy was submitted to all participants for review and comment. A summary and an overview also were prepared by the staff, and these too were returned to the participants for review and comment to assure that justice was done to the various points of view and that factual errors had not been made in representing the content of the various comments. The galley proof was distributed also to the CAST Editorial Review Committee and the CAST Executive Committee for review, comment, and final approval.

On behalf of CAST, I thank the participants, who gave of their time and talents to prepare their comments as a contribution of the scientific community to public understanding. I thank also the employers of the participants, who made the time of the participants available at no cost to CAST. The members of CAST deserve special recognition because the unrestricted contributions they have made in support of the work of CAST have financed the preparation of this special publication.

This publication is being distributed to certain members of Congress, to the National Academy of Sciences, to media personnel who have asked to receive CAST publications, and to institutional members of CAST. Individual members may receive a copy upon request. The publication may be republished or reproduced in its entirety without permission. If republished, credit to the authors and CAST would be appreciated.

Charles A. Black
Executive Vice President
Council for Agricultural
Science and Technology

CONTENTS

Summary	1
Overview	3
Comments by individual scientists	11
Review of <i>Diet, Nutrition, and Cancer</i> , by Elton D. Aberle	11
Review of <i>Diet, Nutrition, and Cancer</i> , by W. H. Allaway	12
Impact on American Agriculture if American Consumers Were to Implement the Dietary Guidelines Proposed in the Report on <i>Diet, Nutrition, and Cancer</i> , by J. Bruce Bullock ...	12
Statement on <i>Diet, Nutrition, and Cancer</i> , by R. G. Cassens	14
A Review — <i>Diet, Nutrition, and Cancer</i> , by C. R. Creger	15
Some Comments on the <i>Diet, Nutrition, and Cancer</i> Report of the National Academy of Sciences, by F. E. Deatherage	16
Potential Impact of the <i>Diet, Nutrition, and Cancer</i> Report on the U.S. Agricultural Industry, by Otto C. Doering III	18
Review of the Publication <i>Diet, Nutrition, and Cancer</i> , by Hardy M. Edwards, Jr.	19
Fact vs. Judgment: Cause of the Diet-Cancer Controversy, by Owen Fennema	19
Economic Impact of the Interim Dietary Guidelines From the Report of the Committee on <i>Diet, Nutrition, and Cancer</i> — National Academy of Sciences, by John Ferris	20
Critique of <i>Diet, Nutrition, and Cancer</i> , by Margaret A. Flynn	26
Review of National Academy of Sciences Publication, <i>Diet, Nutrition, and Cancer</i> , by J. P. Fontenot	27
Comments on the National Academy of Sciences Report, <i>Diet, Nutrition, and Cancer</i> , by Gene Futrell	27
Comments on <i>Diet, Nutrition, and Cancer</i> , by John E. Garst	28
Comments on the <i>Diet, Nutrition, and Cancer</i> Report Prepared by the National Academy of Sciences, by Dennis T. Gordon	29
Comments on the <i>Diet, Nutrition, and Cancer</i> Report, by R. G. Hansen, Bonita W. Wyse, and Carol T. Windham	30
<i>Diet, Nutrition, and Cancer</i> , by A. E. Harper	33
Comments on the National Academy of Sciences Report — <i>Diet, Nutrition, and Cancer</i> , by D. M. Hegsted	34
Comments on <i>Diet, Nutrition, and Cancer</i> Report of the National Academy of Sciences 1982, by John Higginson	37
Comments on the National Academy Press Publication, <i>Diet, Nutrition, and Cancer</i> , by Jules Hirsch	39
Critique of <i>Diet, Nutrition, and Cancer</i> , by Marion L. Jackson	40
Diethylstilbestrol (DES) in <i>Diet, Nutrition, and Cancer</i> , by Elwood V. Jensen	41
The Day That Food Was Declared a Poison, by Thomas H. Jukes	42
Review of <i>Diet, Nutrition, and Cancer</i> , by Gilbert A. Leveille	46
Comments on <i>Diet, Nutrition, and Cancer</i> , by David R. Lineback	46
<i>Diet, Nutrition, and Cancer: A Commentary on the Report of NAS</i> , by George V. Mann ...	47
Comments on <i>Diet, Nutrition, and Cancer</i> , by William W. Marion	49
An Appraisal of <i>Diet, Nutrition, and Cancer</i> , by Albert I. Mendeloff	50
On the Social Implications of the National Academy of Sciences' <i>Diet, Nutrition, and Cancer</i> Report, by Robert L. Moxley	50

The NAS Report <i>Diet, Nutrition, and Cancer: Implications for Agriculture</i> , by Allen G. Mueller	51
The <i>Diet, Nutrition, and Cancer</i> Report and Foods From Animals, by James E. Oldfield	54
<i>Diet, Nutrition, and Cancer: A Critical Review</i> , by Robert E. Olson	55
Comments on NAS Report <i>Diet, Nutrition, and Cancer</i> , by A. M. Pearson	61
Sociological Implications of the Dietary Guidelines in the <i>Diet, Nutrition, and Cancer</i> Report, by Virginia S. Purtle	63
Review of the National Academy of Sciences <i>Diet, Nutrition, and Cancer</i> Report, by Bandaru S. Reddy	65
Review of the Report <i>Diet, Nutrition, and Cancer</i> of the Committee on Diet, Nutrition and Cancer, Assembly of Life Sciences, National Research Council, by Raymond Reiser	67
Review of Report: NAS—NRC Committee on <i>Diet, Nutrition, and Cancer</i> , by V. V. Rendig	69
Statement on the Report on <i>Diet, Nutrition, and Cancer</i> , by S. J. Ritchey	71
Review of the <i>Diet, Nutrition, and Cancer</i> Report by the National Academy of Sciences, by B. S. Schweigert	71
Comments on the <i>Diet, Nutrition, and Cancer</i> Report With Supplementary Comments on Related Reports, by Milton L. Scott	72
Comments on <i>Diet, Nutrition, and Cancer</i> , by Robert E. Shank	75
Comments on <i>Diet, Nutrition, and Cancer</i> , by Joseph J. Vitale	76
Comments on the National Academy of Sciences Report, <i>Diet, Nutrition, and Cancer</i> , by Rex H. Warland	77
Comments on the National Academy of Sciences Report <i>Diet, Nutrition, and Cancer</i> , by Elizabeth M. Whelan	78
Comments on the Chapter on Lipids in the <i>Diet, Nutrition, and Cancer</i> Report From the National Research Council, by Randall Wood	79

SUMMARY

The *Diet, Nutrition, and Cancer* report issued by the National Academy of Sciences—National Research Council in June 1982 includes an extensive literature survey on the subject treated. The report should stimulate research to fill the numerous gaps in knowledge that are evident in the literature surveyed.

One of the persons whose comments are included in this special publication was strongly supportive of the *Diet, Nutrition, and Cancer* report, several expressed their satisfaction with it, several had a few minor criticisms, and a number had strong criticisms. One person commented only upon the philosophy, and several made comments regarding the potential economic and sociological impacts.

Some of the reviewers expressed concern that the numerous reservations and qualifications that accompanied most of the findings reported in the text tended to disappear in the "Executive Summary" and news release. Of further concern were discrepancies between the news release and the report. The news release added information not included in the report, and some of it was incorrect.

A difference of opinion existed among reviewers as to whether the evidence at hand justified the *Diet, Nutrition, and Cancer* report's emphasis upon dietary fat as a carcinogen or whether the primary emphasis should have been placed upon alcohol. The additional point was made that, if fat is carcinogenic when it constitutes 40% of the calories in the diet, it must be carcinogenic also when it constitutes 30% of the calories (as recommended in the report) if one accepts the no-threshold hypothesis of carcinogenesis favored in regulatory circles.

Where food additives are concerned, those reviewers who commented were of the opinion that the coverage in *Diet, Nutrition, and Cancer* was less than objective. Specific comments were made regarding nitrite and diethylstilbestrol (DES).

Perhaps the most basic concern expressed about the *Diet, Nutrition, and Cancer* report has been that it makes recommendations of public policy on the basis of inadequate evidence. Scientists differ in philosophy on such matters. Where the diet, nutrition, and cancer issue is concerned, some scientists readily admit that it may be a long time before we have ironclad evidence to document the connections, but they nonetheless are of the opinion that the evidence we now have is strong enough, and the consequences of failure to act are so important, that we should proceed at once to try to alter people's diets in an attempt to reduce the incidence of cancer. Scientists of this persuasion note that to fail to make a recommendation in the light of the evidence now available is to accept the average American diet

as the best possible diet.

Other scientists are loath to make recommendations of public policy on the basis of the same body of evidence. They say that the available data are "soft" and do not represent scientifically acceptable evidence of causation. Moreover, they argue that when scientific evidence is being offered as the basis for formulating public policy the necessity for scientific rigor is even greater than it is when the evidence is expected merely to find its way into the marketplace of accepted scientific understanding. Scientists of this persuasion note that we do not have evidence to verify that, if persons were to adopt, for example, the recommendation in the *Diet, Nutrition, and Cancer* report to reduce the intake of fat from 40% of the calories to 30%, the incidence of cancer in such persons would decrease and other undesirable side effects would not appear. Examples of unfavorable side effects (increased cancer incidence) are given in connection with dietary recommendations made in the past for preventing heart attacks and strokes.

Scientists of both persuasions agree at least in recommending that persons who are overweight would benefit by decreasing their intake of calories, including those from fat. The principal scientific disagreements regarding a more general recommendation are over why the fat intake should be reduced, for whom it should be reduced, and the possible undesirable side effects of a reduction.

The committee that prepared the report on *Diet, Nutrition, and Cancer* made no attempt to assess the socioeconomic implications of its dietary recommendations. As a result of a Congressional request to CAST, however, social scientists were asked to consider these implications. The social scientists who reviewed the report noted that most people have a poor understanding of nutrients and their effects on the body, and that what most people eat is not strongly related to nutritional knowledge but is conditioned mostly by other factors. Their view was that the report would have little practical impact upon consumers' food choices unless the report should lead to sustained national educational efforts to promote the recommendations.

Continuing educational efforts to improve diets do gradually influence what people want to eat, and agriculture gradually responds by producing the products people desire. Significant changes would result if the recommendations in the *Diet, Nutrition, and Cancer* report were implemented by consumers. According to an analysis made by one economist, adopting a diet that would meet these recommendations and would supply the recommended dietary allowances of the various nutrients would change the annual costs of various agri-

cultural products to consumers in roughly the following amounts, neglecting the changes in prices that would result from the effects of a change in consumption of one product on the consumption and prices of the others: pork, -\$3.5 billion; dairy products, -\$1.5 billion; eggs, -\$2 billion; beef, +\$34 billion; poultry, none; sugars and sweeteners, -\$6 billion; fats and oils, -\$2 billion; fruits and vegetables, +\$12 billion; and grain and bakery products, +\$20 billion. The price changes to consumers would be reflected largely at the farm level rather than in the margin between the farm and the retail outlet. The meat processing industry, however, would be damaged because about 60 to 70% of the pork and 15% of the beef and poultry are sold in processed forms.

The large increase in consumption of lean beef called for in the hypothetical diet was needed to supply the recommended dietary allowances of certain nutrients, while supplying only a moderate amount of accompanying fat. That such a large and costly increase in beef consumption actually would occur was considered unlikely.

Whether the total income to agriculture would be

increased or decreased if consumers were to follow the recommendations in the *Diet, Nutrition, and Cancer* report would depend upon where they made their cut in fat consumption. If the cut were made mainly by reducing their intake of animal products, the total income to agriculture would be expected to decrease. Reduced demand for animal products would have a double effect on agriculture—first on reducing the demand for, and price of, animal products, and second on reducing the demand for, and price of, the feed grains used for animal production.

The hypothetical diet to which reference was made in preceding paragraphs was based upon diets developed by USDA. Other reviewers also noted that certain diets developed by USDA to meet a guideline of 35% of the calories from fat did not supply the Recommended dietary allowances for iron, zinc, vitamin B₆, and folacin and that lean meat is a good source of all these nutrients except folacin. In their view, a nutritionally adequate diet must include about as much fresh meat relative to other foods as Americans are consuming now.

OVERVIEW

In its more than 400 pages, the *Diet, Nutrition, and Cancer* report issued by the National Academy of Sciences—National Research Council (NAS-NRC) in June 1982 includes an extensive literature survey on the subject treated. The report should stimulate research to fill the numerous gaps in knowledge that are evident in the literature reviewed.

It is probably a rare scientific document that cannot be criticized in some way by qualified scientists other than the authors, and the *Diet, Nutrition, and Cancer* report is no exception. Its great length practically guarantees the existence of many points upon which qualified scientists will differ. One of the persons whose comments are included in this special publication was strongly supportive of the *Diet, Nutrition, and Cancer* report, several expressed their satisfaction with it, several had a few minor criticisms, and a number had strong criticisms. One person commented only upon the philosophy, and several made comments regarding the potential economic and sociological impacts.

The Missing Reservations and Qualifications

One concern about the report that was mentioned several times was the fact that the numerous reservations and qualifications that accompanied most of the findings reported in the text tended to disappear in the "Executive Summary" and the news release. Although some of this may be inevitable, the consequence is that the "Executive Summary" and news release, which are the parts most exposed to the public, convey greater conviction than does the text.

Discrepancies Between the News Release and the Report

There were other concerns that the first three recommendations in the news release did not reflect accurately the content of the report. The first recommendation in the news release was to "Eat less foods high in saturated and unsaturated fats. Overall, the committee recommended that fat should be reduced to about 30 percent of daily calories. (*The major sources of fat in the American diet are fatty cuts of meat, whole-milk dairy products, and cooking oils and fats.*)" The portion italicized did not appear in the committee's recommendation on pages 1-14 and 1-15 of the report. One reviewer pointed out that the information added in the news release is misleading in that cooking oils and fats and margarine, which are largely of vegetable fat origin, contribute more calories to the diet than do either meat or whole-milk dairy products. Another reviewer quoted USDA data showing that, in 1980, fats and oils (including butter) contributed 43% of the fat in the U.S. food supply, all meats (including poultry and fish) contrib-

uted 36%, and dairy products (excluding butter) contributed 11%. Noted by several reviewers was the fact that, for lack of better information, the report has equated food disappearance data with dietary intake, an assumption that may be fairly accurate for some nutrients but that provides an overestimate for fats because of the trimming of visible fat from muscle meats and the discarding of some of the fat that cooks out of meat as well as much of the fat used in deep-fat frying.

The second dietary recommendation in the news release was to "Eat fruits, vegetables, and whole-grain cereal products daily, especially those high in vitamin C, carotene which converts in the body to vitamin A, and other as yet unidentified compounds that may protect against certain cancers. (These foods include oranges, grapefruit, dark-green leafy vegetables, carrots, winter squash, tomatoes, and vegetables in the cabbage family such as cabbage, broccoli, cauliflower, and brussels sprouts.) *The committee recommended against high-dose supplements of individual nutrients.*" The passages in italics did not appear in the committee's recommendation on page 1-15 of the report. The sentence in parentheses between the italicized portions is an elaboration on the fruit and vegetable groups mentioned by the committee on page 1-15. As regards the first italicized addition, one reviewer inquired how one would proceed to select foods that contain unidentified compounds that protect against cancer, and how one would know that the foods selected would not contain other unidentified compounds that might promote cancer. Regarding the recommendation in both the report and the news release to eat vegetables in the cabbage family, the same reviewer called attention to a statement about such vegetables that appeared in an earlier NAS-NRC publication that was cited by the committee as an authoritative source of information: "Goiter has been attributed to the consumption of large amounts of cabbage or of kale that was shown to be high in thiocyanate, isothiocyanate, and goitrin." He noted that goiter can culminate in cancer of the thyroid gland.

The third dietary recommendation in the news release was to "Eat very little salt-cured, salt-pickled, and smoked foods. (*Examples of such foods commonly eaten in the U.S. are sausages, smoked fish and ham, bacon, bologna, and hot dogs.*)" The part in italics did not appear in the committee's recommendation on page 1-15 of the report.

The first problem noted with the third recommendation was with the basic recommendation, which, as given on page 1-15 of the *Diet, Nutrition, and Cancer* report, was that "the consumption of food preserved by salt-curing (including salt-pickling) or smoking

should be minimized." Various reviewers noted that the data to support this recommendation were derived almost exclusively from certain populations outside the United States, in which the incidence of stomach cancer is much greater than it is in this country. In the United States, several meat products on the market are preserved largely by salt-curing, smoking, or a combination of these processes, but the frequency of their consumption is low, and so is the incidence of cancers of the stomach and esophagus. Therefore, even though consumption of these products might carry some risk of increasing the incidence of cancers of the stomach and esophagus, little potential exists for reducing the incidence of such cancers in the United States by altering diets to reduce or eliminate the use of products that are truly preserved by salting or smoking.

The second problem is that the basic recommendation in the news release does not faithfully reflect the meaning of the recommendation by the committee (page 1-15 in the report) where smoked foods are concerned. The committee recommended that "the consumption of food preserved by ... smoking should be minimized," whereas the news release says to "Eat very little ... smoked foods." Smoked foods are not necessarily preserved by smoking, and most smoked foods sold in the United States are not thus preserved, as will be noted in a following paragraph.

The third problem is that the recommendation given in the news release is not supported by the evidence. Although the foods listed are supposed to cause cancer of the stomach and the esophagus, the consumption of processed meats, including those listed as examples, has increased from 42 pounds per person per year in 1930 to 61 pounds in 1980, whereas the annual mortality from stomach cancer has decreased from an average of 25 per 100,000 of population in 1930 to 6 in 1970 and is still decreasing, and cancer of the esophagus has been constant at about 4 per 100,000 in men and negligible in women since 1930.

The fourth problem is that the examples added in the news release are mostly inappropriate. In contrast to the basic recommendation by the committee that "The consumption of foods preserved by salt-curing (including salt-pickling) or smoking should be minimized," the products mentioned in the news release that are sold in the United States generally are not preserved and require refrigeration. The composition and methods of preparing these foods generally do not resemble those of the products implicated in China, Japan, and Iceland, from whence was derived the epidemiologic evidence relating consumption of meats preserved by salting and smoking to incidence of cancers of the stomach and esophagus. As regards salt, the *Diet, Nutrition, and Cancer* report does not list this compound (sodium chloride) as a carcinogenic substance, and research summarized on page 17-5 yielded "no correlation between

the salt content of salted fish and the death rate from gastric cancer in Japan." The processes commonly used for meat smoking in the United States are either a light smoking with wood smoke or application of "liquid smoke," which is made from natural wood smoke treated to remove certain components, including polycyclic hydrocarbon compounds that may be carcinogenic. With both techniques, the objective is to impart a smoked flavor, not to preserve the product.

The Emphasis on Fat

One reviewer was in agreement with the diet, nutrition, and cancer committee's assessment that, of all the nutrients affecting the development of certain types of cancer in humans, the most convincing evidence is at hand for the effect of total dietary fat—an effect that the report called 'causative.' This report, he said, reflects the majority opinion of experts in nutritional, experimental, and human carcinogenesis.

Another reviewer saw it differently. In his view, the consistency of reports on the relationship of cancer to excess alcoholic beverage consumption contrasts with the uncertainties for fat and fiber in human cancer. He noted that the summary on page 11-7 of the report does not adequately acknowledge the many studies demonstrating a causal association between alcoholic beverages, liver injury, cirrhosis, and cancer of the liver. He said that there are few better-documented sequences in human pathology. Most epidemiologists accept that the relation between alcoholic beverages, smoking, and cancer is very strong for the esophagus and mouth. Although the mechanisms of cancer induction are still unclear, reduction in alcohol consumption is the one major dietary factor through which public or personal action may significantly reduce the frequency of cancer. Consumption of alcohol can easily be avoided, but this is not true of fat.

The point was made by more than one reviewer that, if fat is carcinogenic when it constitutes 40% of the calories in the diet, it must be carcinogenic also when it constitutes 30% of the calories if one accepts the no-threshold hypothesis of carcinogenesis favored in regulatory circles.

Food Additives

Where food additives are concerned, the diet, nutrition, and cancer committee concluded that "the evidence does not suggest that the increasing use of food additives has contributed significantly to the overall risk of cancer for humans." At the same time, it pointed out that most food additives "cannot be neglected as insignificant risks." In the words of one reviewer, "These statements are either inconsistent or suggest an obvious bias." This assessment was reinforced by two other reviewers who commented on what they regarded as less than objective coverage of diethylstilbestrol

(DES), an animal growth promoter now banned by the Food and Drug Administration.

One reviewer noted that the relationship between nitrate, nitrite, and cancer is overemphasized in the report and that positive evidence is given greater weight than is negative evidence in the conclusions. Another reviewer noted that, in view of the increasing recognition of the value of antioxidants in cancer inhibition, it may turn out that the antioxidant property of nitrite makes the use of nitrite in meat curing a benefit rather than a hazard as far as cancer is concerned.

Nonrecommenders, Hesitant Recommenders, and Recommenders

Perhaps the most basic concern expressed about the *Diet, Nutrition, and Cancer* report has been that it made recommendations of public policy on the basis of inadequate evidence. We have to do here with differences in philosophy among scientists, whom we shall categorize as nonrecommenders, hesitant recommenders, and recommenders, for lack of better terms. Nonrecommenders are those scientists who hold the opinion that the role of scientists is to discover the facts and to set forth alternative public uses of these facts and the probable consequences of such uses, but to avoid making recommendations of public policy on the basis that this is the role of persons designated by society as policy makers. Hesitant recommenders are those scientists who are willing to make recommendations of public policy based upon science when the recommendations are backed by evidence that meets scientific standards. Recommenders are those who are willing to accept less than rigorous evidence as a basis for recommendations if they perceive a need for prompt use of existing scientific knowledge in the public interest or for other reasons. These distinctions in philosophy toward public policy recommendations may be held even by scientists who have strong and perhaps identical personal preferences for, or antipathy toward, particular policies.

The distinction among the philosophies of scientists of these three persuasions is manifested most clearly under circumstances in which scientific evidence is inadequate, immediate societal decisions are not required, and recommendations are optional. When scientific evidence is adequate, the hesitant recommenders and the recommenders merge into a single group. In an emergency in which an immediate decision is required on the basis of inadequate evidence, hesitant recommenders and even some nonrecommenders would become recommenders, and considerable unanimity would emerge.

In the present situation, we have to do with the difference in philosophy between two of these groups. On the one side, we have the recommenders, represented by the committee that produced the report on *Diet, Nutrition, and Cancer*. On the other side, we have the hesitant recommenders, represented by the Food

and Nutrition Board which produced the 1980 NAS-NRC report called *Toward Healthful Diets*. Some of the scientists whose comments are included in this document published by CAST would be classed as recommenders, others as hesitant recommenders.

The *Diet, Nutrition, and Cancer* report was commissioned by the National Cancer Institute in June 1980, shortly after the NAS-NRC's Food and Nutrition Board had published *Toward Healthful Diets*. Absent from the report by the Food and Nutrition Board were recommendations of dietary changes to reduce the risk of cancer. In *Toward Healthful Diets*, the Food and Nutrition Board stated that "The Board believes that in the absence of evidence of a causal relationship between the macronutrients of the diet and cancer, there is no basis for making recommendations to modify the proportions of these macronutrients in the American diet at this time." The Board did make certain other recommendations, however, that place its members in the category of hesitant recommenders.

The National Cancer Institute, which funded the *Diet, Nutrition, and Cancer* report, specifically requested the National Research Council's study committee to "review ... the state of knowledge and information pertinent to diet/nutrition and the incidence of cancer" and to "develop a series of recommendations related to dietary components (nutrients and toxic contaminants) and nutritional factors which can be communicated to the public" Thus, the committee that produced the *Diet, Nutrition, and Cancer* report was under constraints to produce recommendations, and it did produce recommendations. Nonetheless, the individual members of the committee were under no constraint to participate in the work of the committee. Hence, participation is arguably a matter of personal philosophy.

In the diet, nutrition, and cancer controversy, the recommenders note that the occurrence of cancer is greatly influenced by the environment and that diet is apparently the major environmental factor of importance. These scientists admit that it may be a long time before we have ironclad evidence to document the connections, but they nonetheless are of the opinion that the evidence we now have is strong enough, and the consequences of failure to act are so important, that we should proceed at once to try to alter people's diets in an attempt to reduce the incidence of cancer.

Thus, in the first paragraph of the "Executive Summary" of the *Diet, Nutrition, and Cancer* report (p. 1-1) we read that "... it has become absolutely clear that cigarettes are the cause of approximately one-quarter of all the fatal cancers in the United States. If the population had been persuaded to stop smoking when the association with lung cancer was first reported, these cancer deaths would now not be occurring." The recommenders who produced the report used this example as an

analogy to emphasize the need to adopt changes in diet which they imply would otherwise cause a similar cancer problem in the future. One of the reviewers of the *Diet, Nutrition, and Cancer* report whose comments are included in this document noted that to fail to make a recommendation in the light of the evidence now available is to accept the average American diet as the best possible diet. Persons who oppose the kinds of recommendations exemplified by those in the *Diet, Nutrition, and Cancer* report, he said, must accept the responsibility for demonstrating that whatever they do propose will not impose additional health risks upon the American public or reverse the favorable trends already established. (The favorable trends to which reference is made are the declines in mortality rate from coronary heart disease and other cardiovascular diseases that he regarded at least in part as a consequence of changes in diet, including decreases in consumption of fat and cholesterol and substitution of unsaturated fats for saturated fats that have been recommended by the American Heart Association and similar groups.)

The hesitant recommenders, on the other hand, acknowledge that certain epidemiologic associations observed in humans as well as the results of certain experiments with animals may be strongly suggestive, but they say the data are "soft" and do not represent scientifically acceptable evidence of causation. In the words of Philip Handler, the late President of the National Academy of Sciences, they argue that "the necessity of scientific rigor is even greater when scientific evidence is being offered as the basis for formulation of public policy than when it is simply expected to find its way into the marketplace of accepted scientific understanding."

Epidemiologic evidence of association, it is noted, does not necessarily mean that one of the two factors associated is the cause of the other. As an example of the problems one encounters in attempting to draw conclusions about cause and effect from such evidence, one reviewer called attention to a study in which the correlation of breast cancer rate with gross national product was found to be greater than the correlation of breast cancer rate with any nutritional factor examined, including dietary fat. One would infer from this epidemiologic evidence that gross national product is more likely to be a causative factor in breast cancer than is dietary fat. Because there is no obvious direct connection between gross national product and breast cancer, however, most scientists probably would suspect that gross national product is not a causal factor as such but that one or more factors related to gross national product may be responsible for the statistical association observed.

The hesitant recommenders note also that, to have confidence in proposals of the type made by the recommenders, one needs to know whether the proposals actually will produce a decrease in incidence of cancer;

whether the proposals will be effective if initiated in adulthood, childhood, or only in utero; and whether adoption of the proposals will be accompanied by unwanted and unexpected side effects.

In this connection, one reviewer noted that an increase in incidence of cancers of the type associated statistically with fat intake has not occurred through the years that fat intake has been increasing. On this basis, he questioned whether a decrease would occur, were fat intake to be reduced.

Another reviewer noted that the greatest effects of diet probably occur *in utero* (enzyme imprinting), infancy, or early life. This reviewer noted that, if dietary factors act in the late stages of carcinogenesis, it is surprising that, with the exception of stomach cancer (the incidence of which has been decreasing), so few changes have been observed in cancer patterns, e.g., breast, prostate, and stomach that occur in migrants over several generations, suggesting that the effects of such dietary changes, if any, are slow and probably must be initiated in childhood. In contrast, cancer of the colon probably is influenced by dietary promoters that operate relatively rapidly, as suggested by studies in migrants and in animals.

Still another reviewer noted that the outcome of the proposed dietary changes could even be the opposite of what is intended. This reviewer pointed out, for example, that there have been a number of clinical trials of diet change to lower serum cholesterol in the interest of preventing heart attacks and strokes. What turned out, however, was that, in some of them, the serum cholesterol and heart attacks were reduced, but the mortality from cancer was increased. He noted that low serum cholesterol values have been associated with an increase in total cancer mortality in 14 studies and with an increase in colon cancer in 5 studies.

Hesitant recommenders note that we are satisfied about the connection between cigarettes and cancer at this time, but not all epidemiologic relationships turn out to be recognized increasingly as cause and effect as evidence accumulates. Moreover, it is pointed out that, when the Surgeon General's report on *Smoking and Health* was issued in 1964, numerous population studies had been completed, and there was clear evidence that tobacco contains carcinogens effective in causing cancer as well as other substances effective in promoting cancer in animals. Clinical observations on thousands of patients and autopsies of smokers and nonsmokers had shown that the many kinds of damage to body function, organ cells, and tissues occurred more frequently in smokers than in nonsmokers. The committee that prepared the information for the report established and followed criteria for judging the value of each reviewed paper and for assessing the force of the epidemiologic data and for determining when the relationship between an agent and a disease can be considered causal.

One of the important considerations in deciding that a particular agent is the cause of an observed effect in an epidemiologic association is that there be some understanding of how the agent produces the effect in question. Where the alleged carcinogenicity of dietary fat is concerned, such understanding is lacking. At present, we have only educated guesses. One reviewer called attention to the fact that the committee that prepared the report on *Diet, Nutrition, and Cancer* did not employ the critical criteria used in the *Smoking and Health* report; rather, the committee noted only that "It is important therefore that we prepare ourselves for a period of uncertainty, between our present realization that diet affects cancer and our eventual ability to offer the public a precise formula for minimizing the incidence of cancer."

According to the hesitant recommenders, therefore, we are not sure at present that recommendations we might make for changes in diet to reduce the risk of cancer would be effective, and there might be unfavorable health consequences that are unexpected. If a reduction in fat intake were accomplished by decreasing our consumption of animal products, a health problem that could be expected would be deficiencies of certain nutrients. Of the 13 food items tabulated in Table 3.5a of USDA's 1980 Preliminary Report No. 2 entitled *Food and Nutrient Intakes of Individuals in 1 Day in the United States, Spring 1977*, the average daily intake for all people was below the NAS-NRC Recommended Dietary Allowances only for food energy, calcium, magnesium, and vitamin B₆. Animal products are good sources of all these constituents. (One reviewer noted that the intake of food energy may be underestimated because most of the alcohol taxed and sold in the United States is not accounted for by food consumption survey reports. According to his calculations, the caloric content of the unreported alcohol amounts to approximately 200 additional kilocalories per person per day, an amount that would raise the total energy intake almost to the Recommended Dietary Allowance.) The USDA data show that iron supplied by the food does not meet the Recommended Dietary Allowance for women 50 years of age and younger. Animal products are a good source of iron. Zinc also is considered critical, and animal products are a good source of this mineral, although zinc was not included among the 13 items USDA compared with the Recommended Dietary Allowances. The nutritional quality of animal proteins generally is superior to that of plant proteins, but a decrease in protein intake associated with a decrease in intake of animal products probably would not be of such great significance as the decrease in intake of the minerals and vitamins mentioned because, on the average, the protein intake is 165% of the Recommended Dietary Allowance according to the USDA survey data.

And, finally, the hesitant recommenders note that

people differ. One recommendation is not necessarily appropriate for all. As regards reduction of dietary fat, which was the recommendation of principal concern in *Diet, Nutrition, and Cancer*, the committee recommends that intake of fats be reduced from 40% of total calories to 30%, noting that "There is sufficient evidence that high fat consumption is linked to increased incidence of certain cancers ..." and that "the suggested reduction (i.e., one-quarter of the fat intake) is a moderate and practical target, and is likely to be beneficial." *Toward Healthful Diets*, the previous NAS-NRC report representing the posture of the hesitant recommenders, does not recommend a reduction in fat intake to reduce risk of cancer, but it does recommend that, "if overweight, achieve appropriate weight reduction by decreasing total food and fat intake and by increasing physical activity. If the requirement for energy is low (e.g., reducing diet), reduce consumption of foods such as alcohol, sugars, fats, and oils, which provide calories but few other essential nutrients."

Thus, it appears that both recommenders and hesitant recommenders are of the opinion that at least persons who are overweight would benefit by decreasing their intake of calories, including those from fat. *Toward Healthful Diets* quotes the results of a survey showing that approximately 30% of middle-aged women and 15% of middle-aged men in the United States are obese in that they weigh more than 120% of the desired weight. There is agreement, therefore, for many persons. The principal scientific disagreements regarding a more general recommendation are over why the intake should be reduced, for whom it should be reduced, and the possible undesirable side effects of a reduction.

If adequate information were available from appropriate experiments that could be verified by other qualified scientists, the controversy between recommenders and hesitant recommenders described in preceding paragraphs might not have developed. Where human nutrition is concerned, however, the use of the scientific method often is inhibited for ethical reasons. Many important experiments cannot be conducted on humans, and so recourse must be had to the less conclusive kinds of evidence obtainable from epidemiologic studies and experiments with other species.

Socioeconomic Impacts of the Recommendations

The committee that prepared the report on *Diet, Nutrition, and Cancer* made no attempt to assess the sociological and economic implications of the dietary recommendations put forward in the report. This special publication, however, does include such assessments because of a specific Congressional request for them. The social scientists who made these comments are not involved in the controversy regarding recommendations. The social scientists note that research indicates that most people have a poor understanding of

nutrients and their effects on the body. Moreover, what most people eat is not strongly related to nutritional knowledge but is conditioned mostly by other factors. The continued use of alcohol and cigarettes despite the widespread availability of information intended to warn consumers about possible deleterious effects of these products is perhaps the most dramatic example. Although increasing amounts of nutritional information are available on food products and still more is desired by some persons, the results of one study indicate that consumers used only 2 to 3% of the available information in making purchase decisions.

With regard to the *Diet, Nutrition, and Cancer* report, the view was that the recommendations it contained would have little practical impact upon consumers' food choices unless the report should lead to sustained national educational efforts to promote the recommendations. For example, a study to find whether the nitrite scare in 1978 had any impact showed that the price of sliced bacon declined somewhat (reflecting decreased demand) for about 3 years relative to the retail price of pork, but that it now has recovered. Reducing fat intake might require more concern and more attention by consumers than would reducing bacon consumption because so many foods contain fat.

Nonetheless, continuing educational efforts to improve diets do gradually influence what people want to eat, and agriculture gradually responds by producing the products people desire. For example, in 1960, the amount of low-fat milk sold was negligible, but in 1980 1 pound of low-fat milk was sold for each 2 pounds of whole milk. In agriculture, Jersey and Guernsey cows were considered at one time to produce the best milk because they yielded milk with a relatively high content of cream (fat). Now about 85% of the dairy cows are Holsteins, which produce more milk than do Jerseys and Guerneys, but with a lower cream content. Similarly, lard once was used widely as a shortening agent, but consumption of lard for this purpose in 1978 was only half what it was in 1966. In agriculture, the lard content of hogs has been reduced by breeding and by slaughtering at lighter weights.

Changes in agriculture occur continually in response to outside forces, and rather significant changes would result if the recommendations in the *Diet, Nutrition, and Cancer* report were to be accepted and acted upon by consumers. The economists who addressed the question of the potential impact of the recommended dietary changes upon the agricultural sector of the economy were in agreement that the impacts would be substantial.

One economist based his estimates upon the changes that would result if the average diet were to be modified from what it was in 1977 to a diet that would fit the recommendations in *Diet, Nutrition, and Cancer* and would supply the recommended dietary allowances of

the various nutrients. According to his analysis, the changes in cost to consumers in billions of dollars per year at 1981 prices would be roughly as follows, neglecting the changes in prices that would result from the effects of a change in consumption of one product on the consumption and prices of the others: pork, -3.5; dairy products, -1.5; eggs, -2.0; beef, +34; poultry, none estimated because the goal already has nearly been reached by changes since 1977; sugars and sweeteners, -6; fats and oils, -2; fruits and vegetables, +12; and grain and bakery products, +20. These would add to a total of a \$51 billion annual increase in cost of food to consumers. The estimated increase of \$34 billion for beef was considered unrealistic because it would mean an increase in consumption of 50% from 1982 levels at a price 20% above that in 1981. An increase in total expenditures of \$33 billion, or 8 to 9%, was considered more realistic. The price changes to consumers given here would be reflected largely at the farm level rather than in the margin between the farm and the retail outlet. (Nonetheless, the meat processing industry would be damaged because about 60 to 70% of the pork and 15% of the beef and poultry are sold in processed forms.) Thus, although the total farm income would be increased, according to these estimates, some sectors would be damaged. Moreover, there would be regional effects. For example, because of the economic advantage of the Corn Belt in terms of feed-grain production, the decrease in pork production would be felt more strongly in regions of the country other than the Corn Belt.

The reason for the large increase in beef consumption called for in the hypothetical diet is that lean beef was needed to supply the recommended dietary allowances of certain nutrients without supplying much fat. The leanest of the lean portion of beef contains 4 to 5% fat, and, at 9 kilocalories per gram, the fat contributes 40 kilocalories or 29% of the total of 140 kilocalories of energy supplied per 100 grams of product.

Although pork products, on the average, supply more fat than does an equal weight of lean beef, one of the reasons they do is that 60 to 70% of the pork is marketed in processed meats, and the fat is needed to maintain palatability under the current regulatory restrictions on water content of the products. If regulations were changed, the palatability could be largely retained if water were substituted for part of the fat.

The seemingly unreasonable estimate of an increase of \$34 billion in annual expenditures for beef is symptomatic of the general problem with forecasts of economic impacts of the recommended dietary changes. The economic impacts would depend upon the nature of the dietary changes people would make if they were to attempt to meet the dietary guideline for fat, and different economists make different assumptions about what these changes might be. Among the additional econo-

mists whose comments are included in this special publication, one was of the opinion that the reduction in consumption and impact, if consumers were to implement the recommendations in the *Diet, Nutrition, and Cancer* report, would be greatest with pork, intermediate with beef, and least with poultry; one was of the opinion that beef and pork producers would be likely to absorb nearly all the price decline associated with the decreased demand for animal products; one was of the opinion that the dairy industry would be the most vulnerable because the current government support of the dairy industry's excess capacity by government purchases of excess commodities probably would be reduced, thus squeezing out the high-cost producers, whereas the livestock industry has not been the subject of government programs; and one economist expressed no opinion about the differential impacts upon various animal or plant products. The first of these economists suggested that the net farm income generated from pork production could easily be reduced 40 to 50% and that income from beef production could be reduced 25 to 30%. Decreases of this magnitude would have major impacts on the livestock and meat industry. The same economist pointed out that income reductions of 25 to 30% for beef would greatly alter the values of land and other capital assets used in beef production. He noted that domestic utilization of corn and soybeans could decline by 25 to 30%, depressing the prices of these commodities by more than a dollar per bushel. The proposed dietary changes would have a double impact upon the soybean industry because of the reduction in demand for soybean oil for use in foods and the reduction in demand for soybean meal for use in high-protein animal feeds. The heaviest impact would be in the Midwest, where most of the corn and soybeans are produced.

Whether the total income to agriculture would increase or decrease if consumers were to follow the recommendations would depend upon where they made their cut in fat consumption. If the cut were made mainly by reducing their intake of animal products and substituting more whole-grain cereals, fruits, and vegetables, the total income to agriculture would be expected to decrease because animal products are generally of higher economic value than the plant products that would replace them. Reduced demand for animal products would have a double effect on agriculture—first on reducing the demand for, and price of, animal products, and second on reducing the demand for, and price of, the feed grains used for animal production. The effect of an increase in direct consumption of cereal grains as human food probably would be overshadowed by the reduction in use of feed grains for livestock feeding.

No one knows what consumers, individually and in the aggregate, would do if they attempted to make the recommended dietary changes. Very few could be

expected to approach the matter scientifically, and so the hypothetical diet that satisfied the recommended dietary allowances and met the changes recommended in the *Diet, Nutrition, and Cancer* report (or similar scientifically designed diets) would not be followed. No doubt, some nutritional problems would arise, particularly among those who lack understanding and who pursue their convictions with such zeal that they overdo the changes, thereby bringing on deficiencies of some nutrients and excesses of others.

Dietary Adjustments Associated With the Recommended Reduction in Fat Intake

Meeting nutrient needs must be the primary concern in any dietary guidelines. After nutrient needs have been met, attention may be directed to secondary considerations, such as possible associations between food constituents and cancer, heart disease, stroke, osteoporosis, and other problems. In this connection, one of the interesting aspects of the *Diet, Nutrition, and Cancer* report is its recommendation that intake of unsaturated fats as well as total fat should be reduced. This is a distinct break with other reports in recent years in which emphasis has been on replacement of saturated fats with unsaturated fats.

One reviewer pointed out that, for a 2500-kilocalorie diet, the recommended reduction of fat consumption from 40% of the total calories to 30% would be 250 kilocalories or about 26 to 28 grams per day. That is, the recommendation would reduce fat intake from about 111 grams per day to 83 grams. Those who discussed the implications of the recommended reduction of fat consumption in terms of actual diets were of the opinion that the difficulties of diet design would be greater than might appear from the seemingly moderate reduction. The problems were illustrated by calculations based upon USDA diets developed to meet dietary guidelines that would supply 35% of the calories as fat. On the average, the 1600-kilocalorie diets developed for women 23 to 50 years of age (1600 kilocalories is the average energy intake found in a recent USDA survey of women of this age group) did not supply the Recommended Dietary Allowances for iron, zinc, vitamin B₆, and folacin.

In the opinion of these reviewers, for nutrition professionals to design a palatable diet in which only 30% of the calories would be derived from fat, while satisfying the Recommended Dietary Allowances and relying upon currently existing and popular foodstuffs, would not be easy, and for ordinary consumers to make the appropriate food choices in the supermarket would be almost impossible. Lean meat was suggested as a good source of the deficient nutrients. Except for folacin, lean meat contains a higher concentration of the minerals and vitamins deficient in the USDA diets, relative to the number of calories, than do the average USDA

menus.

These reviewers noted that, using foods currently available in the United States, and taking into consideration current consumption practices, a nutritionally adequate diet must include about as much fresh meat relative to other foods as Americans are consuming

now. The Academy is chided for, on the one hand, advising consumers to balance their nutrient intakes and, on the other hand, exhorting them to do it with foods that do not contain the required amounts of the nutrients.

COMMENTS BY INDIVIDUAL SCIENTISTS

Review of *Diet, Nutrition, and Cancer*

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This review has been prepared by the author at the request of the Council for Agricultural Science and Technology (CAST) and as a representative of the American Meat Science Association (AMSA) upon recommendation of that association's representative to CAST. The opinions expressed are entirely mine and do not reflect the position of Purdue University, AMSA or CAST. My current title is Professor of Animal Sciences, and I have been involved in meat science research and meat science and food chemistry teaching since 1967. It is a pleasure to comment on those areas of *Diet, Nutrition, and Cancer* that are within my area of scientific expertise.

A disturbing feature of the Interim Dietary Guideline to minimize intake of salt-cured, salt-pickled and smoked food is that it is made almost entirely on the basis of epidemiological evidence, most of which was obtained from descriptive studies. As stated in the document (page 3-2), data from such studies "are suggestive, rather than definitive, and serve primarily...to generate hypotheses for further investigation." These data are the least desirable for demonstration of causal relationships and development of recommendations.

The recommendation to minimize consumption of food preserved by salt-curing (including salt-pickling) and smoking may be warranted for populations of China, Japan and Iceland who frequently consume these products and in which such consumption is correlated with a high incidence of stomach cancer. But the same recommendation has much less potential benefit for the United States where such products are consumed infrequently and stomach cancer incidence and mortality have declined for the past 30 to 40 years (page 16-7). The suggestion that risks of esophageal and stomach cancer can be reduced measurably by minimizing intake of sausage, ham, bacon, bologna and hot dogs (National Research Council news release of June 15, 1982) borders on irresponsibility. It indicates a lack of knowledge of modern U.S. meat processing and of the composition of the products named. Although these products are said to be examples of salt cured, salt pickled, and smoked foods, the fact is that they are *not preserved* by either salt-curing or smoking. Salt concentration in the products, amount of smoke deposited on surfaces and amount of moisture lost during smoking are

inadequate to achieve preservation. The products require refrigeration (near 0°C) and in most instances are vacuum packaged to delay spoilage. Their composition and methods for preparation do not resemble salt-cured and smoked foods implicated in studies of Chinese, Japanese and Icelandic populations.

Sausage, ham, bacon, bologna and hot dogs are eaten frequently by Americans. Recommendations to minimize their consumption that are based on inaccurate and misinterpreted information generate unnecessary and unwarranted public concern. There is no evidence that the suggested benefits would be realized.

Several processed meat products are preserved largely by salt-curing and/or smoking and do not require refrigeration. Examples include dry, aged, country-cured ham and dry, fermented sausages such as pepperoni and dry salamis. Such products are consumed widely in the United States, but the frequency of consumption is low. Thus, the risk, if any, from their consumption also is probably low.

The recommendation to reduce the consumption of fats so that fat contributes no more than 30% of total calories in the diet may have merit. Epidemiological and some experimental evidence indicates that high fat intake increases the incidence of colon and breast cancer. It has not been shown, however, that the suggested reduction would significantly affect the incidence of cancer. On the other hand, lower fat intake also may aid in the prevention of obesity in that fat provides more than twice as much energy per gram as do carbohydrates and proteins. Obesity is the commonest form of malnutrition in the Western nations of the world, and it is associated with significant increases in morbidity and mortality from hypertension, diabetes, coronary heart disease and gallbladder disease (*Toward Healthful Diets*, Food and Nutrition Board, National Academy of Sciences, 1980). Reduction of fat intake does not disagree with recommendations of the Food and Nutrition Board (1980).

The news release of June 15, 1982 presents a confusing and incorrect description of major sources of fat in the American diet. Cooking oils and fats and margarine, largely of vegetable fat origin, contribute more calories to the diet than either meat or whole-milk dairy products. Intake of calories from fat in animal food products (meat, milk and eggs) has declined, while that from vegetable fats has increased and now equals or exceeds the intake of calories from animal fats.

The meat industry has or could rapidly develop the capability to produce processed meat products such as bologna

and hot dogs with much lower fat content than those marketed currently. However, regulations of USDA-FSQS that control labeling of these products discourage such innovation. The moisture:protein ratio specified for cooked sausages dictates that the fat content be 25 to 30% in order to produce products with texture and palatability properties that are acceptable to consumers. Products lower in fat and with acceptable texture and palatability can be produced, but only if the ratio of moisture to protein is increased. A more enlightened approach to formulation of regulations would permit further reductions in fat content of meat products without loss of product quality.

Review of *Diet, Nutrition, and Cancer*

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The following comments on the *Diet, Nutrition, and Cancer* report have been prepared in response to a nomination made by the Soil Science Society of America.

1. A general adoption of the "Interim Dietary Guidelines," especially No. 1 to reduce dietary fat from 40% to 30% of the average U.S. diet, would have an adverse effect upon the already depressed feed grain-livestock production agriculture of the United States. Quantitative estimates of the impact on national and regional agricultural economies would need to be compiled by agricultural economists and agricultural statisticians.

2. The suggested decrease in average daily intake of meat and dairy products may result in a decreased intake of several essential nutrients. In particular, animal products are the primary source of vitamin B₁₂ in diets, and dairy products are the major source of calcium. Several of the essential amino acids are present at higher concentrations in animal products than in foods from plant sources. Meats are also important dietary sources of iron, magnesium and zinc. The consequences of decreased intakes of these nutrients should be balanced against the possible decrease in cancer incidence before the Interim Dietary Guidelines are recommended to the general public.

3. This reviewer has kept close contact with the evidence relating selenium deficiency to cancer incidence for the past 12 years. The reviewer agrees with the conclusion that a relationship between low dietary selenium and higher cancer risk is not proven by human epidemiological studies, but animal experiments have indicated a need for additional research. However, this reviewer is not in agreement with the references to Schrauzer et al. (1977a, 1977b) and Shamberger and Willis (1971) cited on page 10-2 in support of an inverse relationship between dietary selenium and cancer. These references used either a misinterpretation of the reviewer's data on selenium in plants in the United States or invalid generalizations on the selenium content of different foods in their comparisons.

Impact on American Agriculture if American Consumers Were to Implement the Dietary Guidelines Proposed in the Report on *Diet, Nutrition, and Cancer*

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Acceptance by American consumers of the dietary guidelines proposed in the *Diet, Nutrition, and Cancer* report published by the National Academy Press would require a substantial change in consumer preferences and consumption patterns. According to the June 15, 1982 press release by the National Academy of Sciences, the major sources of fat in the American diet are fatty cuts of meat, whole-milk products and cooking oils and fats.¹ Thus, fat intake reduction would mean fewer steaks, roasts, hot dogs, hamburgers and french fries and less fried chicken, pizza, ice cream and oven-ready prepared foods. Acceptance of the dietary guidelines by the American consumer would significantly impact agricultural producers, food processors and retailers and also the away-from-home eating industry.

The beef and pork industries would be the first industries to feel the impact of the dietary change. In addition to being identified as a major source of fat in the diet, large portions of beef and pork are consumed as processed meat products that have been cured or smoked. About 60-70 percent of the pork and about 15 percent of the beef sold in the United States is in processed form. Thus, if all consumers followed the dietary guidelines, we would probably observe a 40-50 percent drop in the consumption of pork and a 20-30 percent decline in the consumption of beef. The impacts of these changes on beef and pork producers, meat processors and the ready-to-eat food industry are obvious. Only massive expansion of export markets would spare the livestock production and processing industries from the impacts of the drastic change in consumption. Unfortunately, past efforts to expand U.S. beef and pork exports indicate that this is not likely.

At first glance one might think that the poultry industry would be helped by American consumers' adherence to the guidelines. However, about 30 percent of broiler consumption is purchased through fried chicken fast-food outlets. More-

¹Per capita consumption data are developed by dividing production by population. Thus, these data reflect per capita disappearance of food rather than actual consumption. For many foods this creates no measurement problem since there is little, if any, loss in the food preparation and consumption of the product. However, per capita disappearance data grossly overstate fat intake from consumption of meats. Consumers typically trim and discard a major portion of the fat from fatty cuts of meat during the preparation and consumption process. Thus, consumption of fatty cuts of meat is less a source of fat intake than disappearance data indicate.

over, much of the expansion of turkey meat consumption in recent years has been in the form of processed, cured or smoked products such as turkey ham, etc. Thus, a reduction in fried, cured, and smoked meats would also significantly impact the poultry industry. At best, poultry consumption would remain at current levels. However, poultry consumption would most likely decline 10-15 percent.

The reduction of meat intake would generate potential problems for consumers to meet protein and caloric intake needs. Fish would be a potential source of protein. However, fish is already a more expensive source of protein than meats, and any expansion in the demand for fish would make this a prohibitively expensive source of protein for all but the most affluent consumers. Cheese and eggs would also be sources of protein, but fat and cholesterol concerns create problems with meeting protein objectives from these sources.

The reduction of fat from 40 percent of calories to 30 percent of calories would require about a 25 percent increase in carbohydrate intake to maintain the same caloric intake. The replacement of meats and fats with carbohydrates would also result in a 50 percent increase in the bulk content of the diet.² These dietary changes would require substantial increases in the consumption of grain products, fruits, vegetables and skim milk.

Impacts on Agriculture

Meat Industry

The reductions in meat consumption would sharply reduce incomes to the livestock and meat processing industries. The magnitude of the potential reduction in demand is so large that it renders the usual elasticity estimates useless in trying to estimate the impact on industry revenues. The nature and magnitude of the impact would depend on how rapidly the adjustment in consumption occurred. An immediate adjustment would, of course, be disastrous for the livestock and meat industry. More gradual reductions in consumption would be less disastrous but would still have major impacts on the industry.

Cattle feeding would be greatly reduced. Fewer cattle would be fed for shorter time periods to produce "leaner beef." Slaughtering cattle at lighter weights would mean that less meat could be produced per brood cow, and, hence, production costs would shift upward at the same time that demand is being reduced. The final impact on cattle and beef prices is uncertain. However, it is quite likely that production and consumption of beef would be reduced by 20-30 percent and that cattle feeding would decline by as much as 50 percent.

The sharp reduction in total demand for beef coupled with increased production costs means that total net farm income from beef production would be reduced substantially. It is not possible to develop precise estimates of the amount of reduction. However, the reduction could easily be 25-30 percent. Income reductions of this magnitude would greatly alter land values and the value of other capital assets used in the production of beef. These changes would lead to a reduction in the number of cattle and beef producers in the United States.

The pork industry would face an even sharper reduction in demand for its products since such a large proportion of these products is smoked or cured. Demand for bacon and pork sausage would shrink dramatically.

The Corn Belt states have a comparative advantage in pork production due to available feed supplies. Thus, a 40-50 percent reduction in pork consumption would probably eliminate a major portion of pork production outside the Corn Belt and also would reduce the number of producers in the Corn Belt. As in the case of beef, the magnitude of the potential change is so large that precise estimates of net income reductions are impossible. However, if the American consumer followed the suggested dietary guidelines completely, net farm income generated from pork production could easily be reduced by 40-50 percent.

As noted earlier the poultry industry would also be adversely impacted if consumers fully accepted the dietary guidelines. The major negative impact on poultry consumption would be the relatively large share of broiler consumption eaten in the form of fried chicken. If consumers would develop tastes for chicken prepared in other ways, the poultry industry could perhaps avoid some of the reduction in poultry consumption that otherwise would occur. Since most of the fat in poultry meat products is connected to the skin, the development and consumer acceptance of dishes of skinned poultry could be beneficial to the poultry industry.

Grain Industry

The guidelines call for expanded consumption of whole grain cereal products. This would of course increase consumption of grains. However, domestic food consumption accounts for a relatively small proportion of U.S. grain production. Thus, even a doubling of U.S. food use of grain would have only a modest impact on grain prices. Moreover, this increased consumption would not offset the decline in demand for grains caused by the reduced production of beef, pork, and poultry. Animal feeding accounts for over 80 percent of domestic utilization of U.S. corn production. Moreover, feed use accounts for almost all of the domestic use of soybean meal. Domestic uses account for about 70 percent of U.S. corn production and 60 percent of soybean production. Thus, 20-30 percent reductions in beef and poultry production and 40-50 percent in pork production would mean drastic reductions in the demand for corn and soybeans. Domestic utilization of corn and soybeans could decline by 25-30 percent, depressing prices of these commodities by more than a dollar per bushel. Since only small amounts of wheat are used for animal feed, the negative impact of the dietary change on the wheat industry would be less severe.

The dietary changes would have a double impact on the U.S. soybean industry. Soybean oil is a major source of cooking oil and is also widely used as an ingredient in prepared foods. A 20-25 percent reduction in fat intake thus would translate into a substantial reduction in the demand for cooking oils and many foods containing soybean oil. The combination of reduced demand for high-protein animal feeds caused by reduced demand for meats and the reduced consumption of fried foods and other foods containing fat would mean a 30-40 percent reduction in the demand for soybeans in the United States.

The reduced demand for corn and soybeans would lead to massive reductions in farm income throughout U.S. agricul-

²Scala, J. "Responsibilities of the Food Industry to Ensure an Optimum Diet," *Food Technology*, September 1978, pp. 77-78.

ture. The heaviest impact would be in the midwestern portion of the United States, where most of the corn and soybeans are produced.

Fruit and Vegetable Industries

The fruit and vegetable industries would clearly benefit from the expanded demand for their products if consumers were to implement the guidelines. However, fruits and vegetables account for less than 15 percent of cash receipts for U.S. agriculture. In contrast, cattle, hogs, poultry products, feed grains and oil crops account for over 50 percent of cash receipts. Thus, the expanded sales of fruits and vegetables would not overcome the income losses to other segments of U.S. agriculture.

Conclusions

The productive capacity of American agriculture far exceeds the food needs of American consumers regardless of the diet the American consumer wishes to consume. Large portions of U.S. agricultural land are especially well suited for production of corn and soybeans. This natural endowment and major technological developments (hybrid corn, use of fertilizer, irrigation, etc.) have made it possible for American farmers to produce large amounts of grain at relatively low cost. Moreover, as American consumers have become increasingly more affluent, they have been willing to pay agricultural producers to convert some of that grain into a preferred consumption product — meat.

The preference of American consumers to obtain increasing portions of their food needs in the form of meats rather than grain, and their ability to pay for the conversion process, have made possible the development of the livestock, poultry and meat industries as we know them today. The process of providing consumers with increasing amounts of meat relative to grain has: (1) supported the production of much larger amounts of grain than could have been consumed directly by American consumers and (2) supported the development and expansion of a specialized meat production and processing industry. The meat production and processing industry is in a sense a manufacturing industry engaged in converting a raw material, grain, into a higher valued product.

If, as a result of the dietary guidelines, the American consumer were to decide that meat is no longer preferred to grain as a source of food, then both the meat-producing and grain-producing segments of American agriculture would be forced to reduce the level of output. This type of change in U.S. consumer food demand would mean that less resources would be needed to meet U.S. food needs. This reduced need for agricultural resources would reduce the income of livestock and grain producers, signaling the need to reduce production and hence to withdraw some of the natural resources, labor, and capital currently being used to produce meats and other sources of fat in the American consumer's diet.

If the dietary guidelines are correct and, hence, the public welfare would be increased by a healthier (presumably, therefore, happier and more productive) population because of the changes in the diet, then the American society would be better off because of the change. The adjustments in the agricultural sector discussed above would be both necessary and desirable. However, if the guidelines are incorrect and,

hence, the public welfare would be decreased rather than increased by the dietary changes (because the population would not be healthier as a result of eating a less palatable diet), then acceptance of the guidelines would result in a decrease in public welfare, and the resulting adjustments would lead to misallocation of resources.

Given the magnitude of the impacts on the agricultural sector if the diet guidelines were accepted, it is quite critical that the validity of the association between the composition of the diet and cancer be subjected to rigorous testing before government programs are developed to stimulate changes in the American diet.

Statement on Diet, Nutrition, and Cancer

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The report entitled *Diet, Nutrition, and Cancer* is a detailed compilation and analysis of available information on the subject. The vast majority of readers will concentrate on the "Executive Summary," and the population generally will learn about the report by reading or listening to further condensed highlights presented by the media.

The committee that prepared the report points out repeatedly that the data are not clear-cut and are controversial; however, the committee makes some strongly worded recommendations about major changes in the diet. My concern is that the possible consequences of the recommended changes are not properly discussed or acknowledged in the report. For example, the recommendation regarding reduction of consumption of fats seems to me to represent a very substantial alteration in the diet. While the hope is obviously to reduce incidence of cancer, the committee members themselves emphasize that the results upon which they base their recommendation are controversial. Therefore, I believe a statement about potential (and unknown) undesirable consequences of such a change would have been in order. Focusing on one objective (i.e., reduction in incidence of cancer) while neglecting others which, in the case of diet, are more important, can be a dangerous procedure — something like genetic selection for a desired minor trait without carefully monitoring during the selection pressure for the occurrence of unwanted or undesired changes in major traits which may be expressed as progress is made on the trait being selected for. Changing the balance of a biological system in order to make a hoped-for improvement (e.g., changing fat consumption to reduce cancer) almost certainly involves a risk of producing other effects not contemplated.

On a more specific note, the third "Interim Guideline" leaves me a bit puzzled as to the rationale. Is the concern for salt, smoke or nitrite? No mention is made of nitrite curing even though that seems to be what is read into the statement. The report reads that "...some methods...produce higher levels..." but the conclusion is that consumption of salt-cured or smoked foods should be minimized. This recommendation too is a rather strong one, but, I believe, the reader should be

given specifics of what exactly is meant — does the issue center on salt, nitrite, smoke, or a combination?

Finally, while I believe it is commendable and necessary to study exhaustively such a complex situation as diet and cancer, I have great difficulty understanding why nothing is being done about a well-established cause of cancer (smoking) — indeed the committee leads off the summary by informing us it is absolutely clear that cigarettes cause one-quarter of all fatal cancers in the United States. Why not concentrate action on known situations while continuing study of ones for which the evidence is much less convincing?

A Review — *Diet, Nutrition, and Cancer*

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The report, *Toward Healthful Diets*, Food and Nutrition Board, Division of Biological Sciences, Assembly of Life Sciences, National Research Council's (1980) recommendation, "Select as wide a variety of foods in each of the major food groups as is practicable in order to ensure a high probability of consuming adequate quantities of all essential nutrients," in essence will accomplish practically all of the dietary recommendations of the *Diet, Nutrition, and Cancer* report.

It is doubtful that many nutritionists would argue that a reduction of calorie intake from fat from 40% of the total calories to 30% would be harmful to most. A reduction of the total calorie level of the diet would certainly benefit many individuals, especially if this reduction in consumption of fat were replaced by other foods such as fruits and vegetables.

The most alarming aspect of *Diet, Nutrition, and Cancer* stems from a comparison of news releases, the executive summary, and the general text of the report. It is noted that the age-adjusted total cancer incidence and mortality rates for sites other than the respiratory tract have as a whole remained stable during the last 30-40 years, while the total per capita fat intake increased only 27% during the first 50 years. However, along with this was a 56% increase in the intake of separated fats, most of them from vegetable sources.

The Committee (*Diet, Nutrition, and Cancer*) concluded that data from animal studies suggest that the polyunsaturated fats more than saturated fats tend to enhance tumorigenesis, whereas the data on humans do not permit a clear distinction to be made between the effect of different components of fat, and that when total fat intake is low, polyunsaturated fats appear to be more effective than saturated fats in increasing tumorigenesis but that this distinction becomes less prominent as total fat intake is increased. The Committee, in the executive summary, then recommends that the calories from fat intake be reduced from 40% of the total to 30%.

A news release dated June 15, 1982, goes one step further and suggests that the major sources of fat in the American diet are fatty cuts of meat, whole-milk dairy products, and cooking oils and fats. This indicates that the same emphasis should be placed on meat, whole-milk products, and cooking oils and fats. The Committee, however, emphasized cooking oils and fats, especially polyunsaturated fats, as links to carcinogenesis. The overall recommendation of a reduction for the general population in whole-milk dairy products cannot be made on a sound nutritional basis. This type of food is essential for the health and well-being of a large section of our population, especially the young, elderly and blacks. Osteoporosis is a problem in the elderly, especially women. If whole-milk dairy products are to be severely restricted, then other foods high in calcium must replace this excellent calcium source. In a recent report (*Science*, 1982, Vol. 217, No. 4556, p. 267) by McCarron et al., inadequate calcium intake was suggested as a previously unrecognized factor in the development of hypertension.

In general, the evidence reviewed by the Committee suggests that cancer of most major sites is influenced by dietary patterns. However, the Committee concluded that the data are not sufficient to quantitate the contribution of diet to the overall cancer risk or to determine the percent reduction in risks that might be achieved by dietary manipulation. It would seem that if the data are actually that bad or inconclusive, then the level of 30% of the calories from fat is truly arbitrary. From the above statements, it would seem that possibly no calories should be derived from polyunsaturated fats and all calories derived from animal fat.

Instead of a shotgun approach, as part of the news releases seem to be, constructive means of reduction of polyunsaturated fats and saturated fats should be addressed. When a reduction of calories from fat from 40% to 30% is placed in perspective, the alarm factor of the news releases is softened. The elimination from the average daily diet of approximately $\frac{1}{6}$ cup of cooking oil, 1 avocado, 2 Danish pastries, $\frac{1}{7}$ of a pecan pie, 40 potato chips or 6 pats of butter would accomplish the recommended reduction. However, few members of the general public have sufficient knowledge of foods to make these adjustments properly.

No doubt the Committee on *Diet, Nutrition, and Cancer* did not intend the report to be a scare tactic; however, the news releases that came after the report seem to leave much to be desired, and if the general public blindly followed the recommendation of the news releases, serious nutritional consequences could evolve.

It would seem to be highly desirable for the authors of *Toward Healthful Diets* and *Diet, Nutrition, and Cancer* to reassemble together in order to reconcile the difference in their finding. If *Toward Healthful Diets* is incomplete, this should be rectified. If the news releases from *Diet, Nutrition, and Cancer* have overstepped the bounds of good scientific nutritional reporting, that too should be rectified. Members of the public must receive good nutritional interpretations that will not cause more nutritional problems than they actually solve.

Some Comments on the *Diet, Nutrition, and Cancer* Report of the National Academy of Sciences

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Man is only one of the multitude of species of competing biological organisms inhabiting this earth. All organisms live by a well integrated but complex series of chemical processes. We ourselves are obligatory consumers of other organisms in whole or in part. So we must protect and nurture ourselves and the organisms we need for food and inhibit or destroy the organisms competing directly with us and our food organisms. In this way we get the chemical substances, the nutrients, to build and repair our bodies and to provide the energy to live. Even through there are fundamental similarities in the composition of all living things there are also differences. So we have the ability to consume diverse organisms, disassemble (digest) them into fundamental biological materials, separate those substances which our bodies need (nutrients) and destroy and get rid of those materials we do not need and which might be potentially harmful. It is within this frame of reference that the relationship of diet and cancer is to be understood.

Unique among living things, man has depended upon his intellect — his problem solving ability — for survival and for the development of the civilization we know today. So here we are examining and debating the relationship of food and cancer. As social creatures we realize that the maintenance of a stable economic and social structure is necessary in our society to assure a continuing supply of wholesome food. Consequently all food problems have social and economic parameters. Today we are the benefactors of the most nutritious food supply in history.

Perhaps individually and collectively we might be able to use our food resources more effectively. Yet we must be certain that the food supplies for the general population are not deprecatd by dietary changes based on tentative hypotheses. The hypothesis that we could depress the incidence of some cardiovascular diseases by reducing our intake of cholesterol and increasing our consumption of polyunsaturated fatty acids has not been verified in practice. Now the report before us appears to say that such a change may not have been desirable with respect to the development of cancer. The anticholesterol, polyunsaturated-fat campaign increased consumption of vegetable fats. Many of these are hydrogenated and thus put in our food many fatty acids not naturally found in plants or animals. Also these vegetable oils contain many plant sterols foreign to human tissue. This campaign has certainly contributed to the drop in consumption of eggs because of their cholesterol content. Eggs are among the most nutritious and least expensive foods. Yet all of us make in our bodies more cholesterol, a necessary body constituent, than would normally be consumed in our food. The poor result of these heart-disease-diet recommendations did not enhance public confi-

dence in the scientific and medical communities. To forestall a similar situation and further erosion of public confidence, the diet-to-prevent-cancer recommendations should be based on a very firm scientific foundation. Throughout the Committee's report there are numerous contradictions. Equivocating statements are common. These and the reliance on epidemiological evidence which does not prove cause and effect raise some doubt as to the value of the Committee's recommendations, particularly as they have been presented to the public.

People like fatty ("rich") foods. The consumption of fat increases as income increases. Until 80 years ago, fat was a relatively scarce item. In fact, animals were bred and fed for producing edible fat even more than for lean. Early in this century it became possible to refine edible oils from otherwise inedible seeds (e.g., cottonseed), and a new source of food fats became available. Whereas the consumption of animal fats has remained constant or declined slightly since 1900, the consumption of vegetable oils has markedly increased. The amount of animal protein has increased, reflecting increased emphasis in the production of leaner meat and milk of lower fat content. The fact that total dietary protein has not changed much indicates that higher quality animal protein has replaced lower quality cereal protein. The recommendation of the Committee for reducing dietary fat to 30% or less of total dietary energy would require a large increase in consumption of cereals. Fruits and vegetables, recommended by the Committee, are very expensive sources of food energy or protein. The composite American diet has never been in this century as low in fat as the Committee is recommending. The Committee's report is lacking compelling evidence for such a radical change in our diets.

The recommendations on fat appear to focus on a possible relationship between oxidative rancidity or the propensity for this common food spoilage process and the incidence of cancer. The beneficial action of vitamin E, other natural and synthetic antioxidants, and selenium (until a few years ago considered a carcinogen) and the decrease in polyunsaturated fatty acid consumption all suggest that somehow autoxidation of fat or a similar process may be involved in the initiation and/or growth of some cancers.

Since whole grains contain vitamin E and other antioxidants and contain some pentosans, the only fiber constituent the Committee feels may be beneficial, the Committee recommends consumption of whole-grain products. But consuming more of these products is likely to increase our intake of aflatoxins, potent carcinogens resulting from common molds growing on the surfaces of nuts and grains.

For over a century many people have promoted whole-grain products with only limited success. Many consumers do not like them. There may be a number of reasons for this. Although whole grains can be stored well for long periods of time if properly handled, this is not true for milled whole grains — fats in the milled flours oxidize. Another problem with whole-grain products is that the proteins of whole cereals are not well digested. This, coupled with the much poorer nutritive qualities of cereal proteins as compared with most animal proteins in our diet, is certainly a disadvantage. For example, to get the protein equivalent to that in 300 Cal. of meat, a person must consume 5600 Cal. of corn, 3300 Cal. of rice or 2600 Cal. of wheat.

Fruit and vegetable consumption has been emphasized by

nutritionists for years. In spite of the fact that these are relatively expensive foods, their consumption has gradually increased in this century. The emphasis that the Committee put on the consumption of green, leafy, and cruciferous vegetables is apparently based on three factors: 1. These foods are good sources of vitamins A and C and minerals. 2. They contain antioxidant substances. 3. There is some tentative evidence that carotene metabolites other than vitamin A may have an inhibitory effect on the rate of cancer incidence and growth. In stressing consumption of the cruciferous vegetables, the Committee neglected to mention their goitrogenic activity and the fact that many (e.g., cabbage) are quite low in carotene.

Throughout the report the Committee repeatedly expressed concern about nitrite and nitrate in meat curing and the possible formation of nitrosamines, some of which are well known animal carcinogens. That nitrosamines are synthesized in the laboratory using nitrite as a reagent is not *ipso facto* evidence that this happens in humans under normal circumstances. What is completely neglected in the Committee's recommendations is that by far the largest dietary source of nitrate and nitrite is the vegetables which the Committee recommends. These vegetables often contain 1000, 2000 or even more parts of nitrate per million, and this is potential nitrite in the body. Cured meat generally contains 100 or less parts of nitrite plus nitrate per million. It is not clear why these substances from vegetables are no cause for alarm while 1/10 or 1/20 of the amount in vegetables is of such great concern when it is in meat.

"The Committee recommends that the consumption of food preserved by salt-curing (including salt-pickling) or smoking be minimized." This statement was sensationalized in the press release to "Eat very little salt-cured, salt-pickled, and smoked foods. (Examples of such foods commonly eaten in the U.S. are sausages, smoked fish and ham, bacon, bologna, and hot dogs)." The information detailed in the report does not justify such a position, and it is unfortunate that these statements emanated under the auspices of the National Academy of Sciences.

This recommendation arises from epidemiological studies in populations consuming very heavily smoked and dry, salt-cured fish and meat in locales where fresh meat and fish are in limited supply and in locales where refrigerated distribution of meat is not common. (No studies were available on the consumption of salted, unsmoked, sun-dried products.) The extrapolation of findings in these areas to U.S. meat consumption patterns where freshness is emphasized in a refrigerated distribution system is almost ludicrous.

Some of the Committee's concerns apparently center on the polycyclic aromatic hydrocarbons and nitrosamines which may be in smoke. The amount of smoke used in the products of the cited studies is several orders of magnitude higher than would be present in most U.S. meat products where smoke is used more like a flavoring agent or spice than as a preservative. Where "liquid smoke" is used, practically all of the potentially offensive hydrocarbons are removed. Also in many directly smoked products such as hot dogs and bologna the casings are not eaten. Chemical analyses show that these products generally contain only very minute traces or no detectable amounts of the suspect compounds. Higher amounts of these substances are often found in other foods, in tobacco smoke, or in automobile exhausts.

As in the case of smoke, there is no need for excessive salt in meats marketed and utilized in a refrigerated system where neither salt nor smoke is a primary preservative and where freshness of product is emphasized.

The general use of the word "sausages" is unfortunate, for there are so many sausages, such as fresh pork sausage, which are not smoked, cured, or pickled.

Cured meat in the United States refers to meat containing added nitrate or nitrite. For years 200 ppm was the maximum permitted to be added. More recently these levels have been gradually reduced commensurate with safety to 100 ppm or less generally present in cured meat. There is no evidence that this amount of nitrate and/or nitrite in meat promotes cancer. The Committee recommends that we consume more vegetables containing 10, 20, or more times the amount in cured meat.

Nitrate and nitrite have been used for centuries to inhibit microbial deterioration of meat and particularly to prevent the outgrowth of dreaded *Clostridium botulinum* in meat and meat products. Probably no other food preservative has contributed so much to the development of our own civilization. A by-product of these curing agents is the red color of cooked, cured meat in contrast to the browns of uncured cooked meat.

The antioxidant effect in the use of nitrite in the curing of meat is pertinent in this discussion of food and cancer. The possible depressing effect of antioxidants on cancer has been discussed above. The antioxidant effect of nitrite curing is generally neglected. Yet it is fair to say that in the present meat processing and distribution system in the United States this aspect of curing is probably as important as retarding microbial spoilage. Uncured meat of any kind, cooked to temperatures less than the boiling point of water, as is generally the case in meat cookery, is extraordinarily sensitive to oxidation by oxygen of the air. This is evidenced by rapid deterioration of flavor from what people relish and desire in meat to a flavor that many people do not like and describe as "warmed over" flavor. This undesirable flavor quickly intensifies with time. As part of this process fats rancidify, and the color of the cooked meat changes. Nitrite curing stabilizes the flavor of cooked, cured meat. If this were not the case, popular cured products such as ham, wieners, corned beef, luncheon meats, etc., which account for a large share of the meat Americans consume, would not be available. Nitrite in meat is a free radical acceptor and inhibits for a reasonable time the free-radical-propagated rancidification (fat oxidation) process. Consequently it may be that curing of meat may be a benefit rather than a hazard as far as cancer is concerned. Certainly more careful study and research are necessary before condemnation of cured meats is justified.

The complete report of the Committee — more than 400 pages — is a well organized review of the voluminous literature on the subject of diet and cancer. The emphasis is of course on recent literature. The present thinking of the apparent majority of the cancer research community as to the initiation and growth of cancers is particularly helpful, as is the discussion on methodologies. Within the broader scientific community, there are likely to be differing opinions as to the relative emphases being placed on various aspects of the report. There are some imprecise statements which may be mistakes in composition or imprecision by the authors cited. These are unfortunate in a report coming from the National

Academy of Sciences.

The Committee is certainly on sound ground in its plea for more research on food constituents. Analytical techniques developed in the last 15-20 years can identify and quantify hitherto unknown substances in our food supply. These include natural metabolites and compounds produced during food preparation. The number of newly identified food constituents runs into the thousands. Desirable food flavors often develop in cooking by the thermal decomposition of food constituents, since many of the substances making up biological systems are heat sensitive. Fortunately usual cooking procedures which have been practiced for millenia do not appear to cause a great public health problem, or we would not have survived. Nevertheless, as the causes of cancer and the nature of carcinogenesis become clarified, food constituents should be examined.

The detailed report indicates that food additives seem to pose no great problem. This finding by the Committee should help bring some public sanity in this sensationalized aspect of our food supply. Such sensationalism, often woven around unsound information or half truths, undermines public confidence in food and in the scientific community as a whole. It is regretted that sensationalism in the press release has tarnished this Committee's report on the additive picture as well as in other aspects mentioned above.

The Committee is to be commended in publicly recognizing that carcinogens, whether initiators or promoters, are widespread in nature and that zero levels of many of these substances in our environment (food or other) are probably unattainable. Consequently the Committee properly recommends that every practical means be taken to eliminate or minimize the presence of offending substances. The Committee further recommends that, if the substances cannot be eliminated, acceptable tolerance levels should be established.

Potential Impact of the *Diet, Nutrition, and Cancer* Report on the U.S. Agricultural Industry

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The few comments I would like to make relate to the context in which impacts of the report on *Diet, Nutrition, and Cancer* might occur, and the relative importance of such impacts. Today the general condition of our agricultural industry is one of financial stringency, stable or decreasing demand and excess supply. This has been brought on by a number of factors other than changes in consumer behavior as a result of government dietary recommendations. Even if the agricultural industry were healthy and expanding, let alone being in this depressed state, it is my judgment that such things as the nature of government commodity programs and

the level of foreign crop production and demand will have a much greater impact upon the financial health and structure of American agriculture over the next five to ten years than will recommendations one, two and three of the report.

With the record harvests projected for this fall and the large carry-over stocks of grain, the level of loan and target rates and the nature of the set-aside requirements will be critical to the health of the industry over the next five years, far outweighing the impact of any dietary recommendations which may or may not be followed by the American consumer. Such a reactive dependence upon government programs is going to be especially great for dairy producers, whose industry might be considered most vulnerable to 'low fat' dietary recommendations. The dairy industry's current excess capacity is being supported at present by government purchases of excess commodities. The stabilization or lowering of government purchase prices and support levels will result in a squeezing out of this excess capacity that will be far more painful quickly to those high-cost producers facing the brunt of the squeeze than would be government recommendations which might increase only slightly the past trend toward lower consumption of dairy fat.

Livestock producers have not been the subject of government programs, and so the impact of any dietary recommendations would be alone and direct. I suspect that much of the impact of the report has already been suffered in terms of short-term changes in consumer meat purchases as a result of the publicity already given to the findings. An actual government recommendation would have some additional force, but the initial public response to this one has probably been partially spent, and even its force is diminished by a number of earlier studies and reports with similar messages. Probably more important is the fact that price cycles for beef and pork have been at low points recently, and both industries have been in contraction or stable phases. The government endorsement of such dietary recommendations might slow recovery or lengthen the period of stability, but should not be the primary cause of a new decline in the industry. Again, there is already a consumer trend toward lean meat that the industry has already recognized and adjusted to in some degree.

Table 1. Index of Quantity of Grains and Feeds Exported From the United States, 1950-1979^a

Year	Index of Quantity of Grains and Feeds Exported (1967 = 100) ^b
1950	30
1955	28
1960	60
1965	92
1970	97
1974	179
1975	156
1976	184
1977	182
1978	216
1979	225

^aSources: USDA, *Agricultural Statistics* for 1972, 1976, 1980 and 1981 (USDA, Washington, D.C., 1973, 1977, 1981 and 1982), Tables 818, 772, 774 and 773, respectively.

^bMost of the expansion was in feed grains rather than in food grains.

We are increasingly dependent upon foreign purchases of grain, and the growth of these export markets has fueled much of the expansion in our agricultural industry over the last decade. Table 1 gives an indication of this export expansion. Given the increasing proportion of our feed grains exported, dietary recommendations by some foreign governments in the European countries and in Japan might have similar or greater influence than recommendations that might be made by the American government. In past years, we have counted on steadily increasing demand for exports to fuel agricultural prosperity in the 1980s. If this expansion does not occur, it will be a major factor in declining prosperity, far overshadowing any dietary recommendations.

Review of the Publication *Diet, Nutrition, and Cancer*

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A review of this publication from the National Research Council (NRC) can best be initiated by a quote from the NRC publication *Toward Healthful Diets* (1980), p. 5: "Although the Board considers it appropriate to set dietary guidelines beyond those implicit in the RDA, in the hope of correcting metabolic patterns in susceptible individuals in such a way as to prevent or delay the onset of chronic degenerative diseases, it is concerned about the adequacy of the scientific undergirding on which these recommendations are based." This same Food and Nutrition Board 9 pages later states "The Board believes that in the absence of evidence of a causal relationship between the macronutrients of the diet and cancer, there is no basis for making recommendations to modify the proportions of these macronutrients in the American diet at this time." Two years later another NRC committee in the publication *Diet, Nutrition, and Cancer* states "There is sufficient evidence that high fat consumption is linked to increased incidence of certain common cancers..." and recommends "that the consumption of both saturated and unsaturated fats be reduced in the average U.S. diet."

The report *Diet, Nutrition, and Cancer* is a very good report, and the chapters where the literature is reviewed on individual nutrients and other substances in food and their relationship to cancer appear to be thorough and objective. Disagreement with the report is always with some of the conclusions and whether the data quoted in the report can justify the "Interim Dietary Guidelines" (p. 1-14 thru 1-16). I first read the Executive Summary which contained the "Interim Dietary Guidelines" and then proceeded to the chapters on relationships between nutrients and cancer. As I read through the chapter on "Lipids," I kept waiting to read of some really strong conclusive evidence that led the committee to make the recommendation for reducing fat in the diets of all Americans; I was disappointed. I found that the chapter on "Lipids" produced more questions than it did answers; good clear evidence to substantiate the committee's recommendations is not apparent. I had the same disappointment as I read the other chapters on individual nutrients and cancer; there is

not sufficient evidence at this time to make a judgment.

Several times the report pointed out serious problems in interpreting data in the first paragraph of a chapter and then never came to grips with the problem in the course of the review. For instance, any experimental nutritionist who has ever designed an animal experiment or human nutritionist who has calculated human diets is well aware of the complex nutritional relationships between dietary total calories, fat, protein, bulk, and overall nutrient density. An acknowledgment of some of these interrelationships is apparent in the first paragraphs of the chapters on "Total Caloric Intake," "Lipids," and "Protein." These interrelationships make it extremely difficult to interpret the studies on high-fat and high-protein diets; the authors of the publication acknowledge this in the first paragraphs of the chapters but then fail to address the problem as the chapters unfold. It certainly is not clear that the problem in consuming high-energy, high-protein diets is fat. Besides the possibility of high calorie and protein there are also the possibilities of dietary bulk, fiber, nutrient density and nutrient to nutrient ratios to be evaluated; these evaluations are not made.

One could not have the experience of serving on many committees as a scientist and university faculty member or of appointing many committees as an administrator without becoming aware of the make-up of the committee that wrote the report *Diet, Nutrition, and Cancer*. It is relatively easy to appoint a committee to get the Dietary Guidelines desired. The committee that wrote *Diet, Nutrition, and Cancer* contains a number of members with social science-nutrition interests. This committee obviously had a great deal more faith in epidemiological findings than would most basic experimental type nutritionists. The Food and Nutrition Board contains a higher proportion of basic science, nutrition-type members. The basic science nutritionist is more conservative than the social science nutritionist and would not be willing to gamble that the premature nutrition recommendation will fare as well as the no-smoking recommendation did. The Food and Nutrition Board will probably have the last word since its recommendation on controlling obesity probably amounts to a greater reduction in fat intake, for a large percentage of the population, than is recommended in *Diet, Nutrition, and Cancer*.

Fact vs. Judgment: Cause of the Diet-Cancer Controversy

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Since 1980, two reports have appeared from the NRC dealing, at least in part, with the subject of diet and cancer — Report I, *Toward Healthful Diets* (1980) and Report II, *Diet, Nutrition, and Cancer* (1982). Alarming, some say, that the conclusions drawn in these two reports should differ so markedly, to wit:

Report I, page 14: "The Board believes that in the absence of evidence of a causal relationship between the macronutrients of the diet and cancer, there is no basis for making recommendations to modify the proportions of these macronutrients in the American diet at

this time.”

Report II, page 1-14: “The evidence reviewed by the committee suggests that cancers of most major sites are influenced by dietary patterns,” and “...the committee believes that it is possible on the basis of current evidence to formulate interim dietary guidelines that are both consistent with good nutritional practices and likely to reduce the risk of cancer.”

First, let me state that both committees were composed of competent scientists who approached their respective tasks in a dedicated fashion. Why, then, the sharp difference in conclusions that has aroused the ire of Congressmen and industry representatives? The difference in conclusions will surely confuse the public and will tend to undermine the credibility of scientists. It is possible to criticize both reports in a very detailed manner, as some will do, and point to real or suspected weaknesses. I choose to refrain from this approach because (a) I feel unqualified to undertake such an analysis, (b) I have considerable trust in the competencies of scientists on both committees and (c) such an analysis would tend to obscure what I consider to be the single most important factor contributing to the differing conclusions.

Judges ruling on constitutional issues can be categorized as “strict” or “broad” constructionists. So it is with those who interpret scientific data. Let me suggest that the scientists who wrote Report I were strict constructionists. They found no evidence of a cause and effect relation between diet and incidence of cancer (while acknowledging some “associations”) and therefore rejected as inappropriate any recommendations concerning changes in diet.

Correspondingly, let me suggest that the scientists who wrote Report II were broad constructionists. They documented many situations where the incidence of cancer was, or tended to be, “associated” or “correlated” with diet, and considered this sufficient, even without strong independent evidence of causation, to justify recommending changes in the diet.

The controversy, then, does not involve a discrepancy in scientific fact, but rather a difference in the judgment of scientists as to what conclusions and recommendations can be appropriately drawn from the facts. What has clearly happened is that a scientific advisory body, the Committee on Diet, Nutrition, and Cancer, abetted by its charge, has ventured from the scientific community’s time-tested approach of deriving virtually irrefutable conclusions from hard facts, to the less reliable and more contentious approach of composing judgments and educated speculations from factual associations that may or may not be causative in nature. It is important that all interested parties know this, be able to recognize when this occurs and understand that reports prepared in this manner are far less likely to generate unanimity among scientists than those that are confined simply to the summarization of scientific facts.

It is worth adding that the recommendations advanced by the Committee on Diet, Nutrition, and Cancer are unlikely to harm, and may benefit, those individuals choosing to abide by them. In fact, some of the recommendations have been previously advocated for reasons other than avoidance of cancer. However, one can only wonder why the Committee did not openly acknowledge the major differences existing between its findings and those that appeared in *Toward*

Heathful Diets, and why these differences were not fully explained. Although the Committee was charged to develop recommendations that could be used to formulate public policy, some will question the wisdom of devising such recommendations (guidelines) when the data available were primarily associative. This dutiful compliance with its charge is particularly troubling since the Committee surely realized that its recommendations may irreversibly damage or destroy certain segments of our food production and processing enterprises, and that the recommendations formulated are, by its own admission, interim and subject to change as more and better data become available.

Scientific fact or judgment by scientists? Recognition of the distinction is important by all individuals who evaluate reports from any scientific advisory committee.

The opinions expressed in this commentary are solely mine and do not necessarily reflect the views of any organization with which I am associated.

Economic Impact of the Interim Dietary Guidelines From the Report of the Committee on *Diet, Nutrition, and Cancer* National Academy of Sciences

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In Chapter I, the “Executive Summary” of the report on *Diet, Nutrition, and Cancer*, the Committee stated:

It is not now possible, and may never be possible, to specify a diet that would protect everyone against all forms of cancer. Nevertheless, the committee believes that it is possible on the basis of current evidence to formulate interim dietary guidelines that are both consistent with good nutritional practices and likely to reduce the risk of cancer. *These guidelines are meant to be applied in their entirety to obtain maximal benefit.* (Italics are mine.)

While some six guidelines were enumerated, this paper will focus on an economic analysis of three major recommendations which were essentially as follows:

1. The committee recommends that the consumption of both saturated and unsaturated fats be reduced in the average U.S. diet. An appropriate and practical target is to reduce the intake of fat from its present level (approximately 40%) to 30% of total calories in the diet. The scientific data do not provide a strong basis for establishing fat intake at precisely 30% of total calories. Indeed, the data could be used to justify an even greater reduction. However, in the judgment of the committee, the suggested reduction (i.e., one-quarter of the fat

intake) is a moderate and practical target, and is likely to be beneficial.

2. The committee emphasizes the importance of including fruits, vegetables, and whole grain cereal products in the daily diet...especially citrus fruits and...carotene-rich and cruciferous vegetables.

3. The committee recommends that the consumption of food preserved by salt-curing (including salt-pickling) or smoking be minimized.

Three additional guidelines were described, one dealing with the need to minimize contamination of foods with carcinogens from any source, one urging further efforts to identify mutagens in food and to expedite testing for their carcinogenicity and finally one citing the importance of moderation in alcohol consumption. These additional recommendations will not be addressed in this analysis.

The study was a well-organized, encompassing inventory of a vast array of studies dealing with associations between nutrition and cancer. It should provide researchers with a convenient encyclopedia of previous efforts. Perhaps the weakest area was reviewing time series studies on changes in nutrition and cancer (other than lung cancer).

My reaction is that the research results reported do not justify prescriptive conclusions, particularly the general recommendations to a very diverse public. At the same time, the consequences of not heeding cancer warnings from incomplete research when the analysis is indeed correct can be much more serious than the consequences of taking unneeded precautions. But major dietary changes can also be disruptive and have serious consequences.

However, my role is not to evaluate the conclusions but to analyze the effect of the recommendations on agriculture and the food system. The first recommendation for the average American to reduce fat consumption from 40% to 30% of total calories is fairly clear. In fact, this recommendation is not original with the Committee on Diet, Nutrition, and Cancer. It was a recommendation by the Select Committee on Nutrition and Human Needs in 1977 (7). The Food and Nutrition Board of the National Academy of Sciences in 1980 recommended that fat be reduced only to 35% of dietary energy (3).

The second recommendation pointing out the important role of fruits, vegetables and whole grain cereals was not very specific. The implication would seem to be that Americans should increase consumption of these products by some unspecified amount.

The third recommendation on reducing consumption of food preserved by salt-curing or smoking is unclear. Relatively small amounts of food are salt-cured or smoked, but substantial amounts include salt for preservation and seasoning. Only in the press releases and not in the report itself were specific products named, i.e., sausage, smoked fish and ham, bacon, bologna and hog dogs (4).

Several questions are implicit:

1. How can the "average" American reduce fat intake to about 30% of dietary energy, increase somewhat the intake of fruit, vegetables and whole grain cereals, reduce substantially the consumption of certain processed meats (mostly from the pork complex) and meet the minimal Recommended Dietary Allowances (RDA) (3)?

2. What changes would evolve in the cost of the revised diet?

3. How would the food industry respond to such a modification in American diets?

4. Will consumers believe the recommendations?

5. Whether consumers believe the recommendations or not, will they make any significant modifications in their diets?

Dietary Implications

As a result of contacts with a number of nutritionists and food scientists, my impression is that there is consensus that the average fat consumption of Americans should be reduced and that a goal of 35% of dietary energy could be reached without major changes in most diets. However, to reach the target of 30% or less would require substantial modifications. This would not necessarily mean a major reduction in total meat consumption, however, as pointed out by Peterkin, Patterson, Blum and Kerr (6). They generated plans for diets for men and women between the ages of 20 and 50 years which met the RDA requirements, with fat at 30% of the dietary energy, and practically maintained total meat consumption for men while increasing it for women. The only major change was a sharp cut in consumption of bacon, sausage and lunch meat for men. The base for these changes was the U.S. dietary pattern found in the Nationwide Food Consumption Survey 1977-78 (9).

The study by Peterkin et al. was the only one which could be located that seemed to measure up in a reasonable way to the guidelines established by the Committee on Diet, Nutrition, and Cancer. Using this study as a base and modifying it somewhat to fit the Committee's guidelines, a preliminary analysis was made of the possible impact on the food system. Any errors in the interpretation and application are mine and should not be attributed to the original article.

Peterkin, Patterson, Blum and Kerr were researchers with the Consumer Nutrition Center, Human Nutrition, Science and Education, of the U.S. Department of Agriculture when the study was undertaken. They constructed two diets each for men and women of 20 to 50 years of age.

Diet 1 was designed to meet RDAs (3) and the dietary goals of the Select Committee on Nutrition and Human Needs (7). The RDAs do not include specific standards for fat, saturated fat, cholesterol, and sweeteners, and so those suggested by the Select Committee were used. Diet 2 was the same as Diet 1, except that the nutritional standards were relaxed by 15 percent. Some food consumption levels, however, did change much more than 15 percent.

Diet 1 resulted in total fat at 30% of dietary energy and Diet 2 at 34% of dietary energy in comparison with 42% calculated as the pattern in 1977. Saturated fat in the man's diet was reduced from 15% in the 1977 pattern to 9% in Diet 1 and 11% in Diet 2. For women, the reduction was from 15% in the 1977 pattern to 10% in Diet 1 and 11% in Diet 2. Protein as a percent of energy increased from 15% in the 1977 pattern to 18% in Diet 1 for men and 21% for women. It was 18% in Diet 2 for both men and women. While the Committee on Diet, Nutrition, and Cancer intimated in its report that Americans' current high level of protein consumption may contribute to the incidence of cancer, the results apparently were too inconclusive to justify such a statement in the interim guidelines.

In reviewing a detailed table on Diets 1 and 2 furnished to me by Mrs. Peterkin, I was inclined to average Diets 1 and 2

Table 1. Average Per Capita Consumption by Men and Women, 20-50 Years of Age, in 1977 as Compared With Diets Based on Recommended Dietary Allowances (3) and Dietary Guidelines (7)^a

Food Classification	Annual Consumption Per Capita		
	Pattern 1977 ^b	Recommended ^c	Percent Change
	Lb.	Lb.	%
Vegetables			
Potatoes	63.70	80.52	+ 26
High nutrient	82.42	93.70	+ 14
Other	93.08	107.30	+ 15
Mixtures, condiments	13.26	.98	- 93
Fruit			
Vitamin C rich	101.66	119.39	+ 17
Other	80.60	95.71	+ 19
Breakfast Cereals			
Whole grain, high fiber	4.94	9.96	+ 102
Other	5.98	11.02	+ 84
Flour, Meal, Rice, Pasta			
Whole grain, high fiber	2.60	5.15	+ 98
Other	34.06	65.78	+ 93
Bread			
Whole grain, high fiber	9.62	16.38	+ 70
Other	44.46	74.44	+ 67
Other Bakery Products	27.82	33.93	+ 22
Grain Mixtures	8.32	.83	- 90
Milk, Yogurt	209.82	240.60 ^d	+ 15
Cheese	22.88	16.59	- 27
Cream, Mixtures, Mostly Milk	23.40	2.34	- 90
Red Meats, Variety Meats			
Lower cost ^e	67.34	91.55 ^f	+ 36
Higher cost	73.32	93.55 ^f	+ 28
Poultry	43.42	52.57 ^f	+ 21
Fish, Shellfish	20.28	23.84	+ 18
Bacon, Sausage, Lunch Meat	36.14	27.25	- 25
Eggs	34.32	17.26	- 50
Dry Beans, Peas, Lentils	6.24	12.71	+ 104
Mixtures, Mostly Meats and Alternatives	8.06	.81	- 90
Nuts, Peanut Butter	4.42	5.80	+ 31
Fats, Oils	35.36	22.26 ^g	- 37
Sugar, Sweets	36.14	27.25	- 25
Soft Drinks, Punches, Ades	300.30	150.15	- 50

^aDerived from table provided by Betty Peterkin, Consumer Nutrition Center, U.S. Department of Agriculture.

^bDaily consumption by men and women, 20-50 years of age, in spring of 1977 (9), converted to an annual basis.

^cAverage of Diets 1 and 2 (6).

^dLow-fat types.

^eIncludes ground beef and pork; beef chuck roast and chuck steak; fresh and cured pork shoulder and Boston britt; beef and lamb stew meat; canned meats such as corned beef, roast beef, and cured pork and ham; chipped beef; and some organ meats.

^fOnly lean meat and poultry flesh (not skin) are consumed.

^gPrimarily soft margarine and vegetable oils.

because of substantial differences in specific food categories that appeared in these two diets. The average fat composition would be close to 32 percent (average of 34 and 30 from the two diets) and near the target level. To simplify the analysis, the consumption by men and women of 20-50 years of age was averaged and used to represent the total population in terms of change and not actual levels of consumption. Table 1 represents the results of this averaging process and conversion to annual per capita figures more commonly used in economic studies of demand.

Apparent in Table 1 is the point that consumers would have to make a major shift away from fats and oils, the sugar complex, and eggs and cheese and toward cereals and legumes. Vegetable and fruit consumption would also be increased, as would meat products except for bacon, sausage and lunch meat. Implied in the increase in meat consumption is closer trimming of fat. Although milk consumption would show some increase, the trend to low-fat milk would imply little change in whole-fluid-milk equivalent.

The changes indicated in this table are generally in the direction recommended in the interim guidelines of the Committee. The sharp drop in cheese and egg consumption might be questioned as extreme. We might also cut cured ham and a few other salted or smoked meat items from the red-meat category. In Table 1, the increase implied for both lower and higher-cost red meats was 31%. If cured ham and a few other items were to be reduced by 25% from 1977 levels, total red meat consumption would still increase by 28% to meet the standards.

Of course, the diets were derived by a mathematical model which undoubtedly would produce substantially different results with a few changes in assumptions and still result in acceptable dietary standards. For example, if the recommendation were in terms of whole milk equivalent and if fat from meat were eaten rather than discarded, consumption of milk and meat would be less than indicated in Table 1.

While the Committee did appear to favor a shift away from animal protein and toward vegetable protein, the total nutritional considerations, in addition to the cancer concern, appear to preclude a wholesale shift. The guidelines from the *Diet, Nutrition, and Cancer* report do not specify optimum levels of vitamins, minerals, cholesterol, sweeteners and sodium. Much of the change in Table 1 is required to meet the standards used for these dietary components rather than the standard for fat. For example, meat consumption is maintained or increased partly to provide the RDA for zinc. Had a zinc standard been specified below the RDA, meat content of diets probably would have been lower than indicated.

The cholesterol standard implied in Table 1 is somewhat controversial. It should be made clear that the *Diet, Nutrition, and Cancer* report did not identify cholesterol as a risk factor in cancer. This is also the case with sweeteners. For these reasons, Table 1 should not be regarded necessarily as the recommendations of the Committee on *Diet, Nutrition, and Cancer*, but as a combination of guidelines from this Committee plus those from the RDAs and the Select Committee. The changes between the patterns for 1977 and the recommended levels provide some general indications about the possible impact on various sectors of agriculture if consumers were to modify their diets accordingly.

The implications for animal agriculture are that certain sectors would be severely damaged, and other sectors would be enhanced by these recommendations. The egg industry would be most seriously affected, as per capita consumption would be cut in half, and production would decline accordingly. The pork industry also would be affected adversely, as bacon and ham would be used in lower valued products, and more lard would be produced rather than sold as a part of a meat product. While fluid milk consumption would be maintained on a product-weight basis, declining cheese, cream and butter consumption would force a substantial contraction in the U.S. dairy industry. The Lake States,

Wisconsin and Minnesota in particular, would be cut back the most due to the concentration of processing in this area.

The beef, broiler and turkey industries, on the other hand, would appear to be in a position to grow at a somewhat faster pace than otherwise would be the case. The long-term trend in per capita consumption of these meats has been upward with the exception that beef consumption has been declining since the mid 1970s. The beef cycle turned up briefly in 1980 and 1981 but appears to have leveled off in 1982 in response to low profit levels for cow-calf operators. Higher retail and farm prices will be required to generate the implied expansion in the beef industry and to a much lesser extent in the poultry meat industry.

Such a small portion of the fish and shellfish industries involves smoked or highly salted products that the Committee's recommendations should have minor effects on this industry.

Resources available to expand production of vegetables and dry beans and other legumes are such that little economic incentive would be required other than returns somewhat more attractive than competing crops. In economic jargon, the supply elasticity of these products is relatively high. The same could be said of the cereal products, with the additional observation that the export market is very important, and product could easily be diverted to the domestic market if demand warranted. At this particular time, the United States is faced with a large carryover of wheat (nearly 50 percent of annual use). Should domestic consumption per capita increase 50 percent, this would utilize only a fourth of the current carryover or require exports to be reduced by a sixth or require about a 12 percent increase in acreage. The implication is that such a large increase in cereal consumption could be easily accommodated, but of course, higher wheat prices would be required than have been received in the past year or so.

Expanding citrus and noncitrus fruit production by the implied 18 percent or so could not be achieved immediately because of the lag time required for tree fruit production. Prices would therefore tend to rise and remain higher for a longer period of time than with vegetables and cereals. However, eventually production would increase, and real prices at farms and retail outlets would converge to a level that would maintain production sufficient to meet the new demand.

The most vulnerable sectors in this analysis, aside from eggs, are the fats and oils and the sugar and sweetener industries. Not only is there a suggested reduction of 37 percent per capita in fat and oil consumption, but also the indicated reduction in bacon, sausage and lunch meat would add to animal fat supplies.¹ A 25 percent cut is recommended in sugar and sweetener consumption, and a 50 percent reduction is suggested in soft drinks, punches and ades. Alcoholic beverages were not included in this analysis.

In spite of the probable reduction in pork production if consumers followed these guidelines, demand for feed grains and high-protein meals would not change much because of rising consumption of beef and poultry meat. In any case, the capacity of the feed-grain and soybean sectors would be ample.

¹A 37 percent reduction in per capita consumption of fats and oils does not imply a similar shrinkage of the industry since considerable amounts are not ingested but are used in cooking. Also, fats and oils are used for nonfood purposes, and the export market is relatively important.

Cost of the Modified Diet

While costs were not included as a consideration in deriving the target diets, the Peterkin study indicated that the average of recommended Diets 1 and 2 would cost about 7 percent more than the pattern diet (Table 1) at the prices prevailing in the spring of 1977. This, of course, assumes that the change in diets would not have an impact of its own on price. Naturally, if all or a large number of individuals were to begin making the adjustments implied in the recommendations, food prices would be affected. Some prices would increase, some would fall and some would register little change. The impact would be spread over several years since consumers would not readily change their food consumption habits. We would concur that the net effect of the diet change would be to increase costs more than otherwise would be the case.

The price changes would largely be reflected at the farm level rather than in the margin between the farm and the retail outlet. Considering the relationship of farm prices to production costs in 1982, we would expect the most noticeable price declines in pork, milk and eggs. This is not because prices are particularly high relative to total production costs, but that they are well above direct costs. Farmers continue to produce for some time even if all of their fixed costs are not covered. Therefore, prices would likely decline before these producers would respond by reducing output in line with shrinking demand.

Pork

For example, in 1980 and 1981, hog prices averaged below levels considered to be the direct costs for average producers (2). Farmers responded by reducing production in 1982 and may even continue to cut back in early 1983. Prices have recovered nearly to levels which cover both direct costs and costs of adding new facilities. Such prices will eventually generate an expansion in production. If hog prices hold above \$60 in 1983, an increase in production should materialize at least by 1984. However, if demand for pork declines in the meantime, hog prices might well drop to \$40-45 — a decline of a third — before much liquidation would be generated. Since the farmer receives about half of the price of pork at retail (adjusted for by-product values), a 35% price decline at the farm level would mean about a 17-18% drop in the price of pork at retail.

This, of course, is the short-run impact. Farmers would not continue producing hogs without earning some return on fixed factors as well as direct costs, so hog and pork prices would eventually return to levels near those that would have prevailed without the shift in diets. The gross incomes to farmers, marketing agencies and processors would be less because of reduced volume.

In 1981, consumers spent about \$100 per capita for pork, two thirds of which were for hams, bacon, hot dogs, sausages and luncheon meat. If consumption of these items were to be reduced by, say, one-fourth, the eventual reduction in total pork output might be on the order of 15 percent. At 1981 prices, this translates to \$15 per capita for consumers or about \$3.5 billion to the pork industry. These figures are only rough approximations.

Dairy

The dairy price support mechanism is under review because it has generated over-production. As much as 10 percent more

milk was produced in the past year than could be sold in commercial channels at prevailing prices. Stocks of butter, cheese and nonfat dry milk have been accumulating. One alternative being considered is to lower the support price. Should the dietary guidelines adversely affect demand for butter, cream and cheese, the probability would increase for lower supports. Milk prices at the farm could be reduced as much as 10 percent which would translate to about a 5 percent reduction at retail (2).

Commercial disappearance of American and other cheese amounted to about 4 billion pounds in 1981, reflecting a growing demand. This represents a wholesale value of \$5-6 billion. Following the dietary guidelines would amount to a reduction of \$1.5 billion at 1981 prices at wholesale and more at retail.

Eggs

Egg prices have been relatively favorable to producers in 1982 but would decline sharply if consumers followed the dietary guidelines (2). Declines at the farm could amount to 10-15 percent and nearly 10 percent at retail in the short run. The retail value of eggs sold in 1981 was about \$4 billion. A 50 percent cut in egg consumption would mean about \$2 billion to the egg industry at 1981 prices.

Beef

Substantial economic incentives would be required to meet the dietary recommendations implicit for beef. Using 1977 consumption levels as a base, the data used to obtain Table 1 would indicate a need for about a 30% increase in per capita consumption of *lean* beef. Since 1977, per capita beef consumption has declined about 15 percent. Therefore, using 1982 consumption levels as a base, consumption would have to increase about 50 percent to reach recommended levels! This appears quite unrealistic.

At the moment, the beef cattle industry is poised for a modest liquidation because of disappointing returns to calf producers (2). Fed cattle prices would have to increase at least 30 percent to generate an expansion in the beef herd. This translates to about a 20 percent increase in retail beef prices.

In 1981, Americans spent about \$185 per capita on beef; that is about \$42 billion. To increase consumption by 50 percent *and* pay a 20 percent higher price would require consumers to spend \$332 per capita or a total of \$76 billion. This is \$34 billion more than was spent on beef in 1981. The prospective growth in personal income would not easily accommodate such an increase for some time to come. For this reason, beef will not likely play the role that would be indicated in Table 1.

Poultry Meat

The 21 percent increase in consumption of poultry meat could easily be reached without much higher prices to encourage production expansion. Since 1977, poultry meat consumption has already increased by 15-20 percent, so the target level has nearly been reached.

Fats, Oils and the Sweetener Complex

Prices on fats and oils and the sweetener complex have declined sharply in the past year or so to such low levels that further declines are likely to be limited. The substantial reduction in recommended consumption, if followed, would

not likely have much further impact on price. The dimmed outlook would likely prompt producers to adjust output just the same. Consumer expenditures on these products, then, would be reduced roughly in proportion to the quantities indicated. This would amount to reduced expenditures of about \$6 billion on sugars and sweeteners and perhaps \$2 billion on fats and oils.

Fruits and Vegetables

In total, the recommended consumption of fruit and vegetables was about 15 percent above the 1977 pattern as shown in Table 1. Modestly higher prices at the farm and retail level would be needed to generate this expansion. Assume that a 5 percent price increase at retail would be sufficient. This might add about \$12 billion to consumer food expenditures.

Grain and Bakery Products

The combination of the various cereal products in the recommended diet is about 55 percent greater than the pattern level of 1977. During this past year and in the current season, wheat prices have been and remain quite low and below even nonland costs of production. Prices will eventually rise and reach a more balanced relationship with costs. However, an increase in domestic per capita consumption of cereal products would not, over time, force the wheat market up much more than otherwise would have been the case.

Even if such an increase in consumption should add 10 percent to the farm price of wheat, the retail cereal prices would increase only 1 percent or so because of the small share the farmer receives from the consumer expenditures on cereals. Therefore, the increase in costs would be about 55 percent or about \$20 billion.

Total Change in Food Expenditures

All the food items in Table 1 were not discussed, but of those that were examined, total food expenditures under the recommended diet would be about \$50 billion higher than under the 1977 pattern diet. This would represent an increase of about 13 percent above the consumer expenditures for food and beverages in 1981. However, much of this projected increase is due to sharply higher outlays on beef. If beef consumption were to be increased only 25 percent, the total outlay would be closer to \$33 billion, or an 8-9 percent increase.

These increases in expenditures are crude estimates of the *separate* impact of the dietary recommendations and do not constitute what the actual increase in expenditures might be. Even if consumers completely ignore the Committee's report, food prices and budgets are likely to increase substantially over the next several years due to a general realignment of farm prices on a number of products relative to production costs and due to continue general inflation. However, the expectation of a resumption of economic growth in the next few years should enable most consumers to adjust to the recommended dietary levels if they so desire.

Response of Industry to Dietary Guidelines

The pork industry seems to have been singled out more than any other industry by the Committee's interim guidelines. This is somewhat ironic in that the pork industry has made substantial progress in product improvement and has successfully weathered and adjusted to the threat of a ban on nitrite

use in curing bacon. The industry has moved rapidly toward a leaner-type product. In the decade of the 1970s, the lard yield per hundredweight of live hog slaughtered under federal inspection was virtually cut in half, from 9.4 pounds in 1970 to 5.3 pounds in 1980 (8). We would anticipate that efforts of producers, processors, marketing agencies and the leadership in the industry would work aggressively to ensure product safety.

The dairy industry and other food industries as well have directed their efforts at producing low-fat products, and such activities would be intensified if indeed the 30 percent fat diet is a reasonable and justified target.

The beef industry seems to have emerged in a positive position, in the net, from the interim guidelines. A possible exception is the perennial problem of producing tender and flavorful beef without a substantial fat content. Changes in beef cattle types and grading systems are underway or being considered in this regard, but the industry appears divided on the proper course. Considerable effort is needed to improve the production efficiency, processing and merchandising of beef.

We can be assured that the fruit, vegetable, cereal, dry bean, pea and soy food industries would respond readily if the favorable nutritional image were to be translated into effective consumer demand. Processors and retailers would also capitalize on such publicity and enhance that demand. This is one of the reasons that reports on nutrition research need to be very carefully stated and that consumer education needs to be a part of the package.

Consumer Response to the Interim Guidelines

The report of the Committee has received considerable publicity, although it is too early to assess the impact on demand. Prices on pork bellies were declining when the report was released (mid-June 1982), and they continued downward for a short period. However, price behavior later in the summer seemed to indicate a fairly strong demand for pork bellies and pork in general.

A review was made of the impact of the Newberne study on bacon demand after his report was released in mid 1978 (4). The use of nitrite in curing bacon was implicated as a possible cause of cancer, and the report received considerable publicity. The Food and Drug Administration, for which the research was conducted, eventually concluded after additional research that the causal links were inconclusive (1). As can be seen in Table 2, the ratio of retail bacon prices to all pork prices declined noticeably between 1978 and 1979. This was the sharpest year-to-year decline in the ratio in the entire period from 1960 to 1981. However, the price of bacon did gain relative to all pork in the subsequent years and is apparently making a strong performance in 1982.

While a comprehensive study of the demand for bacon was not undertaken, a statistical analysis was made of the total retail demand for pork in 1960 to 1981. This analysis identified major influences on the retail price of pork, including production of pork, other red meats and poultry meat, consumer incomes and the Consumer Price Index. These factors were associated with 98 percent of the annual variation in retail pork prices in this 22-year period. While the demand for bacon may have slipped in 1979, this analysis indicates that any concern about nitrites in preserving bacon had no adverse effects on the total demand for pork in 1979.

Table 2. Relationship Between Retail Prices of Sliced Bacon and Retail Prices of Pork, 1960 to 1982^a

Year	Retail Price of Sliced Bacon as a Percentage of the Retail Price of Pork
1960-69	105.7
1970	107.9
1971	101.3
1972	103.5
1973	108.1
1974	109.0
1975	117.3
1976	115.0
1977	112.7
1978	113.2
1979	104.7
1980	105.0
1981	109.4
1982 (first half estimated)	116.0

^aRetail prices of sliced bacon were derived by combining the Consumer Price Index for bacon (as reported in Food Consumption, Prices and Expenditures, 1960-80, Stat. Bul. No. 672, ERS, USDA, p. 84) with the prices reported for 1980 and 1981 in the Livestock and Meat Situation (LMS-245, May 1982, ERS, USDA, p. 24). Retail pork prices are the standard USDA series for calculating marketing spreads.

Actually retail pork prices were higher in that year than would have been expected. Possibly consumer demand shifted away from bacon to other pork products, or merchandising efforts were shifted in that direction.²

The implication of this analysis is that the impact of the Committee's report could affect the demand for certain products for a period of time. But unless the evidence is more conclusive than that now available, the effect is likely to be transitory, especially on the total meat demand.

Conclusions

The challenge posed by the Committee on Diet, Nutrition, and Cancer is one that deserves very serious consideration by consumers, nutritionists, food scientists, social scientists, and the entire food industry as well. Certainly the issue is a most topical one, and every thread of evidence should be woven into a total fabric. Fortunately, research such as that completed by Peterkin and her associates has provided some perspective on the implications of the interim guidelines. More extensive research of this type is needed, not that the solution to such mathematical models should be regarded as the only answer, but at least marginal changes in diet can be oriented in the direction of the recommendations.

My suggestion is to improve the dialog within the scientific community and among industry representatives before recommendations such as the interim guidelines are released. Indications are that even among the profession of food scientists and nutritionists, differences of opinion remain. Perhaps the perspective of social scientists should be injected into such studies.

²In 1980 and 1981, the demand for pork did decline in the sense that retail prices were below levels that would have been expected if the longer-term relationships were maintained. However, this was also true with beef and is attributed to elements in the recession not measurable from past experience.

Clearly, there are few if any absolutes in the links between nutrition and cancer. As is true in most areas of inquiry, considerable uncertainty exists, and choices have to be made with incomplete information. Rather than prescribe for the general public, efforts should be directed toward enumerating alternative diets, health consequences, and the probabilities of health problems. Differentiation should be made among the major types of consumers by age, sex and other characteristics. Cost of the various alternative diets should be estimated. Then the consumers can make informed choices within the framework of their own preference structure, values, and economic circumstances.

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Critique of *Diet, Nutrition, and Cancer*

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The most glaring "error" in the ad hoc Committee report, *Diet, Nutrition, and Cancer*, commissioned by NAS-NRC is their definition of per capita *food intake*, which is given synonymy to food availability/food disappearance data/food inventory data. The report *admits* (Chapter 3, p. 4) that "Although national per capita intakes have been very useful in providing leads for further research, they are inaccurate as measures of food that has actually been eaten. They really only measure food that has 'disappeared' into the food supply — which is why they are sometimes called 'food disappearance data.' They do not account for food produced by individuals, for waste in stores, restaurants, or homes, or for differences in consumption within a country by different age and sex groups."

Yet, in the next sentence the report *states* "In this report, the term 'per capita intake' is used synonymously with 'food

disappearance data.'" Hegsted (1) has summarized well the recognition among scientists that the associations among food and cancer and coronary heart disease based upon epidemiological studies in different countries are based upon estimated food supplies developed by the Food and Agriculture Organization. He stated that "While there is no doubt about the general trends, it must be emphasized that these are rather soft data and particularly that data from some countries are much softer than for others, but we are generally ignorant of the accuracy of the data from any particular country or for any particular nutrient. Thus, when Dr. Berg presents correlations between breast cancer and total fat of 0.8, but 0.6 with regard to protein and 0.5 with regard to sugar, one cannot assume that the data for each country (the food data or the prevalence data) are equally accurate or that the data with regard to fat, protein, and sugar are equally accurate. Information on local production is often poor. The values do not necessarily represent consumption values. Wastage is substantial but the degree of wastage and the kind of food wasted differ from one country to another. Even in the United States or other developed countries, we have rather poor data on actual food consumed and we can expect, for example, that wastage of fat in this country may be large for many groups, and larger than, say, for sugar. Furthermore, we must remember that dietary patterns within countries (between regions with differing agricultural practice or between social classes) may differ as much as the differences between countries...."

Hegsted also states "One must also consider the cancer rates. For many we are talking about rates of 5, 10, or 100 per 100,000 of the population. A doubling of the rate from 5 to 10, or even from 100 to 200 would be a very large change. Yet during the year there are 99,000 or so in the population who do not develop the disease. Unless the dietary differences are large, these differences in rates must be well within the error term of dietary data."

On Page 2-10 of the NAS ad hoc Committee report the statement *is* made that "it is not easy to determine precisely what people are eating now, and it is even more difficult to learn what they were eating many years ago when the seeds were presumably being sown for cancers they now have."

Also, the second sentence in the first paragraph of Chapter 3 states "It is especially difficult to identify the connections between cancer and what people eat, not only because of the complex nature of the disease, but also because of the complex nature of the food supply, the variations in eating habits, and the limitations of scientific tools."

Yet, the Committee comes out with interim dietary guidelines that are "likely to reduce the risk of cancer" and "are meant to be applied in their entirety to obtain maximal benefit." The Committee further "suggests that *agencies* involved in education and public information should be encouraged to disseminate information on the relationship between dietary and nutritional factors and the incidence of cancer, and to *publicize* the conclusions and interim guidelines in this report," derived, by their own admission, from very inadequate data (italics supplied by the writer).

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Review of National Academy of Sciences Publication, *Diet, Nutrition, and Cancer*

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The report is very detailed and quite comprehensive. The Committee that prepared the publication was composed of competent scientists from different disciplines and locations. The committee members are to be commended for an exhaustive coverage of the subject and for preparation of a detailed report.

It appears that the Committee has done a good job of searching and summarizing the literature on the various segments of the subject and pointing out the many voids which prevent firm conclusions. It is unfortunate that the Committee felt compelled to formulate "interim dietary guidelines." The evidence cited in the report seemed to be too fragmentary and inconclusive to recommend such guidelines.

If possible, it would have been desirable for the Committee to separate the effects of dietary fat and caloric intake on incidence of cancer. The apparent increase in cancer with high fat content of the diet may have been due to an increase in caloric intake rather than an increase in fat content of the diet. This is especially critical since the report indicates that much of the evidence of the effect of caloric intake is based on associations between body weight or obesity and cancer. Is it possible that the apparent protective effect of fiber is due to lower caloric intake?

It is interesting that the Committee indicated that polyunsaturated fats appear to be more effective than saturated fats in enhancing tumorigenesis. Previous reports by other groups have recommended the use of unsaturated rather than saturated fats to protect against heart disease. The divergent recommendations will place the consumer in a difficult position.

The Committee's statement that it was unable to arrive at a firm conclusion concerning the independent effect of protein is certainly in keeping with the evidence presented. From the information covered in the report, it does not appear that consumption of meat *per se* can be blamed for cancer. In fact, one of the recent studies from Japan indicates that meat may be beneficial. Caution should be exercised in making recommendations concerning the beneficial effect of reducing the protein intake. In some cases the low protein diets were deficient. It is well established that feeding a protein-deficient diet will have deleterious effects on health.

The statements concerning consumption of foods preserved by curing or smoking appear to be strong in view of the evidence presented. The Committee admitted that the epidemiological evidence that nitrate, nitrite and N-nitroso compounds play a role in the development of cancer is largely circumstantial. The Committee also points out that the data on nitrate indicated that it is probably not carcinogenic.

The inference that consumption of animal products is more likely to cause cancer than plant products is without founda-

tion. It appears that no experiment has been conducted in which comparisons were made between animals fed diets in which the protein and fat were from animal vs. plant sources. This kind of experiment is possible.

It is hoped that the report will stimulate research to fill the voids in the area of the effects of diet on cancer. The widespread adoption of some of the dietary guidelines would do harm to both consumers and producers of food. For example, cutting down drastically on the protein consumption would seriously harm the health of consumers, especially the young. A sudden shift away from certain foods, such as meat, would be harmful to livestock producers who are trying to produce desirable products at marginal profits. Such a practice would subsequently be detrimental to the national economy.

The report, if properly used, will be of benefit. It points out possible associations between diet and cancer. This kind of report should be a stimulus to increase research effort in these areas.

Comments on the National Academy of Sciences Report, *Diet, Nutrition, and Cancer*

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The National Academy of Sciences report, *Diet, Nutrition, and Cancer*, includes the following recommendations:

(a) The committee recommends that the consumption of both saturated and unsaturated fats be reduced in the average U.S. diet. An appropriate and practical target is to reduce the intake of fat from its present level (approximately 40%) to 30% of total calories in the diet.

(b) The committee emphasizes the importance of including fruits, vegetables, and whole grain cereal products in the daily diet.

(c) Therefore, the committee recommends that the consumption of food preserved by salt-curing (including salt-pickling) or smoking be minimized.

With respect to (a), the committee specifically cited fatty cuts of meats, whole milk dairy products, and oils and fats used in cooking. With respect to (c), the committee mentioned specifically smoked sausages, smoked fish and ham, bacon, bologna and hot dogs.

Reducing fat intake from 40% to 30% of total calories would require a 25% reduction in consumption of foods contributing fat to the diet. The potential economic impact on the agricultural sector from implementing these recommendations is difficult to estimate with much precision. One reason is that the basic recommendation to reduce fat intake to 30% of total calories could conceivably be achieved by any of several alternative combinations of diet adjustments. There would be negative impacts on demand for those products consumed in smaller quantity. But demand for other agricultural products, primarily fruits, vegetables and whole grain

cereals, would increase.

The primary sources of fat in our diet from the present food supply are fats and oils, meat and poultry, and dairy products. In 1980, fats and oils (including butter) accounted for 43.0% of the fat in the U.S. food supply (Table 1). Meat (including pork fat cuts), poultry and fish contributed 36.1% of the fat, and dairy products (excluding butter) added 11.2%. These three food groups combined accounted for 90.3% of the fat in our food supply.

Thus it is clear that any effort to reduce fat intake would emphasize lower consumption of foods from within these food groups. Specifically where the cutbacks would occur, however, would determine the nature of the economic impact.

A number of scenarios could be developed, based on alternative combinations of reduced consumption of specific meat, poultry and fish products, dairy products and fats and oils — along with increased consumption of foods with lower fat content. Price effects on the basic commodities could be estimated from research-based estimates of price elasticities of demand, in combination with the quantitative changes in individual food product usage.

Development of these estimates of economic impact would require fairly comprehensive research and analysis. Any estimates would also be speculative and reflective only of possible alternative scenarios to implement the changes recommended in the National Academy of Sciences report.

Table 1. Contribution of Major Food Groups to Nutrient Supplies, 1980^a

Food Group	Percentage of Total Dietary Fat ^b
Meat (incl. pork fat cuts), poultry & fish	36.1
Eggs	2.7
Dairy products (excl. butter)	11.2
Fats & oils (incl. butter)	43.0
Citrus fruits	0.1
Other fruits	0.3
Potatoes & sweet potatoes	0.1
Dark green & deep yellow vegetables	^b
Other vegetables, incl. tomatoes	0.4
Dry beans & peas, nuts, soya flour & grits	3.7
Grain products	1.3
Sugar & other sweeteners	0.0
Miscellaneous	0.5

^aSource: "Nutrient Content of the National Food Supply," *National Food Review*, NFR-13, ERS, USDA, Winter 1981 (Ruth M. Marston and Susan O. Welsh).

^bLess than 0.05%.

Comments on *Diet, Nutrition, and Cancer*

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I have read with considerable interest the NRC publication on *Diet, Nutrition, and Cancer*. In general, I must say it is a comprehensive summary of the subject. It is of particular

interest to me since many aspects of it are covered in my courses "Animal Science 360, Introduction to Biochemical Toxicology" and "Animal Science 460, The Enzymatic Basis of Detoxification."

Although I generally agree with the interpretations given by the authors, I occasionally found myself questioning certain statements. However, rather than deal with those specific issues, my review will concentrate on the six major conclusions or interim recommendations described at the end of the first chapter of the report and specifically with their appropriateness and completeness.

The six major recommendations offered by the NRC committee are summarized as below:

1. Cancer development is associated with fat intake, thus fat intake should be reduced.

2. Fruits, vegetables, and whole-grain cereals appear to protect against cancer, and their intake should be increased.

3. Consumption of foods preserved by salt-curing (including salt-pickling) or smoking should be minimized.

4. Contamination of foods by carcinogens should be minimized, permissible levels of such constituents should be established, and the food supply should be monitored closely to assure that these levels are not exceeded.

5. Mutagens in foods should be identified and, where feasible and prudent, removed or their concentrations minimized.

6. Alcoholic beverages, especially if taken in combination with cigarette smoking, should be consumed in moderation.

Acknowledging that recommendation 3 deals with other nations, where it is a far greater problem, no person reasonably skilled in this area could find fault with the last four recommendations (i.e. 3-6) by which cancer incidence may be reduced or avoided on either an interim or final basis. I support existing regulations on food additives (Delaney clause) because they protect the public from misguided or intentional additions to our food supply. With the food supply system we have today, one mistake could poison the entire nation. Although not covered by this clause *per se*, the Michigan episode with polyhalogenated hydrocarbons is an example of the potential for harm which could result if that clause did not exist. Furthermore, the clause is not inflexible. Congress can overrule it, as was evident with the saccharin situation and would likely occur with nitrites, should the clause be enforced in relation to them.

It is my opinion, however, that the first two interim conclusions are flawed and unacceptable in either the interim or final proposal at this time. Furthermore, what is not stated in these recommendations is perhaps more important than what is stated relative to diet, nutrition, and cancer. These deficiencies raise even more questions about the accuracy of these interim guidelines.

Item Number One

There can be little doubt from experiments with rodents that increased intake of calories and fat increases the risk of cancer from proven dietary carcinogens. However, whether a decrease in cancer incidence would follow if humans were to diminish their fat intake is far from established. There is no evidence that reduced dietary fat would affect human cancer incidence. While data do suggest strongly that a carcinogen in rodents will probably be a carcinogen in man, there is less

evidence to suggest that a promoting agent, such as fats appear to be in rodents, would necessarily promote cancer in man. Indeed even less evidence is available for complex food types, such as fat, than for single chemical entities, such as a phorbol ester. While I certainly cannot recommend that people consume the current high level of fat *per se*, this first proposal is insufficiently established to include it in a report on diet and cancer at this time. Furthermore, even if it should become scientifically established later, its early inclusion might do more harm than good. The general public increasingly has the incorrect opinion that everything causes cancer. Thus, inclusion of such a broad statement, without the necessary proof, may encourage the public further to take a "so what" attitude, as it has with cigarettes.

I cannot help but mention the press release on the *Diet, Nutrition, and Cancer* report by Susan S. Lang, quoting an evidently irresponsible T. Colin Campbell at Cornell, who suggested that meat intake be diminished to reduce fat intake. Such a suggestion is implied in the report (page 5-1) as well. Both suggestions are ridiculous at best, and at worst the consequences could be increased incidence of cancer.

It is true that high protein intake increases the activities of the cytochromes P450, which are responsible for the metabolic activation of countless carcinogens. However, meat is also the best natural source of zinc, an antilipid-peroxidation metal, known to be protective against cancer initiation (pages 10-8 to 10-10). Zinc pretreatment can protect against the toxicity of bromobenzene and carbon tetrachloride, both of which require bioactivation by these enzymes. Zinc levels are potentially far more important than enzyme levels. Even if fat, by some mechanism not yet understood, does promote carcinogenesis, for anyone to recommend a decrease in meat consumption in an effort to reduce fat consumption is ridiculous. There are numerous other sources that can be more easily eliminated (e.g., fat-fried foods). Reduced meat intake could actually reduce bioavailable zinc, a metal already believed deficient in many Americans, and therefore increase rather than decrease the cancer rate in this country. In this regard, I would call attention to the decreased cancer rate evident in rodent studies at high protein levels (pages 6-10 to 6-11).

Item Number Two

There are numerous instances in which vitamins, A, E, and C in particular can protect against certain cancers. I do not disagree with these studies. I shall, however, indicate that caution is necessary in translating these studies into nutritional recommendations. Firstly, depending on where they are grown, fruits and vegetables can concentrate nitrates, nitrites, and develop carcinogenic nitrosamines. Therefore, the so-called protective foods could actually cause cancer, rather than protect from it. Secondly, the evidence that high-fiber diets are protective is simply not convincing. Many of those studies are contradictory, the implication being that this factor may or may not have any bearing on the cancer issue. Lastly, sugars contained in fruits may promote mutagenicity and/or cause diabetes, as discussed in the next paragraph.

A number of important points relative to diet, nutrition, and cancer have been left out of this report. Little has been done or said about cancer and the sugars. In this regard, a research paper we shall be presenting in October will link *alpha*-hydroxy ketones and, implicitly, high sugar consumption (e.g., the ring-opened carbonyl form of sugars) with

mutagenesis mediated by superoxide. This process is important, not only in its own right, but also because the wealthier nations of the world consume far more sugar than do the poorer nations. However, in the epidemiology sections of the *Diet, Nutrition, and Cancer* report, wealth was linked more with fat and protein intake than with sugar intake. This is also important in that the open ring form of sugars may also be diabetogenic, since alloxan diabetes has now been linked to superoxide production. Increased consumption of fruits, vegetables, and grains may actually increase the incidence of diabetes, with the consequence that people may fail to live long enough to acquire cancer.

Besides the sugars, little has been said about the major extent of drug abuse and drug consumption in this country. Twenty percent of the population are quoted as using marihuana, a potentially carcinogenic substance, not to mention the even more illicit street drugs. Likewise, little was said of the anti-epileptic drugs, sleeping drugs, and other abused prescription drugs, many of which are barbiturates. The effects of these agents on cytochromes P450 are far more important than is that of protein. What about these agents and their role in cancer? Many of these substances have a proven link to cancer and are far more significant a "dietary" factor than the highly questionable associations made with fat in the NRC report.

Comments on the *Diet, Nutrition, and Cancer* Report Prepared by the National Academy of Sciences

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There are at least three major reasons for differences between the report *Diet, Nutrition, and Cancer* (1982) and the document *Toward Healthful Diets* (1980). The more recent report reviewed a greater number of individual studies relating dietary components to cancer. More recent studies have also been completed in the interim, with epidemiological surveys showing a positive correlation with dietary fat and certain types of cancer. Thus, the current panel of experts has recommended that consumption of dietary fat should be reduced in the American diet. Second, the current report deals specifically with cancer, whereas the 1980 report reviews five of the most serious maladies affecting western man. And, finally, there appear to be major differences in professional backgrounds or philosophy of panel members drafting the two reports. To do a completely thorough job of reviewing *Diet, Nutrition, and Cancer* would require close examination of the published reports cited to determine what they do and do not show.

The current report indicates a strong correlation between dietary fat, of all types, and cancer. The obvious emphasis of

this report is on high fat consumption. However, not one cited research study has specifically implicated one or more foods (e.g., hot dogs, smoked fish, whole-milk, etc.). Thus, to have specifically targeted specific foods was wrong. It is the press release that is inappropriately worded. If the press release can be considered the public abstract, it should contain only a summary of information in the document. Neither in the Executive Summary or the report itself were the words or phrases, "fatty cuts of meat, whole-milk dairy products, cooking oils and fats, sausage, smoked fish and ham, bacon, bologna and hot dogs" used. In first reading the press release and other press clippings, I was lead to believe that specific foods were implicated with cancer. There is no documented evidence that suggests any one food is responsible for the initiation or promotion of cancer. Studies in China, Japan and Iceland, where salt-cured products are consumed, indicate a higher incidence of stomach cancer in these countries than in the United States. With the consumption rate of salt-cured processed meats in this country increasing, why, then, is the incidence of stomach cancer decreasing in America?

An example of a poor choice of food to single out is smoked fish. Total seafood consumption by Americans is less than 15 pounds per person per year. The amount of smoked fish produced in this country, or imported, and consumed on a per capita basis is infinitesimal. Since the intake of nitrate from drinking water is probably higher than the intake of potential carcinogens from smoked fish, and maybe other foods, the current report could have more logically recommended that people avoid water.

I am not trying to be funny or sarcastic. The current report cannot be taken lightly. It has brought together a great number of highly-sophisticated research findings which suggest that food consumption patterns should be altered to retard the development and spread of cancer. The general recommendations of the document are to reduce fat consumption and eat more vegetables, fruits and whole grain cereal products. This advice is sound — as it has been for a long time; variety and moderation in food selection will help in the prevention and development of many disease processes. The idea of diet balance should have been more clearly stated in the report and, especially, in the press release.

Cancer is defined as the loss of cell regulation. While different cancers can be broadly classified, based on the organ or area of the body they affect, each person's lack of cellular regulation (i.e., cancer) is different as is the response to treatment. Cancer does not seem to be caused or inhibited by a single compound or food — as evidenced by the number of food components and ingredients reviewed in this report. For that reason, there is no one magic bullet that can stop cancer. Only continued research will tell if one, or more, specific compound(s) is responsible. No one compound, or food item, has been found that causes cancer!

Diet is implicated in this report to be a promoter of cancer. For cancer and many other diseases, I subscribe to this theory. But the term diet implies all foodstuffs collectively consumed. Over-consumption is possibly more to blame for a disease process than any one food. In those individuals for whom moderation of food intake is not the problem, more variety in food selection may correct imbalances of food component intake (e.g., high fat).

Pinpointing specific foods that have established themselves as important and traditional sources of nourishment does

nothing but create excessive anxiety in the minds of most people. Without specific evidence that a food is associated with a disease, the scientific community may have to use a little more restraint in telling the public what is good and what is bad for them. Eggs have taken the burden of the attack as a single food most responsible for heart disease. However, a definitive study that links eggs and dietary cholesterol with heart disease has yet to be accomplished.

I tend to believe that total caloric intake may be just as important, or even more important, than fat intake in the promotion of cancer. Excessive calories go to fat. Only continued study will answer this question.

I see no major fault with the report, *Diet, Nutrition, and Cancer*. Only after doing all the work and reading all the materials, as this committee has, would I offer more specific comments. The major problem that has developed is in the transition from a scientific report to a press release. I think the committee should be asked to restate its findings and recommendations.

Comments on the *Diet, Nutrition, and Cancer* Report

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**Bonita W. Wyse, PhD, RD, Professor of
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The *Diet, Nutrition, and Cancer* publication announced by the National Academy contains many significant elements and, in large measure, should be considered a positive contribution to nutrition education. Undoubtedly, however, criticism will be leveled at specific sections and recommendations, especially with respect to their possible interpretations and applications.

It is regrettable that recommendations in this report appear to conflict with the contents of *Toward Healthful Diets*, also released (as recently as 1980) by the National Academy of Sciences. This may induce public confusion similar to that experienced when *Toward Healthful Diets* was released and compared with the *Dietary Guidelines for Americans*, which had been issued jointly by the Departments of Agriculture and Health and Human Services (then Health, Education, and Welfare) earlier in 1980. In reality, the recently issued documents can only be confusing to consumers if their differences rather than their much more significant similarities are accentuated.

The documents in question are: (1) *Dietary Guidelines for Americans* (issued jointly by USDA and HEW), (2) the USDA publications, *Food and Ideas for Better Eating* —

Menus and Recipes to Make Use of the Dietary Guidelines, and (3) the National Academy of Sciences reports, *Recommended Dietary Allowances, Toward Healthful Diets*, and *Diet, Nutrition, and Cancer*.

These reports actually concur on the following issues:

1. Obesity is recognized as an important health problem, in and of itself, or as a potential risk factor for certain chronic diseases.
2. Dietary intakes and energy expenditures should be adjusted, if necessary, to maintain or attain appropriate weight and height relationships. Over-weight individuals should achieve an appropriate weight by decreasing total food and fat intake and by increasing physical activity.
3. Particularly if the requirement for energy is low, consumption should be reduced of foods (such as alcoholic beverages, sugars, fats, and oils) that provide calories but few essential nutrients.
4. A nutritionally adequate diet should be consumed by selecting each day "appropriate" servings of meat, legumes, vegetables, fruits, cereals, breads, and dairy products. (What is considered "appropriate" may vary among different reports.)
5. Foods with adequate fiber and starch should be consumed.
6. Salt should be used in moderation.
7. If alcoholic beverages are consumed, the rule should be moderation.

The dietary guidance publications differ primarily in the nature of their recommendations regarding amounts and types of fat acceptable in a diet. Further, the *Diet, Nutrition, and Cancer* report recommends a decrease in consumption of smoked foods, in addition to salt-cured and salt-pickled foods as implied in #6 above. In *Dietary Guidelines for Americans* it is recommended that Americans avoid too much fat, saturated fat, and cholesterol. The *Diet, Nutrition, and Cancer* study suggests that the consumption of both saturated and unsaturated fats be reduced in the average diet; the overall goal is that fat intake be reduced to about 30 percent of daily calories. No recommendation is made for altering the cholesterol level of the average American diet.

Some groups, such as the American Heart Association, have recommended that unsaturated fat should increase as a proportion of this total derived from fat. In contrast, the *Diet, Nutrition, and Cancer* study results suggest that intakes of unsaturated fat, as well as of total fat, should be reduced. Comparisons of saturated versus unsaturated fats and the direct linkage of these and dietary cholesterol to chronic diseases obviously appear to be, at best, uncertain. Actually, the references in each of the reports to total (as well as saturated and unsaturated) fat could serve their purposes just as well if they restricted their terminology simply to "fat."

Few nutrition and health professionals would argue against a recommendation to decrease the fat content of the American diet. Their rationale, however, would probably be less for prevention of chronic diseases than in the interest of combating obesity and increasing the nutrient density of diets and thus making it easier for consumers to balance nutrient needs with caloric expenditures. In fact, based on current information, meeting nutrient needs must be the primary consideration in any dietary guidelines.

In this regard it is unfortunate that, in the *Diet, Nutrition, and Cancer* report, the recommendation is made to reduce fat to 30 percent of calories. For nutrition professionals to design a palatable diet based on 30 percent fat, while relying upon currently existing and popular foodstuffs, is not all that easy. For the ordinary consumer to make the appropriate food choices in the supermarket, even if she/he desires to do so, is almost impossible.

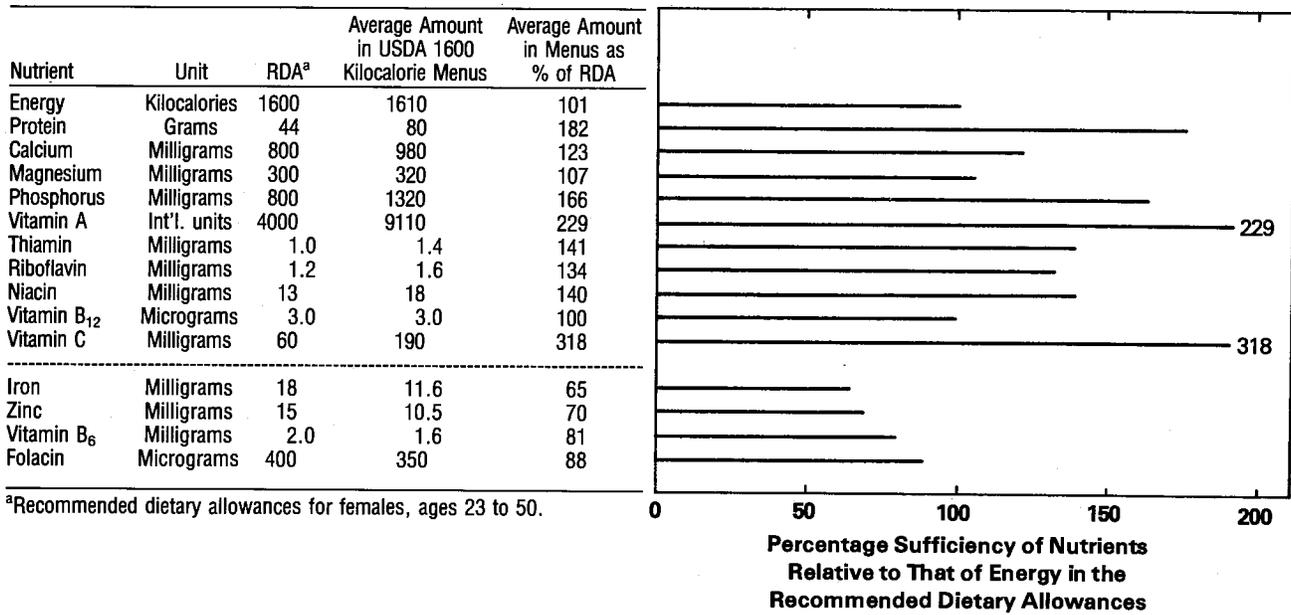
The difficulties become obvious in a review of the menus in *Ideas for Better Eating — Menus and Recipes to Make Use of the Dietary Guidelines*. The menus in this publication are designed for healthy adults, and the foods considered in aggregate contain about 35 percent of calories as fat. The menus contain more grains, fruits, and vegetables than Americans normally consume, along with moderate amounts of fat, salt, sugar, and cholesterol. In addition to about 35 percent or less of calories as fat, the menus suggest that 50 percent or more of a diet's calories be consumed as carbohydrates. Cholesterol contents of the menus vary, but, on the average, are slightly lower than current consumption levels.

Two versions of each day's menus are presented in *Ideas for Better Eating*. One provides 1600 kcal and the other 2400 kcal. These reflect the average amounts of energy from foods that women and men reported consuming in recent food consumption surveys. Figure 1 illustrates the average amounts of nutrients provided by the 1600-kcal menus and the associated percents of Recommended Dietary Allowances for females, ages 23-50. The energy standard used was the lower value (1600 kcal) of the range of recommended intakes for this group. The analysis of the nutrient levels provided by the menus indicates that iron, zinc, and vitamins B₆ and folacin are the nutrients most difficult to obtain from a 1600-kcal diet with 35 percent of its calories coming from fat. As caloric intake is progressively lowered from the 2400-kcal diet to 1600 kcal, these are the nutrients that become limiting.

Recent USDA data, if taken at face value, indicate that total food consumption of Americans is at a relatively low level. The average caloric intake of women was reported at about 1600 kcal a day, which is within the range of recommended intake, but considerably lower than the average recommended allowance of about 2000 kcal. There are, however, indications that alcoholic beverage consumption has been under-reported. If so, alcohol may be providing additional calories. As much as 80 percent of the alcoholic beverages that are reportedly taxed and sold in the United States are not accounted for by food consumption survey reports. This amounts to approximately 200 additional kcal per person per day when averaged over the U.S. adult population.

In diets with 1600 kcal (or an 1800-kcal diet with 200 kcal from alcohol), it is difficult to obtain recommended levels of all nutrients, particularly those such as iron, zinc, and vitamins B₆ and folacin, which occur only in relatively low concentrations in foods. To obtain recommended allowances of all nutrients from a 1600- to 1800-kcal diet requires careful selection of nutrient-dense food items.

To help consumers become more aware of nutrient-dense and calorie-dense foods in their diets, the U.S. Department of Agriculture recently published a booklet, *Food*, in which the basic four food groups plus one additional group are discussed. The fifth group includes foods high in fat, sugar, and alcohol. When these latter foods are included in a diet in



^aRecommended dietary allowances for females, ages 23 to 50.

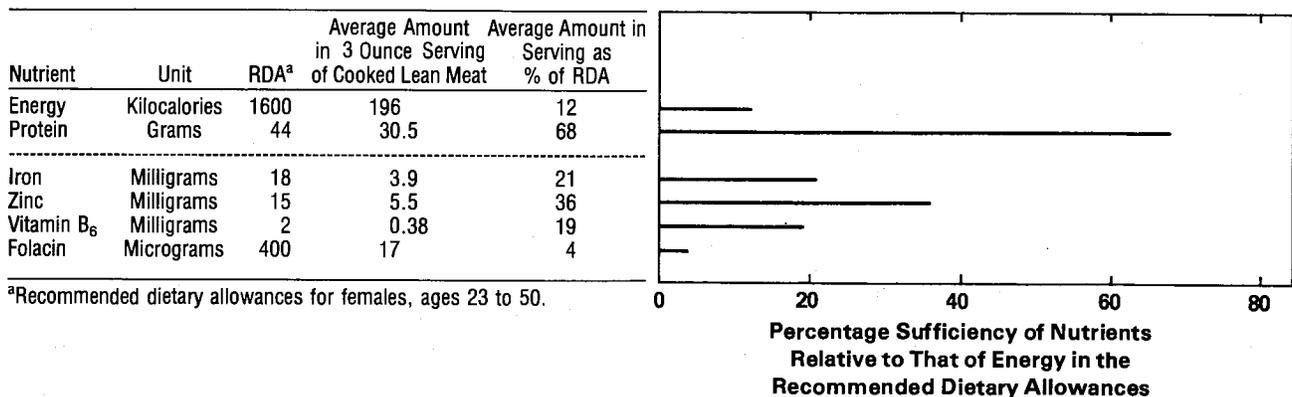
Figure 1. Average Amounts of Nutrients Provided by USDA 1600-Kilocalorie Menus in Relation to National Research Council's Recommended Dietary Allowances (RDA)

significant quantities, the remaining foods must be carefully selected to ensure nutritional adequacy. In other words, to maintain appropriate body weight, a person consuming alcoholic beverages needs to be concerned about reducing calorie intake from other food sources while maintaining adequate levels of the essential nutrients. One way to do this is to increase consumption of lean meat, a food mentioned in the releases associated with the *Diet, Nutrition, and Cancer* report. In fact, increased consumption of lean meat is also suggested in the USDA *Food* publication as one way to improve the zinc and iron content of a low-calorie diet. A 3 oz. serving of cooked lean meat provides considerable quantities of B vitamins, minerals, and trace minerals (especially iron and zinc), yet will contain only about 200 kcal.

The iron, zinc, and vitamins B₆ and folacin contributed to a

diet by lean meat can be seen in Figure 2. Relative to the amount of calories provided, each serving supplies 1.76 and 1.55 times the recommended allowances for iron and vitamin B₆, respectively, three times the zinc allowance, and about 35 percent of the allowance recommended for folacin. The fat content of the illustrated diet is about 35 percent of calories. To achieve a balanced diet while satisfying the universal standard (the *Recommended Dietary Allowances*, also published by the National Academy of Sciences), significant amounts of lean meat must be included.

The livestock industry has recognized the public's concern about relationships between diet and health and has accepted the associated interest in having access to meat of relatively low fat content. The industry is therefore using genetic and management techniques to produce leaner meat. Even so,



^aRecommended dietary allowances for females, ages 23 to 50.

Figure 2. Average Amounts of Certain Nutrients Provided by a Three-Ounce Serving of Cooked Lean Meat in Relation to the National Research Council's Recommended Dietary Allowances (RDA)

dramatic changes in the composition of other foods and in consumption patterns would be necessary to reduce average dietary fat intakes (which now amount to about 42 percent of calories) to 30 percent of calories, as suggested in the *Diet, Nutrition, and Cancer* report. The releases relative to the report advised that, by reducing the average diet's proportion of foods such as eggs, meat, and dairy products, as well as vegetable fats and oils, a diet containing 30 percent fat could be achieved. If such recommendations were followed, it would be difficult for most of us to consume recommended (RDA) amounts of iron, zinc, and other trace minerals. Meeting the *Recommended Dietary Allowances* while maintaining a low calorie intake means difficulty in food choices, which is complicated by the recommendations for reduced fat intake. Using foods currently available in the United States, and taking into consideration current consumption practices, a nutritionally adequate diet must include about as much fresh meat as Americans are now consuming in proportion to other foods.

On the one hand, the various reports from the Academy advise consumers to balance their nutrient intakes; on the other hand, they are exhorted to do it with foods that don't contain all of the nutrients. This can only confuse consumers trying to make appropriate choices. While it would be useful to reduce fat in an average diet for the purpose of enhancing nutrient concentration and meeting the dietary allowances, 30 percent is unrealistic at the present time. The results are unpalatable and unattractive to consumers and very difficult to accomplish on an individual basis. Food availability, current consumption practices, and the practical ability to translate recommendations into foods that are appealing and palatable should be important considerations when developing dietary guidance statements. The National Academy's 1980 recommendation (RDA) of 35 percent of calories from fat seems much more realistic and practical.

The efforts of the Diet, Nutrition, and Cancer committee to set dietary goals have been premature as related to diet and cancer. To be practically acceptable, there must be a realistic way for consumers to meet the guidelines and Recommended Dietary Allowances with clearly labeled foods available to them in the supermarket, and without making drastic changes in their current dietary practices. When the guidelines are translated into menus, foods, or other forms that are understandable to the public, the results must have some degree of appetite appeal and palatability. It is not clear that these ends are possible using the suggested stringent level of 30 percent of total dietary calories from fat.

If the *Diet, Nutrition, and Cancer* report, or any other report, is to be useful to consumers, scientists must refrain from unnecessarily confusing the public by publicizing questionable benefits that may be derived by adhering to each of various dietary guidance statements. There are many similarities among the reports before the public, and the similarities are what nutrition and health professionals should be talking about. The beneficiary of such discussion would be the consuming public. Moving away from a defensive posture into a new era of accentuating the positive would do much to alleviate public confusion about nutrition and instill confidence in the value of the U.S. food supply. It would also assure consumers that the scientific community of nutritionists is competent to give them advice.

*Diet, Nutrition, and Cancer*¹

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The panel of the Assembly of Life Sciences (ALS) that prepared the report *Diet, Nutrition, and Cancer*, released in June 1982 by the National Research Council-National Academy of Sciences (NRC/NAS), concluded: "Unfortunately, it is not yet possible to make firm scientific pronouncements about the association between diet and cancer." In his letter of transmittal, sent with the report to the National Cancer Institute (NCI), Frank Press, President of the NAS, stated: "...the many variables that confound the study of diet and cancer are likely to diminish rather than enhance the statistical probability that any existing connection can be identified." The Food and Nutrition Board, in its 1980 report *Toward Healthful Diets*, concluded "in the absence of evidence of a causal relationship between macronutrients of the diet and cancer, there is no basis for making recommendations...at this time." Doll and Peto, in a critical evaluation of the causes of cancer published by the NCI in 1981, stated: "There is still no precise and reliable evidence as to exactly what dietary changes would be of major importance [in reducing cancer incidence]." There is, thus, considerable agreement that the available scientific evidence does not permit reliable conclusions to be drawn about relationships between diet and cancer.

The ALS panel on diet, nutrition and cancer, nonetheless, stated: it "believes that it is possible on the basis of current evidence to formulate interim dietary guidelines that are...likely to reduce the risk of cancer." What motivated it to make recommendations on the basis of beliefs when it had concluded that "the data base is not yet adequate for firm recommendations to be made"? Was it because of its assumption that "the public often demands certain kinds of information before such information can be provided with complete certainty"? Was it because, as noted by Frank Press, there is "a pervasive desire to adopt 'preventive' measures against chronic diseases"? Was it because it had agreed to provide the NCI with recommendations as part of the contract under which the report was prepared? Whatever its motivation, the committee did release, with much fanfare, a set of six "interim dietary guidelines."

Two of the guidelines — "that efforts continue ... to minimize contamination of foods with carcinogens" and that "further efforts be made to identify" and test "mutagens in food...for their carcinogenicity" — are affirmations of current FDA activities.

Two other guidelines — include "fruits, vegetables, and whole grain cereal products in the daily diet" and "if alcoholic beverages are consumed" do so "in moderation" — have been recommended for decades on sound scientific grounds as general nutritional guidelines. They did not need to be proposed on the tenuous grounds of reducing cancer risk, largely on the basis of results from questionnaires showing an inverse relationship between consumption of carotene- or

¹Published by permission of *Nutrition Today*.

vitamin C-rich vegetables and the incidence of certain cancers. The panel also noted a similar inverse relationship between milk consumption and the incidence of gastric cancer. The panel states "protective factors may include consumption of milk," but did not include a recommendation for consumption of milk in the interim guidelines. This raises a question as to whether the committee described "the range of possible interpretations," or only selected ones.

The remaining two guidelines received most of the attention from the press. These are "reduce the intake of fat...to 30% of total calories" and "that consumption of food preserved by salt-curing...or smoking be minimized."

The committee also noted some inconsistencies in its review of information pertaining to these two guidelines. It stated: "the epidemiologic data [on fats and cancer incidence] are not entirely consistent." Doll and Peto went further in a discussion of colon cancer, stating: "no good correlation is observed with dietary fiber as a whole, nor with vitamin C, fat or beef." Also, they emphasized, after noting the correlations that have been observed between fat intake and the incidence of colon and breast cancer, "these correlations...do not mean that avoidance of dietary fat" will ensure avoidance of these cancers.

In relation to salt-cured and smoked foods in which mutagens occur, the committee itself stated "it is not yet possible to assess whether such mutagens are likely to contribute significantly to the incidence of cancer in the United States." It also noted that mutagens are found in many vegetables but did not mention this in the interim guidelines. Doll and Peto emphasize that gastric cancer, toward which this recommendation is directed, is low and diminishing in the United States. The United States was 40th in gastric cancer incidence in males among 44 countries for which the American Cancer Society has given figures, and 43rd for females. Is it possible that this low incidence is related to consumption of a moderately high fat diet? And, is there something to be learned from the fact that the populations of most of the countries with high fat intakes are among those with the longest life expectancies?

In an article in the New York Times, a spokesman from the NAS is reported as stating in response to a reporter's question about the difference between the recommendations on fat of the Food and Nutrition Board and those of the diet and cancer panel: the FNB "was weighted with biochemists who look for direct evidence of cause and effect." The diet-cancer "panel membership included epidemiologists and public health experts, who rely more on statistical correlations to reach conclusions." Doll and Peto state, in agreement with John Bailar of the NCI, that "preventive measures [should] be evaluated by scientific criteria as strict as those for laboratory science." Philip Handler, former President of the NAS, said in an address at the opening of the Northwestern University Cancer Center "the necessity of scientific rigor is even greater when scientific evidence is being offered as the basis for formulation of public policy than when it is simply expected to find its way into the marketplace of accepted scientific understanding."

In the most recent newsletter of the ALS, Handler is quoted on procedures for dealing with reports as follows: "If there is no compelling scientific evidence on one side or the other, our obligation is to let the committee work until it describes the range of possible interpretations." The committee states that it

attempted "to indicate the range of scientifically-acceptable interpretations." The report is replete with statements about the inadequacy of the available information: "Neither the epidemiological studies nor the experiments in animals permit a clear interpretation of the specific effect of total calorie intake on the risk of cancer"; "...the committee is unable to arrive at a firm conclusion about an independent effect of protein"; "...the committee found no conclusive evidence to indicate that dietary fiber...exerts a protective effect against colorectal cancer in humans." It drew similar conclusions about carbohydrates, the B-complex vitamins, vitamin E, nine minerals, food additives and naturally occurring carcinogens. It felt no compulsion to make recommendations about any of these dietary constituents.

Was it wise or scientifically sound for a committee, stated to have made "an objective appraisal of the scientific knowledge concerning diet and nutrition as they relate to cancer" yet which had itself noted: "epidemiologists have found it relatively easy to demonstrate a correlation between diets...and the incidence of [certain] cancers...But it has proved to be much more difficult to establish causal relationships and to determine which, if any, of the dietary components is responsible," to come to the conclusion that it can "formulate interim dietary guidelines...that are likely to reduce the risk of cancer"?

The interim guidelines were transmitted to the NCI with the statement: "As you well know, the often conflicting advice rendered in recent years has done little to strengthen the public's confidence in scientific pronouncements. Clearly, there is a need for scientists to provide carefully considered and timely advice to the public." Is the report, as is claimed, "a comprehensive analysis and an objective appraisal of the scientific knowledge concerning diet and nutrition as they relate to cancer"? And, will the report "be of considerable assistance to scientists and the public in understanding the complex interrelationships among these factors and to policy-makers in their deliberations on a national nutrition policy"? Or will it take its place among the sources of conflicting advice that do "little to strengthen the public's confidence in scientific pronouncements"? The desire of some individual nutritionists, various panels and committees, government agencies and politicians to respond to conjectured demands by the public for information that does not exist about diet and disease threatens to undermine the credibility of science generally and of the science of nutrition in particular.

Comments on the National Academy of Sciences Report — *Diet, Nutrition, and Cancer*

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We were asked to comment on the report entitled *Diet, Nutrition, and Cancer* from the National Academy of Sciences. It was emphasized that there was special concern about

the differences in the recommendations in this report and those in the prior report from the Food and Nutrition Board entitled *Toward Healthful Diets*.

The *Diet, Nutrition, and Cancer* report is a thorough and competent review of the current state of knowledge relating diet to the occurrence of cancer. Given the concordance between the experimental and the epidemiologic evidence and the near impossibility of directly demonstrating the causes of cancer in man, the conclusions and recommendations are not only rational, they are inevitable. Experts in the field will undoubtedly vary somewhat in the emphasis that they give to certain kinds of data, depending upon their special expertise and interest, but this Committee has achieved a well-balanced overall report. There is overwhelming evidence that the occurrence of cancer is greatly influenced by the environment and that diet is a major, apparently *the* major, environmental factor of importance. As this report emphasizes, the high fat diet of Americans is a major risk factor, and, most importantly, a reduction in fat intake would impose no health risk on the population.

Many expert groups have considered the relationship between diet and heart disease. Probably the latest summary of the recommendations made by these various groups was that compiled by Dr. Stewart Truswell in 1981 (Appendix 1).¹ Of the 37 recommendations tabulated, the great majority include a reduction in fat intake, usually to 35% of total calories or less when the amount is specified. *Toward Healthful Diets* is a major exception, which recommends a reduction in fat intake only if the individual is obese and sedentary. A reduction in cholesterol consumption is recommended by 27 groups, usually to 300 milligrams per day or less if a specific amount is recommended. Twenty-three groups recommend an increase in the intake of polyunsaturated fatty acids. The groups include a number of national health departments and heart associations, the Royal College of Physicians of the U.K., the FAO-WHO Expert Group on Dietary Fats and Oils, the Intersociety Commission for Heart Disease Resources and the Surgeon General's Report of 1979. This list should now be supplemented with two additional reports. The Working Group on Arteriosclerosis of the National Heart, Lung and Blood Institute (1,2) and the Nutrition Committee of the American Heart Association (Appendix 2)² have published thorough reviews of the current evidence relating diet to coronary heart disease. Both of these reports fully support the prior consensus and recommend that the American public should maintain normal body weight, avoid excessive consumption of fat, especially saturated fat, and of cholesterol, and increase the proportion of polyunsaturated fat in the diet.

It should be emphasized that when committees of this kind limit their considerations to specific diseases — cancer and heart disease in these instances — this precludes to some extent a consideration of some of the evidence available. An example may be found in their conclusions relative to dietary fiber. As the reports note, there is presumptive evidence that a low intake of dietary fiber favors the development of cancer of the lower bowel and some evidence that dietary fiber plays a role in the regulation of serum lipid levels and risk of coronary heart disease. Yet neither group finds the evidence at this time sufficient to make a very strong recommendation. I agree with this assessment, but there is also evidence that an increased intake of dietary fiber is helpful in controlling constipation and diverticulosis and may be helpful in controlling diabetes. A consideration of all of the relevant evidence strengthens the rationale for recommending an increased intake of dietary fiber.

As the cancer committee emphasized, one of the difficulties in making recommendations relative to dietary fiber is that current knowledge does not permit an adequate definition of what dietary fiber actually is or what various forms of dietary fiber may do physiologically, and does not permit adequate measurements of the dietary fiber content of foods. Considerable research is required to develop this field.

Another example relates to the consumption of sugar. Sugar consumption is not causally implicated in cancer (except that a high sugar consumption will indirectly limit the consumption of essential nutrients, dietary fiber, etc., which may be significant in relation to cancer), and there is very limited evidence that sugar consumption is related to heart disease or diabetes. Yet excessive and frequent use of sugar contributes to dental caries (3) — an expensive and almost universal disease of Americans — and certainly limits the consumption of essential nutrients. It is sensible to recommend that Americans reduce their consumption of sugar.

A third example relates to salt. There appear to be no data which implicate high salt consumption in risk of cancer, and no evidence is mentioned in the Cancer Report. The Working Group on Arteriosclerosis and the American Heart Association recommend a reduction in salt consumption, but they do not place a great deal of emphasis upon this dietary factor although hypertension is identified as one of the most important risk factors. Most of the research on hypertension has dealt with treatment, especially with drugs, rather than prevention. Yet salt is certainly one of the factors affecting blood pressure, and there are no known advantages to a high salt diet. One can safely and sensibly recommend that salt consumption be kept at modest levels. It is also of substantial interest that recent research (4,5,6) clearly implicates diets high in saturated fat in the etiology of hypertension.

I make these points not in criticism of the above mentioned reports but to emphasize that: (a) various dietary factors obviously have more relevance to one disease than another, yet (b) whether one considers cancer or heart disease or any other disease, there must be a general agreement in the kinds of recommendations which are made to the public, and (c) all pertinent evidence needs consideration when developing general dietary recommendations.

Thus it is extremely important and encouraging that in-depth considerations by these committees, of the two most important causes of death and disability in the U.S. popula-

¹Truswell, S. Diet and coronary heart disease — how much more evidence do we need? *British Nutrition Foundation Bull.* No. 32, 1981. (This publication was submitted by the author as Appendix I to his comments, but is not reproduced here. Write to the British Nutrition Foundation, 15 Belgrave Square, London, England SW1 8PS, for a copy.)

²Grundy, S.M., Bilheimer, D., Blackburn, H., Brown, W.V., Kwiterovich, P.O., Jr., Mattson, F., Schonfeld, G., and Weidman, W.H. Rationale of the diet-heart statement of the American Heart Association. *AHA Committee Report. Circulation* 65(4): 839A-854A, 1982. (This publication was submitted by the author as Appendix II to his comments, but is not reproduced here. Reprints may be obtained from the American Heart Association, 7320 Greenville Avenue, Dallas, Texas 75231. Ask for No. 72-202-A.)

tion, are consistent and mutually supportive. A consideration of other relevant data does not modify the conclusions and recommendations but provides additional support for them. The recommendations of these groups are consistent with *Nutrition and Your Health: Dietary Guidelines for Americans*, which was published jointly by the USDA and HHS in 1980 (Appendix 3)³.

The aberrant report of the Food and Nutrition Board, *Toward Healthful Diets*, was unfortunate and confusing to the public. A detailed critique of the report was prepared by the Chicago Heart Association (7) which emphasized that the conclusions were at variance with those of expert groups, both current and past. It is only fair to point out, however, that the nature of this report was not entirely unexpected by much of the scientific community. The leadership of the Food and Nutrition Board at that time and the primary authors of the report were known to have opinions which were contrary to the prevailing scientific opinion (8,9), and there were no established scientists on the Board representing the opinion of the American Heart Association or similar expert groups. It has also been emphasized that several of the important scientific fields, such as epidemiology and cardiology, had no representation on the Board. Indeed, the majority of the Board had little expertise related to diet and heart disease which was the basis of the major part of the report. Thus, the Academy failed to follow well-established procedures for selecting well qualified and well balanced groups to prepare reports in this instance, and the result was not surprising. An appropriate committee was established to prepare the report on *Diet, Nutrition, and Cancer*.

An additional and important point is made by the American Heart Association Committee. They note that "the combined data implicating the U.S. diet to the high incidence of CHD (coronary heart disease) in our society presents a strong challenge to the dietary habits of most Americans. Because of this challenge the AHA has deemed it necessary to make a judgment on the probably best diet for the U.S. public." They then note "It recognizes that a failure to make a recommendation is to condone the current American diet, i.e., a high intake of total calories, saturated fat and cholesterol." Committees of this kind can only fail to make recommendations for dietary change when they find that the evidence indicates that the current diet is advantageous compared with other feasible diets. Clearly these groups cannot conclude that the average American diet is the best possible diet and cannot be improved.

It should be emphasized that the American diet is continually changing, until recently with little attention to health consequences. During the past decade or so, several changes in diet and life style have occurred which have been at least partially due to the recommendations of the American Heart Association and similar groups. There have been modest decreases in fat and cholesterol consumption, the composition of dietary fat is changing, more people are exercising, smoking has decreased in some groups, etc. While simultane-

ous changes of this kind preclude assigning cause and effect to any specific factor, we should expect that these changes would have an effect upon coronary heart disease. In fact, there has been a marked decline in mortality rates from coronary heart disease and other cardiovascular disease since 1968. "Whereas in the late 1960's the mortality rate for American men age 35 to 74 was higher than for any English speaking country, the second highest (to Finland) among all 27 countries, by the late 1970's the U.S. rate was lower than for any other English-speaking nation except Canada, and seventh from the highest among the 27 countries" (2, p. 261). And "Of the total of about 1.1 million premature deaths spared over the decade 1969-78 among persons age 35 to 74, 586,000 were coronary and 806,000 were cardiovascular deaths that were avoided" (2, p. 263). Thus, although coronary heart disease remains the major killer of Americans, a great deal has been accomplished. Relatively minor changes in life style and diet appear to be paying very large dividends in health. Thus, those who oppose the kinds of recommendations which have been made and which have been associated with a very favorable trend in health statistics must accept the responsibility for demonstrating that whatever they do propose will not impose additional health risks upon the American public or reverse the favorable trends already established.

We can anticipate the objections that "we do not know enough to make these kinds of recommendations." The reports have adequately refuted this claim. But it must be noted that the Food and Nutrition Board feels there is sufficient evidence to recommend, for example, that the average adult female should consume 46 g. of protein, 12 IU of vitamin E, 1.2 mg. of riboflavin, 1.0 mg. of thiamin, etc. Almost 500 specific age-sex-nutrient recommendations have been made. It is well known that these recommendations are made not because the evidence is adequate or that there is proof that they are correct, but because an expert guess is thought to be more useful than no recommendation at all. Yet some involved in these detailed and precise recommendations will argue that we do not know enough to recommend moderation in the consumption of fat, saturated fat, cholesterol, sugar and salt.

As the *Diet, Nutrition, and Cancer* report emphasizes, all dietary recommendations may be modified by additional research. Diet and cancer is an emerging field, and much research is required in many areas. Yet it should also be emphasized that there is simply no indication that the overall recommendations in this report or those related to heart disease will be reversed by additional research. Nor is there any indication that these recommendations impose any health risks on the American population. The recommendations of the *Diet, Nutrition, and Cancer* report, the American Heart Association, the *Dietary Guidelines for Americans* and those of many other reports are in accord and should now be standard health education and nutrition policy.

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³U.S. Department of Agriculture and U.S. Department of Health and Human Services. Nutrition and your health: Dietary guidelines for Americans. U.S. Department of Agriculture Home and Garden Bulletin No. 232. 1980. (This publication was submitted by the author as Appendix 3 to his comments, but is not reproduced here. Copies are available from the U.S. Department of Agriculture, Washington, D.C. 20250.)

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Comments on *Diet, Nutrition, and Cancer* Report of the National Academy of Sciences 1982

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Introduction

There has been renewed interest in the role of diet in carcinogenesis, a field in which the report *Diet, Nutrition, and Cancer* published by the National Academy of Sciences (1982) may prove a milestone.

This 1982 NAS/NRC report was written by a committee of distinguished scientists and provides to date the most complete compilation and review of the literature on diet and cancer, although there may be disappointment that some early references are missing. The report, in addition to covering all aspects of diet, including macro- and micro-nutrients, food additives and contaminants, etc., also includes a good introduction to current hypotheses of carcinogenesis and their implications in terms of diet. The committee, after strongly emphasizing the role of diet in human cancer, makes a number of definitive suggestions as to changes in American eating habits which, it is implied, will reduce overall cancer incidence. Some of these conclusions seem inconsistent with the caveats in the text and contrast with *Toward Healthful Diets*, an earlier report (1980) prepared by the Academy, which stated that the data available were largely insufficient to allow concrete recommendations.

Toward Healthful Diets was prepared by an equally distinguished panel but with some differences in disciplinary backgrounds and experience. In view of the confusion caused among the public by the different views as to the benefits of

dietary changes and their significance for public health policy, it is important to determine whether the differences are the result of new scientific developments, value judgments, or the different composition of the two groups.

General Comments on 1982 NAS/NRC Report

It is impossible here to review *in toto* the inconsistencies in the epidemiological data, the complexities of the experimental studies presented in the report, and the range of possibilities and limitations that these indicate. These are adequately documented in the text. The latter, however, may not be apparent to the uninformed reader considering only the summary conclusions, which he may accept as more scientifically certain than they are. Thus, the reviewer is forced to examine the overall evaluations and conclusions of the workshop, an area where legitimate differences in scientific interpretation may exist.

Fat, Fiber and Alcohol

Disagreements as to evaluation are probably greatest in relation to the committee's views on fat, fiber and alcohol. In my view, the strength of the evidence on their role in human cancer can be ranked as follows: excess alcoholic beverages, low fiber and excess fat, whereas the report implies the opposite ranking. While admitting to personal prejudice, I examined the appropriate chapters to see how this discrepancy arose. The chapter on fat contains most of the appropriate references and emphasizes the weaknesses of correlation studies. A number of experimental studies are discussed in which the different effects of various types of fat on the promotional stages of cancer have been demonstrated. The text also draws attention to the fact that even the best case-control study of breast cancer was only weakly positive.

Any attempt to causally relate cancer to a specific dietary component requires a reasonable explanation of inconsistencies in the data. Thus, if a population had been heavy cigarette smokers for years and did not develop lung cancer, this discrepancy must be explained before fully accepting the lung-cancer, smoking hypothesis. In my opinion there are still too many inconsistencies in terms of breast cancer, large bowel cancer, prostate cancer, etc., including studies in Mormons, Seventh Day Adventists, vegetarian and nonvegetarian nuns, differences in cancer frequency between Iceland and Denmark, high breast cancer rates in Burmese females, migrants, etc., to accept a simple causal relationship with fat intake with any strong conviction. Further, it is far from established that simple reduction in dietary fat, as distinct from reducing obesity, will necessarily be effective in reducing cancer incidence of the breast, prostate, or, possibly, large intestine, especially if commenced only in adult life.

For example, I find it difficult to be convinced regarding the role of fat in prostate cancer. On page 5-2 it is stated: "In Hawaii the incidence of prostate cancer in *four* ethnic groups was highly correlated with consumption of both animal and saturated fat (Kolonel et al., 1981)" (italics supplied). On page 17-20: "A correlational analysis based on dietary data obtained from individual interviews in Hawaii indicated that there was a significant association between the incidence of prostate cancer in *five* ethnic groups and the consumption of animal fat and protein (Kolonel et al., 1981)" (italics supplied). On 16-12: "Kolonel et al. (1981) determined the average daily consumption of several components of fat in the

diets of the *five* main ethnic groups in Hawaii. The intake of total fat correlated with the ethnic-specific incidence rates of breast cancer in Hawaii, but *not* with colon or prostate cancer incidence" (italics supplied). On page 17-21 the conclusion is reached that "There is *good* evidence that an increased risk of prostate cancer *is associated* with certain dietary factors, especially the intake of high fat and high protein foods, which usually occur together in the diet" (italics supplied). On page 5-17: "There is *some* epidemiological evidence for an association between dietary fat and cancer at a number of sites, but most of the evidence pertains to three sites: the breast, the prostate, and the large bowel.... The data on prostate cancer *are more limited*, but they too *suggest* that an increased risk is related to high levels of dietary fat" (italics supplied).

While all of the above statements may be accurate, *in toto*, they leave the average reader somewhat confused as to the strength of the evidence on the role of fat and protein in prostate cancer. Further, any discussion on prostate cancer must differentiate between latent and invasive cancers. The prevalence of latent lesions is much the same in populations with very different incidences of invasive tumors, e.g., Japanese and white Americans. Invasive carcinoma is much higher in U.S. blacks than U.S. whites, which again is much higher than in the United Kingdom or Denmark. Such deviations should have received more extensive treatment, especially in terms of fat as an initiator or a late-stage carcinogen, e.g., a promotor or enhancer. In consequence, I find the group's views on fat unconvincing and no better than for the relationship between fiber and large intestinal cancer. I do not understand why the group emphasized the significances of different types of fiber but not different types of fat, in downplaying the strength of the causal association.

Alcoholic Beverages

The consistency of reports on the relationship of cancer with excess alcoholic beverage consumption contrasts with the uncertainties for fat and fiber in human cancer, and, thus, the lack of emphasis on the role of such beverages by the panel is somewhat surprising. The summary on page 11-7 does not adequately acknowledge the many studies demonstrating a causal association between alcoholic beverages, hepatic injury, cirrhosis and hepatoma. There are few better-documented sequences in human pathology. Most epidemiologists accept that the relation between alcoholic beverages, smoking and cancer is very strong for the esophagus and buccal cavity. The mechanisms whereby ethanol and alcoholic beverages induce cancer are still unclear, but are unlikely to be related to contaminants in the beverages. Nonetheless, it is the one major dietary factor through which public or personal action may significantly modify cancer frequency.

Age and Dietary Changes — The Implications of Time Trends and Migrant Studies

In making recommendations, the committee does not adequately emphasize the importance of age. Thus, the general reader gains the impression that changes in adult life may be as effective as those in childhood.

Animal studies suggest that dietary macronutrients influence cancer indirectly through modifications of "host susceptibility" or by modifying "late stage" carcinogenesis, but these concepts require much more study. Further, the greatest effects

of diet probably occur *in utero* (enzyme imprinting), infancy or early life. It is thus necessary to consider time trends and variations in migrants. If dietary factors act in the late stages of carcinogenesis it is surprising that, with the exception of gastric cancer, so few changes have been observed in cancer patterns, e.g., breast, prostate, and especially colon, in North America, Europe and Australasia despite the marked dietary changes that have occurred over the last three decades in contrast to probable diet-related heart disease. These findings are consistent with the slow changes in the incidence of cancers of the breast, prostate and stomach which occur in migrants over several generations, suggesting that the effects of such dietary changes, if any, are slow in humans and probably must be initiated in childhood. In contrast, cancer of the colon is probably influenced by dietary promoters which operate relatively rapidly as suggested by studies on migrants and in animals. These uncertainties must be adequately discussed as fundamental to the assumption that dietary changes will be beneficial when initiated in elderly or middle-aged adults as well as in infancy or childhood.

Micronutrients

The text fairly represents the situation with regard to micronutrients, but division into subsummaries which have different degrees of emphasis in the same section is confusing. The section on iron has certain deficiencies. On page 10-12 it states "...there is no evidence pertaining to the effect of high levels of dietary iron on the risk of cancer in humans." In fact, there is a considerable body of data from southern Africa where many of the black population ingest up to 100 milligrams of iron a day. Siderosis is widespread but is not associated with any changes in cancer patterns in a population where cancer incidence is well documented.

On page 10-16 it is stated: "In the Iceland/Scotland study, investigators also found a higher incidence of papillary carcinoma in the populations with a high dietary iodine intake." The phrasing on page 10-15 also implies that a high iodine intake is associated with papillary carcinoma of the thyroid. It is my impression that there are no data to support this viewpoint, but, rather, that where iodine is adequate the relative ratio of follicular carcinoma is low, giving an apparent relative increase in papillary tumors. I believe the latter have been related etiologically only to ionizing radiation.

Food Additives

There is useful discussion on dietary additives, contaminants, mutagens, etc., which provides an overall review of the literature and further emphasizes that such factors are unlikely to play a significant role at present in most human cancers. The summary, however, is less definite. On page B-2, the uninformed reader may be confused by the discussion on the legal definition of a food *additive*.

Inhibitors

There is considerable discussion of the possible role of vegetable inhibitors in human cancer referencing many epidemiological studies in which there is some evidence that vegetables may inhibit the onset of cancer. The same types of studies have been utilized in other contexts to suggest a potential role for vitamins A and C. The report does not emphasize that in many of these studies other explanations could be considered. Further, single dietary items in small

quantities in human diets may not necessarily have the same effects as the pharmacological doses used in animal experimentation.

There is a definite lack of consistency in the presentations in Chapters 15 and 17 regarding the role of vegetables in gastric cancer, and I think it would be more accurate to say that at present it is unknown why the incidence of gastric cancer has fallen within the United States. The relationship between nitrates, nitrites and cancer is overemphasized, and positive evidence is given greater weight than negative in the conclusions.

The Differences Between the Reports

The present reviewer, while convinced of the role of diet in many cancers, does not believe that new published data developed between the 1980 report and the 1982 report are sufficient to justify the differing opinions. He is of the view that the first report (1980) may have been unduly conservative, whereas the second (1982) has been unduly positive and attempted to push interpretation of the scientific data to the maximum.

During the years between the reports certain developments in scientific thinking on carcinogenesis occurred which may partly explain the differences: (1) There has been increased interest in multistage carcinogenesis and the possible role of promoting, enhancing and inhibiting factors. There is evidence that many of the latter are related to lifestyle, of which diet is a major component. (2) There has been increasing understanding that diffuse exposure (whether exogenous or endogenous) to initiators or chemicals in very small doses may not have a significant impact on cancers of the endocrine-dependent organs or digestive system unless other enhancing factors interact. (3) The incidence of stomach cancer, almost certainly a dietary cancer, has markedly fallen in many countries in recent years. (4) The possibility that active intervention by use of inhibitors and other agents in the early stages of carcinogenesis offers an exciting new approach to control through chemoprevention. (5) The marked fall in the incidence of myocardial infarction has encouraged the view that dietary changes may be equally influential on adult cancer patterns. (6) There has been renewed interest in the effects of diet in experimental studies and an increased emphasis on mechanisms.

The above observations are not new, but their implications have encouraged in recent years a more positive or activist approach to cancer prevention through dietary manipulation. It is not impossible that the prevalent scientific climate as well as disciplinary background may have colored the analysis of the scientific data of the two groups, resulting in different interpretations. While both recommendations may be scientifically tenable, the difference between them does cause confusion among the public. Thus, it is necessary to examine the strength of the data with care and to document and explain the discrepancies and uncertainties.

General Conclusions

The committee should be congratulated on a valuable compendium which will be essential reading for anyone studying the role of diet in cancer. However, one has the impression that regrettably the group had insufficient time to evaluate its summaries, especially the handout, with the same care as the body of the report. Thus, the uninformed reader

may have a false impression as to the benefits to be gained by altering the intake of individual food items without considering the total dietary context, the age at which dietary changes are initiated or other diet-related diseases. The report's guidelines are inconsistent with the concluding paragraph on page 18-11.

It is my impression that, while members of the group had strong convictions that diet is important in human cancer, they had great difficulty in producing more than circumstantial evidence as to their specific conclusions. Nonetheless, they felt justified in making positive recommendations, about which those of us who remember the enthusiasm for the role of diet in cancer in the 40s and the early 50s and were later disappointed may be less sanguine. Thus, the conclusion that infantile protein deficiency (Kwashiorkor) was the cause of primary liver cancer in Africa and that choline deficiency provided the background to alcoholic cirrhosis and hepatoma were found to be wrong. Further, food additives and contaminants have proved also to be of little importance in human cancer.

While gluttony was one of the original deadly sins, one of mankind's few remaining pleasures is that of the table. Whole cultures have been based on eating and attendant social intercourse. Therefore, attempts to change such activities, especially in childhood, must be based on sound and logical data with some degree of certainty, and it is insufficient to make major recommendations based only on a probability and the view that they will do no harm. Although future research may show that the views of the 1982 NAS/NRC committee are justified, one may question whether it is wise at present to give the impression of certainty in such a controversial area, especially in view of the limited published data base and the tendency of the public to embrace dietary recommendations, especially where related to cancer. It is hoped that some of these inconsistencies may be discussed in greater depth in a revised edition.

Comments on the National Academy Press Publication, *Diet, Nutrition, and Cancer*

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The publication of the National Academy Press entitled, *Diet, Nutrition, and Cancer*, is a very careful work summarizing an enormous amount of clinical and animal observation and experimentation, skillfully pieced together by a distinguished committee. The role of various agents in either initiating or promoting the occurrence of malignancies is carefully distinguished and discussed. Likewise, the various epidemiologic approaches which implicate various agents in the production of cancer are carefully delineated. Thus, it is noted that there are: descriptive studies, correlation studies, case control studies, cohort studies, and intervention studies. The strongest of these are of course intervention studies in

terms of establishing true or causal relationships, but these are practically nonexistent in an evaluation of the relationship of diet to cancer. Descriptive studies at the other end of the spectrum are the weakest.

A major contention of this report is that (1) there is a relationship between diet and cancer, but this is currently uncertain, and (2) the level of uncertainty is roughly the same as was true for the relationship of cigarettes to cancer approximately 20 years ago. This statement is a judgment on the basis of the evidence presented in the report. Although my judgment on the basis of the evidence would be that there are in some instances very suggestive relationships of diet to cancer, a recommendation of reduction of fat intake at this time is not warranted by the data at hand.

The analogy to the situation of cigarette smoking, to my way of thinking, falls down in the following respects: (1) With cigarette smoking, a mechanism linking the smoking and cancer could be clearly seen in the presence of carcinogens or initiators in tobacco smoke and also the production of a chronic inflammatory response in the respiratory tree thought to be a promoter mechanism or perhaps further initiator of malignancy. In the case of diet, and in particular fat consumption, such an obvious relationship to malignancy is not at hand. Having a reasonable biological mechanism whereby fat intake and malignancy are related would make the matter more plausible. (2) The nature of the correlation between cigarette smoking and lung malignancy comes from extensive case study type data. Too often, with the dietary relationship to cancer, the data are descriptive or from correlational studies. Also, when case studies or cohort studies are done, the difficult matter comes up of evaluating what the diet is or has been for any individual. This is far more liable to be in error than an evaluation of the number of cigarettes smoked.

Another general comment is that diet, or what individuals say their diet is, can be closely related to other aspects of life-style which may independently influence the likelihood of developing a malignancy. In recent years there has been, for example, interest in psychologic factors as modifiers of immune function. The possibility that life-style, frequent grieving or bereavement, or similar nondietary aspects of life are related to the incidence of malignancy and also correlate with what a patient says his diet is or has been must be taken into consideration.

The notion that excess calorie intake or obesity is related to malignancy must be looked at with great care. In general, the human data come not from an examination of the number of calories consumed or diet, but rather the body size of the subject under consideration. It should be noted that body size is multiply determined by genetic influences and physical activity, as well as diet. Obese individuals do not necessarily consume more calories over a lifetime than nonobese control subjects. In many instances the differences may be due to physical activity. Furthermore, the presence of obesity has profound meaning as to occupation, socioeconomic status, and psychologic differences. To have selected the excess consumption of calories as being the single, meaningful parameter in the obese relative to malignancy, is to have overlooked these other possibilities. I note also on page 7-5 the statement that "excessive carbohydrate consumption contributes to caloric excess." This is not clear. If it is meant that obese individuals tend to be high carbohydrate eaters, the

statement is false. Obese Americans become obese eating the same proportion of calories from protein, carbohydrate, and fat as do nonobese persons. They either eat somewhat more of these calories or more likely, are physically underactive and utilize the calories they do consume more efficiently than do nonobese persons.

As concerns the consumption of fat and the relationship to cancer, nearly all of the strong data come from animal experimental models. The human studies of the case and cohort varieties can be faulted by the extraordinary difficulty of obtaining dietary histories with any degree of fidelity. I am greatly impressed by the large-scale changes in the type of fat consumed by the American public, particularly the switch from natural fats and oils to more highly processed or hydrogenated fat during the course of this century, in the face of a fairly fixed incidence of most malignancies.

Ultimately, the various studies quoted sometimes support each other and sometimes are in conflict, and, ultimately, a judgment is required. Given the uncertainties I have mentioned above, I do not feel that the diet-cancer relationship as concerns excess calories and calories consumed as fat, which are my areas of expertise, have advanced to the stage that the cigarette smoking-cancer relationship had reached 20 years ago. I therefore believe it is premature to recommend a reduction in fat intake to the American public as a technique for reducing the incidence of cancer. I found the other portions of the report also intriguing, particularly that relating carotenoids and retinol to cancer, but this is not my area of expertise, and I therefore have no public comments to make.

Critique of *Diet, Nutrition, and Cancer*

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Thesis

The thesis of this critique:

"An inescapable lesson of contemporary medicine is that when treatment of a given disease is ineffective or where costs are insupportable, attention must be given to prevention." — from *The Final Epidemic* (Physicians and Scientists on Nuclear War).

A scale of 100 to 110 years of potential useful human lifetime is given by the American Geriatric Institute. The principal killers in the late second and in the third quadrant are cancer, cardiovascular diseases, and immune faults, which come close to the situation quoted from another context. Therefore, a *prevention* slant is appropriately a part of the thesis of the report.

Commendations

The review of literature is splendid, a major value throughout the report. The key importance of traces of many chemical elements is recognized in a multitude of enzymes (100 for zinc, they say on p. 10-8). Trace chemical element essentiality for human beings is axiomatic with the description

of the key takeoff point for cancer (paragraph 3, 18-1), because a multitude of enzymes is known to be involved in immunocompetence (repair of DNA before neoplastic cell division).

Use of bulky foods, such as vegetables, and particularly use of coarse whole wheat, is commendable. Fruits may add to rapid transit in the gut, with anticarcinogenic effects noted. Obesity certainly is to be avoided, and fat limitation may assist in this.

Criticism

Unfathomably, for each trace chemical element reviewed, the authors take the "easy out" of declaring that not enough is known to draw conclusions! At least some of the authors are aware of the deficiency of selenium for livestock in two-thirds of the states in the United States. Also, they know that regional areas of the world are endemic for cancer (molybdenum deficiency? or copper deficiency, if it occurs), and endemic for early heart deaths (selenium deficiency), and endemic for goiter (iodine deficiency), with an estimated 200,000,000 goiterous persons in the world today (Shamberger, 1980).

Human experiments have shown that the selenium level in blood is related to total intake, and the statement at the bottom of page 10-7 that 200 ug/day would not make any difference in blood level of selenium is patently untrue. China has brought about improvement in selenium level with 1 mg/person/week. Mushrooms are discussed in relation to hydrazine (p. 12-9), but the fact that mushrooms are selenium accumulators (5 ppm) and an assessment of this benefit vs. hydrazine risk is not taken up.

Trends in cancer incidence, with urban-rural relationships and between-nation differences, are discussed without due consideration for essential and/or toxic chemical element supply, exposure, or antagonism between elements. A recommendation for a blood-profile analysis of trace elements and their ratios would have been cogent.

Meat is considered "suspect" without due consideration of the fact that selenoaminoacids are more abundant in selenium-supplemented (Fed. Register 44:19:5392) animals than in plants, which do not require selenium. Plants are grown in ever more trace-element-depleted soils. Zinc deficiency occurs in calcareous soils, for plants and for people, because zinc proxies for calcium in calcium carbonate.

Trace minerals are supplemented for livestock (dollars are involved), but human beings are not considered likely to be deficient, where livestock animals are!

Incomplete treatment is given to the role of vitamin E in sequestering free radicals (known to be carcinogenic) from unsaturated fats, particularly when those fats are fried. The role of selenogluthathione peroxidase in the correct metabolism of fats and protection of lipid cell wall membranes of animals (people) is not mentioned. Animals still retain some anaerobic needs relative to vitamin E, reminiscent of life's origin in strictly anaerobic conditions. Note: I approve of fat limitation (on a calorie basis), such as avoidance of an excess of deep-fried food, so common in the United States.

Animal products may be charred in cooking. The tar-like products may cause cancer attributed to meat as such.

Use of citric acid in some beverages and some fruits may be dangerous because of its powerful chelation of many major and trace chemical elements and resultant mobilization of

essential elements from the body, but this is not discussed.

No attention is paid to the toxicity to animals of aluminum in foods and beverages (tea) or pharmaceuticals, but aluminum is known to react with phosphorus (the chain fence in the DNA helix), in reference to page 18-1, paragraph 3, on cancer initiation.

Diethylstilbestrol (DES) in Diet, Nutrition, and Cancer

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Because of my interest in the area of estrogenic hormones, my attention was called to pages 14-13 and 14-14 of the report *Diet, Nutrition, and Cancer*, where diethylstilbestrol is discussed. I must say I was surprised at the poor quality of this section. Some statements are wrong, while others tend to give a distorted impression about risks from the minute (usually undetectable) levels of DES in the diet that might result from its use as a growth promotant in ruminants.

Some of my criticisms may sound trivial, but one should remember that the question of DES residues in meat has tended to become an emotional and political issue rather than a scientific one. In the minds of many leading scientists in the field of estrogenic hormones, the banning of DES by the FDA as a growth promotant represents not only economic masochism and a travesty of justice but also a triumph of emotion over scientific reason. Much of the FDA's case was based on the arguments that DES has cancer-inducing properties not shown by natural steroid estrogens and that there is no threshold or "no-effect" level of its action. Since both of these premises are scientifically untenable, I think it is important that a report bearing the imprimatur of the National Academy of Sciences present a balanced picture of the facts rather than superficial statements that could be interpreted as support for irrational arguments concerning imaginary hazards.

The statement in the first paragraph that until June, 1978, DES was permitted for use in humans for various purposes implies that its use is no longer permitted, which is not true. DES is still standard therapy for advanced carcinoma of the prostate and breast, and it is prescribed by many gynecologists for postmenopausal replacement therapy, especially to retard osteoporosis. Although the Physicians' Desk Reference now contains a statement by the manufacturer that diethylstilbestrol should not be used as a postcoital contraceptive, the Code of Federal Regulation still provides that "the drug is safe and effective as an emergency treatment only, and not as a routine method of birth control." It is my understanding that estrogen no longer is used to prevent postpartum breast engorgement.

Much has been made of the alleged carcinogenicity of DES without recognizing that, in every animal system in which DES administration leads to an increased incidence of tumors, natural estrogens, where they have been tested, will do the same. Discussions, such as the one in the NRC report, tend to give an impression that DES has some special carcinogenic properties. A balanced description of the controversial Gass

experiment should contain the information that natural estrogens also increase the incidence of breast cancer in C3H mice and that the effect is seen only in those animals carrying mammary tumor virus, which already have a 33% incidence of mammary cancers in the control group receiving no estrogen. Neither DES nor estradiol has any "carcinogenic" effect in the C3H strain that lacks the tumor virus. The statement that "concentrations ranging from 6.26 [actually 6.25] to 1,000 $\mu\text{g}/\text{kg}$ produced mammary carcinomas in increasing incidence with increased doses" is not the conclusion of the authors nor of qualified biostatisticians who have examined the data. While it is true that the 6.25 ppb group appeared to have a slightly higher proportion of tumors than the control group, the tumor incidence in the groups receiving 12.5 and 25 ppb DES, respectively, was less than in the 6.25 group and not significantly different from the controls. It was not until 50 ppb was reached that dose-dependent increase in tumor incidence was evident.

The FDA argued strongly that the fact that the lowest dose of DES used in the Gass experiment gave a higher incidence of tumors than the control was evidence that there is no threshold, ignoring the lack of any effect in the 12.5 and 25 ppb groups. They also spent a great deal of money and effort repeating the Gass experiment at the National Center for Toxicological Research. The results did not support the no-threshold concept (the smallest dose, 10 ppb, actually had a lower incidence of tumors than the control), but these findings unfortunately were not made public during the hearings. The NCTR study was finally published (B. Highman, D.L. Greenman, M.J. Norvell, J. Farmer and T.E. Shellenberger. 1980. Neoplastic and preneoplastic lesions induced in female C3H mice by diets containing diethylstilbestrol or 17 β -estradiol. *J. Environmental Pathology Toxicology* 4:81-95). Among other things, it concludes that tumor promotion in this animal system is a general action of estrogen rather than anything special about DES and that there is a "no-effect level" (as rational consideration would predict for a phenomenon that depends on reversible interaction of hormone with receptor).

If one is going to refer to the Gass study in a way that implies risk from minute traces of DES residues in the diet (negligible in comparison to the amount of estrogen each of us produces naturally), one should not ignore the experiment at the NCTR which invalidates the premises on which this conclusion is based.

Finally, I have a comment about DES in pregnancy. Although it has figured prominently in the emotional arguments concerning the dangers of DES, the relatively rare phenomenon of vaginal or cervical adenocarcinoma in daughters of women receiving DES to prevent miscarriage has little relevance to the question of residues in meat. Though the doses administered (usually 5 to 150 mg/day) were those believed at the time to be required for this particular purpose, the term "therapeutic" is a bit misleading. Compared to the therapeutic dose needed to replace physiological estrogen levels in postmenopausal women (100-200 $\mu\text{g}/\text{day}$) these amounts are massive, and they are enormous in relation to the undetectable DES residues in edible flesh of DES-treated cattle or sheep (<0.5 $\mu\text{g}/\text{kg}$). Though a great deal of hysteria has been generated concerning cancer in DES-daughters, causing much mental anguish and a large number of lawsuits, the actual risk of cancer fortunately has turned out to be much

less than anticipated originally. For that reason, the most recent summary of the epidemiology probably should be included in the references cited. (A.L. Herbst. 1980. The epidemiology of vaginal and cervical clear cell adenocarcinoma. Chapter 5 In A.L. Herbst and H.A. Bern, eds. *Developmental Effects of Diethylstilbestrol (DES) in Pregnancy*. Thieme-Stratton Inc., New York). If the NRC report on diet is going to include mention of the transplacental effect of DES on female offspring, it should do it in such a way that puts this phenomenon in its proper perspective as it exists today, not in 1972 or 1973.

My general criticism can be summarized by saying that this report properly mentions adverse effects that are caused in animal and human systems by large amounts of an estrogenic agent, but it does not indicate that the relevance of these phenomena to risk from the minute residues of the substance that might be present in meat is open to considerable question, especially when these levels are negligible in comparison to the estrogen produced endogenously or present in the diet from plant sources.

The Day That Food Was Declared a Poison

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On June 15, 1982, the National Research Council, as an agent of the National Academy of Sciences (NAS), issued a press release containing dietary guidelines for reducing cancer risks through diet (1). This was based on a committee report on a study financed by a contract from the National Cancer Institute (NCI). The release was headed "Eat less fat, more fruits and vegetables." It recommended eating very little sausage, smoked fish and ham, bacon, bologna and hot dogs. It stated that current evidence suggests that most common cancers are influenced by diet.

There have been many dire warnings in recent years about carcinogens in the food supply. The Delaney Clause (1958) prohibited the use of cancer-causing substances in food additives. It was based on the allegation that no such substance is safe at any level. This was promptly followed by the "cranberry incident" (1959) in which Mr. Arthur Flemming, then Secretary of Health, Education and Welfare, warned repeatedly in radio broadcasts that cranberries might cause cancer because a few batches were contaminated with aminotriazole, a weed killer (2). From then on, the concept of "no safe level" for carcinogens in food was emphasized. For example, a report of 1971 Congressional hearings said that five physicians "emphasized that no one knows how tiny an amount of a carcinogen, taken for how short a time, can induce cancer" (3). One of the physicians, Dr. Roy Hertz, said in the same context that "human cancers which may result may not be detectable for 10 to 20 years."

Following such terrifying warnings against contaminants in food, NAS now tells us that a normal and universal component of food itself is carcinogenic. Evidently, there is no place to hide. The committee found the strongest evidence for a connection between cancer and consumption of fats.

Consumption of substantial quantities of fats is unavoidable. A tolerable level of fat was set by NAS (4) as 35%, while reference (1) recommends 30% of fat calories in the diet, as opposed to the present level of 40% (Ref. 5, pp. 1-15). A level of 30% of fat calories in the diet corresponds to more than 10% of fat on a dry-weight basis. If 40% of calories as fat is carcinogenic, how can 30% be tolerated? This conflicts with all previous dogma that there is no safe level of any carcinogen. The Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA), aided by the National Cancer Institute (NCI), have used this dogma with telling effect in obtaining bans on a number of substances, including cyclamates, several pesticides, and diethylstilbestrol (DES).

Now we are told that a 25% reduction in the intake of an alleged carcinogen, fat, is recommended. If this is an effectual step, should not the entire "no-threshold" concept, including the Delaney Clause, be discarded?

The second assault on the meal table is a warning against sausages, bacon and four other staple foods (1) that are "salt-cured, salt-pickled and smoked," implying that these are carcinogenic apart from their fat content. This news appeared in June 1982 after the FDA had announced in August 1978 and then denied in August 1980 that meats treated with nitrites (including bacon) were carcinogenic (6). One envies the person in the novel who, after purchasing a newspaper, kept the sporting section and threw the rest away (7).

Nitrites and nitrates have been present in the environment ever since photosynthesis by algae started and oxygen became a major component of the atmosphere, about 3 billion years ago. They are formed by oxygen combining with nitrogen during lightning in thunderstorms, and they are part of the nitrogen cycle in which green plants and soil bacteria participate. Nitrates in food are changed to nitrites by bacteria in the saliva. Nitrites are well known to be mutagenic by a chemical reaction with DNA. Nitrites react with other compounds in the digestive tract to produce nitrosamines, which are carcinogenic in animal tests. The extent and significance of these reactions in human beings is unknown, but it is certain that the reactions will still take place even if bacon and sausages are not eaten. Have animals evolved through the eons to develop protective detoxifying or resistance mechanisms against the normal levels of nitrites and nitrosamines?

The procedure of smoking foods is a practice of ancient origin, and undoubtedly introduces carcinogens, which are always present in smoke. Liquid smoke is extensively used to replace smoking.

The warning refers to "the greater incidence of cancers at some sites, especially the esophagus and the stomach" in "some parts of the world, especially China, Japan and Iceland, that frequently consume salt-cured (including salt-pickled) or smoked foods" (Ref. 5, pp. 1-15). This is oversimplification of complex information.

In Japan, people who eat bracken fern daily appear "to have three times as great a risk of developing cancer of the esophagus" (8). Fusarial infestation of stored food "may contribute to the high incidence of esophageal cancer in parts of China" (8), and "gastric cancer is rapidly diminishing in incidence in the United States" (8). Very heavy smoking of foods is practiced in Iceland. Furthermore, the sharp drop in gastric cancer in Japan has been linked to the consumption of

milk (9). The press release (1) recommends a reduction in the consumption of whole milk dairy products. This recommendation is based on the minor contribution of fat to the diet made by usual intakes of such products. On p. 2-1 of its report (5), the committee states "For a more complete coverage, the reader should turn to two books [one of which is] *Origins of Human Cancer*, Hiatt et al., 1977...."

Let us turn to this book. On p. 62, Hirayama says, "Just as in Western Countries, the stomach cancer rate [in Japan] has declined steadily since 1955....As shown in Figure 6, the consumption of milk products increased 23-fold from 1949 to 1973.... A series of retrospective studies showed...a significantly lower risk of stomach cancer among those who drank two glasses of milk daily...."

The report mentions this briefly on p. 9-3, but ignores it in its recommendations. Two glasses of milk (500 ml) would supply about 160 fat calories.

Discussion

People are easily disturbed when told that their food may be poisonous, and probably no disease is more dreaded than cancer. Add to this the allegation that there is no safe level of a carcinogen, and the statement that cancer may take 20 or more years to develop, and it seems that the press release (1) was either extraordinarily callous or was intended as a "shock treatment." In either case, the report itself (5) must be scrutinized closely for accuracy and credibility.

It has long been known that reduction in caloric intake below the level of adequacy in experimental animals inhibits the growth of tumors and diminishes the effect of carcinogens. This matter is discussed very briefly on pp. 4-1 to 4-5 of the report, which gives references on p. 4-2 showing that there is less cancer in underfed populations. In this sense, food itself can be termed a carcinogen. This statement is not a trivial one, because, in general, populations that are deprived of food have short life expectancies, and are correspondingly less prone to the degenerative diseases, including cancer.

The second suggestion in the press release contains a recommendation: "Eat fruits, vegetables and whole grain cereal products daily, especially those high in...as yet unidentified compounds that may protect us against certain cancers." How can one select foods that contain unidentified compounds? Furthermore, how can one be sure that such foods will not contain unidentified compounds that may promote cancer? This is not a scientific recommendation; it sounds like "health food store" literature.

One of the most active research fields is the detection and evaluation of carcinogens occurring naturally in foods. Pyrolysis produces benzpyrenes in broiled or scorched meat or fish (8), and Sugimura and his colleagues have recently identified powerful mutagens, which are also carcinogens, formed by charring foods, especially proteins (10).

The National Academy of Sciences published in 1973 an authoritative and widely-used book, *Toxicants Occurring Naturally in Foods* (11). This book lists many "natural" carcinogens, and was used as a reference in preparing the National Academy of Sciences report (5) which contains very many literature references and numerous brief summaries of them, as might be expected from the size of the NCI contract to the National Academy, alleged to be \$1 million. The

compilation is very useful for study and evaluation. The astonishing part is the way in which this information has been whittled down to four hand-picked remedies: reduce fat intake; eat lots of specified vegetables and fruits; hold off sausages, bacon, smoked fish and bacon, bologna and hot dogs; cut down drinking. The committee said "It is not now possible, and may never be possible, to specify a diet that protects all people against all forms of cancer." Amen. It is remarkable that the committee should even mention such an idea, given the known complexity of carcinogenesis, and its association with the accumulation of mutations in DNA that are an inevitable accompaniment of aging. Eight other "avoidable causes of cancer" (cigarette smoking, reproductive and sexual behavior, occupation, pollution, industrial products, medicines and medical procedures, geophysical factors and infections) are listed by Doll and Peto (8).

Let Them Eat Cake

Eat oranges, grapefruit, dark-green leafy vegetables, carrots, winter squash, tomatoes, cabbage, broccoli, cauliflower and brussel sprouts, says the press release (1). Such recommendations for good eating often come from the Council of California Growers, favoring the state that supplies half of the nation's fruits and vegetables. This advice, if it works, is great as long as environmentalists and the Medfly don't slow agricultural production. But how feasible a recommendation is this for city dwellers who can't afford such luxury foods today?

And, incidentally, how about cabbage and other Cruciferae? Reference 11 says on p. 218: "Goiter has been attributed to the consumption of large amounts of cabbage or of kale that was shown to be high in thiocyanate, isothiocyanate and goitrin." Goiter can culminate in cancer of the thyroid gland; this circumstance was what led to the "cranberry incident" (2).

Nutritionists realize the problems, now and in the future, of providing a rapidly increasing population in the United States and the world with an adequate diet, especially in view of steady migration from rural to urban areas. Food additives, including minerals and synthetic vitamins, will be needed more and more. The committee ignores this.

Carotene and Vitamin A

Carotene is recommended rather than retinol as a source of vitamin A (Ref. 5, p. 9-7) on the questionable basis that vitamin A (retinol) is toxic in high doses. This is bad logic and retrogressive nutrition. Synthetic vitamin A has been of great value as a food additive for preventing blindness in children in tropical countries. Many nutrients are toxic at high dosages. There is no need to place this stigma specifically on vitamin A. As far as carotene is concerned, it is a matter of record that its consumption was recommended in Great Britain during World War II to aid night vision, whereupon some people ate such large quantities of carrots that their skin turned yellow.

Food Additives

This topic is sloppily treated on p. 1-13. The subject is correctly introduced (p. 8-1) by pointing out that the term "food additives" is often generically used to refer to all substances that may be added to foods, but that under legal definition, the list excludes many classes of substances including GRAS food ingredients and flavoring agents, also 30 color additives. Therefore, the term does not connote a

class of substances with common properties. Unfortunately, this is not publicly recognized, so that the term "Contains no additives" is widely used for advertising purposes. The summary ignores these points, and adds to the confusion by stating that only a few epidemiological studies have been conducted to assess the effect of food additives on cancer incidence. Many "food additives" are food substances such as citric acid and propionic acid, the latter of which has a valuable role in preventing the growth of potentially carcinogenic molds in bread: This point is omitted in the report.

Diethylstilbestrol (DES) is discussed on pp. 14-13 to 14-14. The reference to Jukes (1974) should be updated by more recent calculations (12) that the average per capita intake of DES, pessimistically estimated, was 3.4 nanograms per person per day in the United States prior to the termination of use of DES for meat production in 1979.

A small percentage of "DES daughters," young women whose mothers received large doses of DES during pregnancy in an ineffective attempt to prevent miscarriage, developed vaginal adenocarcinoma (13). Herbst and co-workers (14) later placed the risk at 0.14 to 1.4 cases per thousand exposures. However, Herbst (15) noted vaginal epithelia changes in half of the exposed cases in one survey, resulting from an average daily dosage of 50 milligrams during pregnancy, without cancer.

To be as pessimistic as possible, let us suppose that all these changes are potentially precancerous. If a daily dosage of 50 milligrams results in 500,000 cases per million exposures, then 3.4 nanograms should produce 0.034 cases, or 0.055 cases per year in the 1.6 million female births per year in the United States, or 1 case of vaginal changes in 20 years.

However, this assumption relies on the absence of a threshold for the carcinogenic action of DES. Studies with mice by Gass et al. (16), cited on p. 14-13, indicate the existence of such a threshold (Testimony by Gass in court trial, Wichita, Kansas, 1980), and a threshold is also indicated in Highman et al. (17). The minimum daily dose of DES to produce a physiological response is 100,000 nanograms (18), so that 3.4 nanograms should be well below the threshold. Understandably, therefore, "There are no reports of epidemiological studies concerning the health effects of DES residues in food" (Ref. 5, p 14-13), nor, in view of the disparity between the intake and the minimum effective dose, are there likely to be, unless the health effect of DES in lowering the fat content of beef carcasses (18) could result in a positive health response.

Also relevant to this discussion are the conclusions by Jensen (19) who points out that 40 nanograms of active DES in a 200-gram serving of beef liver, containing two parts per billion, "could have no physiological significance in comparison with the 20,000 to 400,000 nanograms of endogenous estradiol that humans normally produce. ..." His conclusion is based on his research showing DES and estradiol "exert their biological effects by the same biochemical mechanism" (*loc. cit.*).

The references in the section on "Epidemiological Evidence" on p. 14-13 and in the first two paragraphs on p. 14-14 in the *Diet, Nutrition, and Cancer* report (5) are to experiments with levels of DES that are many orders of magnitude greater than the maximum levels that have ever been encountered in meat. One wonders if these references were

gleaned at random from a computerized literature survey.

Surely the committee should have addressed itself to a quantitative evaluation of the question of DES in meat, in which there has been so much confusion among consumers caused by absence of distinction between the huge doses (around 50,000,000 nanograms) administered daily to pregnant women in the 1950s, and the traces, probably not more than 1 part per trillion (1 nanogram per kilo), present in muscle meat from implanted animals (Testimony by FDA at trial in Wichita, Kansas, October 1980).

The report *Diet, Nutrition, and Cancer* makes recommendations that differ sharply from the Food and Nutrition Board's publication *Toward Healthful Diets* in 1980. The contrast inevitably provokes a comparison of the two groups who were responsible for the respective reports. The committee that produced *Diet, Nutrition, and Cancer* was chaired by a cell biologist. Its members were predominantly scientists who work in the field of cancer and molecular biology, although there were also three members of the American Institute of Nutrition (AIN) and one consumerist. The Food and Nutrition Board consists predominantly of members of AIN (12 out of 15 so listed in 1980) which is the professional society to which most nutritionists are elected.

Nutritionists tend to have a very positive attitude toward food because they are conscious of world hunger and Third World food shortages, especially of calories and protein. Probably for this reason, nutritionists find it difficult to regard basic foods as being carcinogenic. It was with this thought in mind that I gave this article the provocative title "The Day That Food Was Declared a Poison," because I do not agree with the general viewpoint presented in *Diet, Nutrition, and Cancer*.

Conclusion

The publication *Diet, Nutrition, and Cancer* starts as follows (p. 1-1):

Scientific pronouncements are usually viewed by the public as carrying a rather high level of certainty. Therefore, scientists must be especially careful in their choice of words whenever they are not totally confident about their conclusions. For example, it has become absolutely clear that cigarettes are the cause of approximately one quarter of all the fatal cancers in the United States. If the population had been persuaded to stop smoking when the association with lung cancer was first reported, these cancer deaths would not now be occurring. Twenty years ago the "stop-smoking" message required some rather cautious wording. Today, the facts are clear, and the choice of words is not so important.... We are in an interim stage of knowledge similar to that for cigarettes 20 years ago. Therefore, in the judgment of the committee, it is now the time to offer some interim guidelines on diet and cancer.

The implication is clear. The authors believe that diet, like cigarette-smoking, is a major cause of cancer. In effect, they say, "If you had heeded the warnings about smoking 20 years ago, the deaths would not be occurring. If you will follow our advice on diet today, you will avoid cancer in the years to come."

It is easy, especially for a committee, to promise something 20 years from now. Contrast this self-confidence with the moderate statement by Doll and Peto (1981) in an article to which we are referred by the committee (Ref. 5, p. 2-1):

There is still no precise and reliable evidence as to exactly what dietary changes would be of major importance. The chief need is, therefore, for continued and more intensive research. In humans, both observational evidence and, perhaps, randomly controlled evaluation of the more promising hypotheses may be needed....

The report lists many food ingredients, such as aflatoxins, as carcinogenic without making recommendations or warnings against them, because of lack of epidemiological evidence. The number listed is too large to enumerate in this brief summary.

The result is that a cloud of suspicion has been cast over many foods. The committee's rationale for targeting a few and ignoring others appears judgmental rather than logical.

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Review of *Diet, Nutrition, and Cancer*

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The report reviews available literature on the possible relationship between diet and cancer. It also considers the possible relationship between nonnutrient components of food (i.e., food additives, contaminants, etc.) and cancer. There are chapters dealing with risk assessment, carcinogenesis, and cancer incidence.

Overall, the report is extensive and thorough. The pertinent literature is adequately reviewed. The report does not present any new information but merely reviews once again the growing literature on the subject. Nonetheless, it should prove to be a useful compilation of references on the subject of diet, nutrition and cancer. The chapters on carcinogenesis and risk assessment are rather superficial. The weakest parts of the report and those most likely to be controversial deal with interpretation of the data and dietary recommendations.

The major dietary recommendations made are as follows:

1. Reduce fat intake to about 30% of calories (both saturated and unsaturated.)
2. Eat fruits, vegetables and whole-grain cereals daily, especially those high in vitamin C and carotene.
3. Eat *very little* salt-cured, salt-pickled, and smoked foods such as sausage, smoked fish and ham, bacon, bologna and hot dogs.
4. Drink alcohol only in moderation (moderation not defined).
5. High protein intakes *may* be associated with an increased risk of cancers.

Also of importance is the committee's conclusion that "the evidence does not suggest that the increasing use of food additives has contributed significantly to the overall risk of cancer for humans." It should also be noted that a caveat was included that most food additives "cannot be neglected as insignificant risks." These statements are either inconsistent or suggest an obvious bias.

Critique of Recommendations:

1. Reduction in fat intake — This recommendation is consistent with that of many other groups and is based on an accumulation of epidemiological and experimental evidence linking dietary fat to certain cancers; namely, cancer of the breast, colon and prostate. This conclusion is by no means ironclad. The epidemiological studies are not totally consistent, but collectively, they do present a fairly convincing case. Fat appears to function as a promoter and *not* as a carcinogen, and, therefore, it is not possible to predict with any degree of certainty the value of dietary fat reduction.

2. Eat fruits, vegetables and cereals daily — This is based on accumulating evidence that β -carotene protects against certain tumors and that vitamins C & E, through their antioxidant properties, may offer protection. The epidemiological and experimental evidence for the effect of

β -carotene is suggestive, whereas the evidence of a protective effect for vitamins C & E is weak.

3. Eat very little salt-cured, salt-pickled and smoked foods — This is bound to be a highly controversial recommendation. It is based on the known mutagenicity and carcinogenicity of *N*-nitroso compounds, polycyclic aromatic hydrocarbons, and amino acid pyrolysis products. *N*-nitroso compounds *may* be formed *in vivo* from nitrite reacting with primary amines. Polycyclic aromatic hydrocarbons are formed in cooking protein foods such as meats. Recent evidence shows that pyrolysis products of aromatic and possibly other amino acids are mutagenic and carcinogenic in animals. To date, no convincing evidence has been presented to suggest that these materials contribute to human cancers. In the words of the committee: "Epidemiological evidence suggesting that nitrate, nitrite, and *N*-nitroso compounds play a role in the development of cancer in humans is largely circumstantial," and, "It is not yet clear to what extent the mutagens produced by pyrolyzing proteins or amino acids are found in normally cooked foods. The finding that some constituents of food can enhance or inhibit the *in vitro* mutagenicity of other compounds should not be interpreted as meaning that these compounds would produce the same effects in living animals or humans."

Obviously, the relevance of these compounds to human cancer incidence is debatable, and available evidence does not demonstrate these materials to be human carcinogens, certainly not at current exposure levels. The role of salt-cured products in human cancer etiology is speculative. The available evidence is grossly inadequate as a basis for dietary recommendations.

Finally, it should be noted that the report reiterates the well-known fact that cancer incidence or mortality are *not* increasing except for lung cancer, and the increase is attributable to smoking and not to diet.

Comments on *Diet, Nutrition, and Cancer*

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The committee that prepared the National Academy of Sciences — National Research Council report on *Diet, Nutrition, and Cancer* has done an excellent job of surveying the literature relating to the impact of diet and nutrition on cancer incidence. In the Executive Summary, it is stated: "In general, the evidence suggests that some types of diets and some dietary components (e.g., high fat diets or the frequent consumption of salt-cured, salt-pickled, and smoked foods) tend to increase the risk of cancer, whereas others (e.g., low fat diets or the frequent consumption of certain fruits and vegetables) tend to decrease it." However, throughout the body of the manuscript, as various items are discussed, are conclusions in the general vein, "the evidence from epidemiological and laboratory studies does not permit any firm conclusions to be drawn about the effect of dietary

exposure to...and cancer incidence.” This is reflected in statements in the Executive Summary, such as “neither the epidemiological studies nor the experiments in animals permit a clear interpretation of the specific effect of total caloric intake on the risk of cancer.” From this, “The Committee concluded that of all the dietary components it studied, the combined epidemiological and experimental evidence is most suggestive for a causal relationship between fat intake and the occurrence of cancer.” It is evident that the data summarized are not sufficiently clear cut or complete to verify the existence of a causal relationship between diet and cancer. I do not think it arguable that there is suggestive evidence, particularly in the areas highlighted by the Committee. However, to make dietary recommendations based upon “suggestive evidence” lacks substantiation and may not be warranted.

The recommendation that intake of fat be reduced from approximately 40% to 30% of total calories in the diet does not appear to be substantiated in the body of the report. There is little evidence cited to prove the validity of the values chosen, i.e., a reduction from 40% to 30%. While the epidemiological and experimental evidence may indicate an association between high fat intake and the occurrence of certain types of cancer, there appear to be no controlled studies indicating the reduction recommended by the Committee. How these two values were chosen is not documented in the report.

There is also little or no evidence to indicate the effects of the changes in diet recommended by the Committee. While the recommendations may seem logical in terms of the consumption of certain foods being “associated” with the incidence of cancer, particularly by epidemiological studies, there is little or no work cited on the impact of the diet recommendations advanced by the Committee. Would such diets lead to a reduced risk of cancer, or would they increase the occurrence of other pathological states?

It is difficult to reconcile the divergences between the current report and the report *Toward Healthful Diets* issued by the Food and Nutrition Board in 1980. To say that additional evidence has accumulated in the intervening two years is not a substantial argument for the recommendations of the current report. In fact, many of the studies reviewed in this report were also available for use by the Food and Nutrition Board in preparing their report. The recommendations of the 1980 report *Toward Healthful Diets* appear to be much more valid and supported by evidence than do the recommendations of the current report, particularly recommendations 1, 2, and 3. I have little quarrel with recommendations 4, 5, and 6 of the report and feel that the evidence presented warrants those recommendations. The major concerns I have with the current report are:

1. Sufficient evidence does not appear to be presented to validate the recommendation of reducing fat intake from 40% to 30% of total calories in the diet.
2. The emphasis upon “the consumption of fruits (especially citrus fruits) and vegetables (especially carotene-rich and cruciferous vegetables)” does not appear sufficiently substantiated by experimental evidence to justify a dietary recommendation.
3. The recommendation that “the reduction of food preserved by salt-curing (including salt-pickling) or smoking be minimized” seems unwarranted in a

population in which the consumption of these foods is not major as it is in some parts of the world such as China, Japan, and Iceland.

4. Would the dietary recommendations advanced by the Committee actually result in a reduction of cancer, or would they increase the incidence of other pathological states? There appears to be little evidence bearing on this.

Diet, Nutrition, and Cancer: A Commentary on the Report of NAS

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The horror of the old epidemic infectious diseases has been assumed by another cause of death — cancer. Curiously, the new bad guy is only a poor second among the causes of death, but for some obscure and some other obvious reasons, cancer is now the dreaded and socially unacceptable way to die, while heart attack and stroke have certain prestigious, even socially desirable attributes. This perception of cancer has produced some unscientific, even outrageous, reactions. Scientific studies of cancer which should be cool and rational are often feverish and hysterical.

From time to time, wars are declared on cancer, and new fronts are opened. Vast amounts of public and private moneys are spent, and, when the war or the engagement is lost, some face-saving strategies are brought out. The War On Cancer declared by President Nixon in 1971 was based on the premise that human cancer is caused by viruses. Vast sums were spent by the microbiologists and the molecular biologists, but cancer goes on unabated. The war was lost. Now the leaders and profiteers who thrive on research money seek a new opportunity, and a new front is opened, based on the proposition that the majority of cancers are caused by environmental agents, by the things we do, specifically by what we eat. The nonsense of this argument must be examined to be believed. While cancers of the colon and the lung have increased and cancer of the stomach has decreased in the past 75 years, the overall rate of cancer deaths in the United States has not changed much when calculated for the changing age of the population. But our Western diet has changed dramatically during this time. There is less fiber, more protein, fat and sugar, more vegetable fat and fruit and less whole grain cereals. There are more phosphates in our diet and less calcium and iron. On the average, there is less vitamin deficiency if we can judge by the rarity of clinical deficiency states in our medical centers and our clinics or by the national nutritional surveys. Americans have available, and most of them take, a superb diet. Our youngsters are larger, fitter and earlier to reach maturity. All this is some combination of a better diet and of less infectious disease. How then can one argue that such an abundant diet causes cancer? Or is this only some jealous attack on the goodness of our diet, like that of the Reverend Jonathan Edwards in Puritan times who con-

demned bear baiting, not because of the pain for the bear but because of the pleasure of the spectators.

The notion that environment, and especially diet, causes cancer here is based on two specious arguments:

1. The cultural and regional differences of cancer deaths by site are used to support the argument in an amusing way. The country or ethnic groups with the lowest level of, say, cancer of the stomach is used as the irreducible minimum, the inevitable, God-given frequency of that cancer. Any other place with a higher level is said to have an added environmental cause. This arithmetic ignores the fact that diagnostic facilities and accuracy will vary from place to place. The Zaire Pygmies are likely to seem to have less cancer of the gastrointestinal tract because there is no one to help the medicine man with X-ray studies. The solemn statements that 35% of cancer in U.S. men and 60% of that in U.S. women is caused by diet are based on such nonsense. Bishop Berkeley dealt with that argument some time ago, when he said, "To be is to be perceived." Here in the United States where surgeons abound, breast cancer is over-diagnosed because the surgeons want to do their thing.

2. When cultural groups move, say, the Japanese to America, they take on the diseases of their new home. It would be more convincing to argue that they take on the diagnostic skills and acumen of their new homeland. To assign the change to diet is naive. A part of this migrant argument assumes that the U.S. diet has not changed significantly since 1910 while the rate of cancer deaths has been constant. In fact, the diet has changed dramatically and mostly by the addition of sugar, of "trans" fatty acids in hydrogenated fat and particularly the addition of the class of food additives called emulsifiers.

This new dietary front on cancer prevention has two salients. The first is the naive conclusion that because fat intake is associated with breast and colon cancer, therefore fat causes these forms of cancer. This is a kind of rerun of the discredited Diet/Heart proposal of 25 years ago. But this is epidemiological nonsense. Wearing shoes, the number of cars per capita, or watching television will work as well as fat intake to "explain" the frequency of cancer. Notably absent from this argument is the demonstration that lowering the fat intake from 40 to 30% of energy intake will reduce experience with cancer. The notion that high-fat diets cause cancer or heart disease is a fundamental error of epidemiological logic and is based on the school boy's conclusion that association means causation.

The two new fronts on cancer research which are used in a giant inflationary leap of logic to advise the public on prevention are these: Because animals deficient in vitamin A are more susceptible to cancer induced by chemicals and because vitamin A tends to retard certain experimental tumors in animals, it is concluded that everyone should take more vitamin A and carotenoids in their diet. But vitamin A is toxic at high intakes, causing headaches, skin lesions and even blindness. During World War II the British public was encouraged to take more dietary carotenes, and many of them developed carotenemia with yellow skin. Thus the advice to prevent cancer by eating carotenoids lacks evidence for either efficacy or safety. This advice is a form of intellectual inflation, guesswork from false prophets.

The other advice is to take more fiber in the diet in order to

prevent cancer. The trouble is that fiber includes many materials, and no one knows which of these, if any, are effective. In the Orient and Middle East, where people eat more fibrous foods, cancer of the stomach is prevalent, and cancer of the colon is rare. Here in the United States, where the fiber content of the diet is low, cancer of the colon has replaced cancer of the stomach. Does the National Academy of Sciences Committee propose to swap one cancer for another?

Citizens and elected officials must come to understand how science works. Using the available information, a scientist constructs an hypothesis stating the way things seem to be. Then he considers and examines experimental data to see if he can show the hypothesis is wrong. If it can be shown wrong, he makes a new hypothesis using his new position. Since Francis Bacon's time that is the way we have progressed in science, by disproving. But now the administrators who produced the *Diet, Nutrition, and Cancer* report are trying to change the procedure. They raise a tenuous set of hypotheses and, without testing, rush out to tell the public the way they suppose the real world is, according to their presumptuous opinions. This is not science. It is a reversion to the mysticism of the medicine man, all incantation and monkey bones.

It is a curious thing that one governmental agency, The National Cancer Institute, would spend almost a million dollars to contract with another governmental agency, The National Academy of Sciences, for this survey and advice. Is this million dollar ping pong game not the ultimate bureaucratic boondoggle? The chairman states in the preface that the present report is a response to the White House conference on nutrition. But that was held 12 years ago. Is The National Cancer Institute just that slow, or is the report an admission that The National Cancer Institute, having lost one war on cancer in the 1970s, now needs somewhere else to open a new front? Bureaucrats, like generals, need to be told when and where to fight.

The report has many curious features. It is strong in the subjunctive voice. These things "may" or "might" or "are likely to be" beneficial in preventing cancer. The advice is a tired rerun of the Diet/Heart diversion. Avoid saturated fat and cholesterol, avoid nitrites, eat plenty of green and leafy vegetables, be careful with alcohol and we will spend another million dollars in five years on a follow-up series of committee meetings.

There are some notable deficiencies in the report. No comment is made about the procancerous effects of folic acid which were discovered in the 1950s and led to the "antifols," the most effective chemotherapy for many cancers. No recognition is made of the increased frequency of cancer in persons with iodine-deficient goiter, and thus there is no emphasis on the importance of taking iodized salt. The spectre of aflatoxins is raised, but there is no human cancer yet detected which can be shown to be caused by aflatoxin or by any other dietary agent, for that matter. The committee studiously avoids the health significance of the most prevalent food additives, for example the "trans" fatty acids now amounting to 40 grams per person per day; salt, amounting to 15 grams per day; and emulsifiers, amounting to 10 grams per day. The committee refers to diethyl stilbestrol and the hydrazines in food as potential carcinogens, but the committee members should know that the dietary contribution of those compounds is miniscule compared with the oral contracep-

tives and the drugs used in the management of hypertension and tuberculosis. The committee seems to have a blind side or a bias.

This report is a clear demonstration of the intellectual bankruptcy in the field of cancer research. The war on cancer as an infectious disease has been lost. The federal budgets for science are shrinking, and the soldiers need money and diversion. How better than to ask a prestigious sister agency to assemble a committee of administrators who will sound a bugle and signal a new war on cancer through diet? Use the Diet/Heart scenario and invoke the universal demon, saturated fat and cholesterol. As for the dialogues and settings, select, patch, improvise and schedule the next meeting in five years. The paying public deserves better than this nonsense.

The interpretation of science for the citizen does not require such an interlocutor. The debacle of the Regional Medical Program was set up by the false premise of Michael DeBakey and Mary Lasker that scientific progress was not being transferred and applied at the public level. When such self-proclaimed interpreters are allowed into the mechanism, the result is apt to be the scientific inflation seen here. Such policy prophets "come for the milk, not to count the calves." Science is distorted and abused. The citizen is cheated.

Comments on *Diet, Nutrition, and Cancer*

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I compliment Chairman Grobstein and the Committee on *Diet, Nutrition, and Cancer* of the National Research Council for their enormous effort in attempting to review the pertinent literature associated with the influence of diet on the etiology and prevention of cancer. Given the difficulties of accurately measuring dietary intake of a person or a population, the task of tracking the effects of diet on health is at best difficult. At the core of the difficulty is the challenge of how to collect, collate and analyze dietary data. The fact that data often are based on animals other than humans complicates the issue still further, often encouraging extrapolation to humans, a practice that is loaded with uncertainty and risk. Even so, the Committee obviously has spent much effort in review and summary of the literature.

The report attempts to separate data and research findings into two important categories: epidemiological and experimental. This separation is important, and the distinctions should have been maintained both in summaries and press releases on the report. Often, experimental data have been accumulated on species other than the human, or if based on human studies, the experiments generally are of short tenure for obvious reasons. Thus, given the diverse nature of dietary data, some high quality, but some incomplete, out of date, or perhaps inaccurate, the Committee has done an admirable task of summarizing relevant epidemiological and experimental data on the relationship of diet and cancer.

In sharp contrast to the above statements, parts of the report are cause for great concern. These include summary state-

ments at the end of chapters, extrapolations made to the human, and the press releases. The following are representative examples of concerns this reviewer has about the total report:

1. The Committee on *Diet, Nutrition, and Cancer* should have made a concerted effort to reconcile differences in its interpretation of the literature with those in *Toward Healthful Diets* published in 1980 by the National Research Council's Food and Nutrition Board Committee chaired by A.E. Harper of the University of Wisconsin, which stated that "there is no basis for making recommendations to modify the proportions of these macronutrients [e.g., fat] in the American diet at this time." Mere reference to this finding related to diet and cardiovascular disease is made in a footnote on p. 5-20 of the *Diet, Nutrition, and Cancer* report. Medical and nutrition advisers, and the public as well, could have expected the two major committees to recognize and attempt to reconcile their different conclusions. There seems to be no evidence that an attempt to do such was made.

2. A major weakness of the overall report is the assertion that diet and nutrition are linked closely with cancer, notably of the breast, prostate and colon. As documented at various places in the report, there are facts that do not support this assertion. Data on age-adjusted total cancer incidence and mortality rates for sites other than the respiratory tract have remained relatively stable over the last 30-40 years. In contrast, the American diet has changed markedly during the twentieth century. Large decreases in the consumption of grain products and potatoes, large increases in processed foods and poultry, and a moderate increase in fats and sweeteners characterize certain dietary changes. Further, the report (p. 2-9) states that a reduction in stomach cancer has occurred in the last 50 years, and the authors suggest that it is "a change brought about presumably by some alterations in our diet that took place during that period." The facts do not seem to support an argument for major dietary changes intended to reduce the incidence of cancer. Changes are warranted if, and only if, through risk assessment studies a particular dietary ingredient or food is found to be tumorigenic in the human, or in multiple animal species from which extrapolation to the human appears advisable.

3. In Chapter 5, and elsewhere, the Committee refers to the "association" between fat consumption and cancer. On page 5-5 the Committee cites the work of Miller et al. (*Am. J. Epidemiol.* 107:499, 1978) as "the most thorough case-control study of breast cancer yet reported," and yet the relationship of diet and breast cancer reported in this study was only slightly positive. Direct experimental evidence, although very necessary, is difficult to obtain because of cost and many sociological factors.

4. In Chapter 5, the Committee notes that when fat intake is low (10% of total calories) polyunsaturated fats appear to be more effective than saturated fats in enhancing tumorigenesis. This trend should not be mentioned in connection with humans. Few healthy humans (in America) would be on such a low fat diet, considering that about 40% of calories in the diet of the average American comes from fat. Certainly, this point should not be mentioned in a summary of the study or in a news release.

5. In the "Interim Dietary Guidelines" (p. 1-15, Item 3), the Committee recommends that the consumption of food preserved by salt-curing or smoking be minimized. Only a small proportion of the meat and fish consumed in the United States is cured and smoked by the techniques in use in the other countries mentioned.

Moreover, although the concern of the Committee over the incidence of cancer of the esophagus and stomach is important, it is interesting to note (and remember) that the incidence of stomach cancer in the U.S. population has been declining over the past few decades.

6. I caution against any type of campaign by educators and public information personnel to encourage major dietary changes, except for the need to reduce total consumption of food. Too little concrete evidence exists today to warrant such a program. One strongly suspects that nutritionists and medical practitioners are not in sufficient agreement to initiate changes. Even if a much greater amount of experimental data indicating the need for change existed, the public is totally unprepared for such change.

7. Finally, but in a related sense, the inference that the consumer can alone or with the assistance of an adviser select a diet that will significantly reduce the risk of cancer is implicit in this report. Note the remarks on page 1-14: "It is not now possible, and may never be possible, to specify a diet that protects all people against all forms of cancer." These remarks do imply that health practitioners can even now make progress in that direction. This inference seems to be premature and probably incorrect.

An Appraisal of *Diet, Nutrition, and Cancer*¹

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The committee assembled for the National Research Council has produced, in its report called *Diet, Nutrition, and Cancer*, a remarkably well written and clear summary of the epidemiologic, laboratory, and clinical evidence of the relationship between dietary factors and the initiation, promotion, or inhibition of malignant disease. Extremely lucid expositions describe the nature of cancer, the basis of epidemiological methodology, the laboratory induction of tumors in animals, and methods of testing mutagenesis.

The committee did not regard the linkage of dietary factors and human cancer as truly demonstrated by the evidence. The author concurs in this view, and is of the opinion that the evidence currently available is inadequate to support recommendations that all Americans modify their dietary intake for the sake of preventing deaths from a wide range of cancers.

The willingness of the committee to advise the public to reduce its intake of fats from 40% of total calories to 30%, and to increase the intake of fruits, vegetables, and whole grain

cereal products by an unspecified amount, is probably a consequence of the general feeling among nutritionists that the U.S. diet contains more animal protein, fat, salt, and sugar than can be demonstrated to be necessary for maintenance of good health. The committee seems to have a general sense that modifying the diet in the direction of suggestions made by those interested in decreasing heart disease or diabetes will also decrease the risk of cancer.

As regards cardiovascular disease, in which the serum cholesterol and various lipoprotein fractions related to it have long been generally accepted as markers of susceptibility, there is still no consensus on the question, "Will the initiation of a 'prudent diet' substantially decrease plasma lipid levels in the majority of the population, decrease the risk of cardiovascular disease, and be free of any potentially harmful side effects?" For the 80% of the U.S. population that will die of diseases other than cancer, it is hard to imagine that we could assess the effects of reducing dietary fat intake of the entire population on the cancer-promoting effects, if any, of total fat, or for that matter, of proteins, carbohydrates, vitamins, and minerals.

On the Social Implications of the National Academy of Sciences' *Diet, Nutrition, and Cancer* Report

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This is a response to a request by CAST (Council for Agricultural Science and Technology) for commentary on the National Academy of Sciences' report, *Diet, Nutrition, and Cancer*. Having been nominated to CAST by the Rural Sociological Society, I want to indicate that the ideas about to be expressed do not represent those of that society or CAST.

Because this is an issue which is extremely important to all the people of this nation, I welcome this assignment. Also, this topic runs parallel to the family nutrition research in which I was involved during the 1970s when I worked as the sociologist on a multidisciplinary USDA Science and Education Cooperative Regional Research Project. I continue to maintain an active professional interest in this area and will confine my discussion to the social aspects related to my work.

My first awareness of the National Academy of Sciences' *Diet, Nutrition, and Cancer* report was through my local newspaper. A one-column article on one of the interior pages briefly outlined the report's recommendations. I remember reading it with mild interest and thinking that the recommendations were not inconsistent with general accumulating knowledge, but that making specific recommendations is somewhat unusual for scientists.

To begin with, we should remind ourselves that no scientist can predict the future in the real world with certainty. At the

¹An abstract of a review to be submitted for publication elsewhere by the author.

same time, we should consider that if human matters were completely unpredictable, none of us, scientists or otherwise, could make it through a working day. When it comes to assessing the impacts of a report such as this, the surest way would be to set up a research project to study them. We could probably learn a great deal about the effect of such reports if we had a research project in place at this time to make an evaluation. Short of this, however, one can examine what is already known about similar situations or, failing that, the most similar situations which can be found. So far as I am aware, there are no readily available scientific studies of occurrences exactly like the NAS report.

Fortunately, there have been some studies of nutritional knowledge. The results do not suggest a great deal of influence. In the first place, one could ask to what extent are people exposed to, and to what extent do they pay attention to, understand, and recall nutritional information. The results of these four steps would be nutrition knowledge. Past research suggests that nationally there is a rather poor understanding of individual nutrients and their effects on the body.¹

Of course, even if nutritional knowledge is incorrect, it could have an influence on buying or eating behavior. Writers who have reviewed research in this area up to the time of the early 1970s conclude that previous research has failed to verify a strong relationship between nutritional knowledge and actual eating patterns.²⁻³

Here in North Carolina, several recent studies have dealt with this issue. Analysis of a state-wide random sample survey indicated that the knowledge of homemakers about the nutritional quality of foods served could be detected as statistically significant in only one out of the eight nutrients studied. Even in this one case (riboflavin) the relationship was weak.⁴ In an experimental study, a five-month school nutrition education program was given to fifth, seventh, and tenth grades. Evaluation showed "encouraging signs of effectiveness" only at the fifth grade level.⁵

Elsewhere, research on high school students showed that a 25 percent increase in nutritional knowledge was not associated with any changes in students' food choices.⁶ Even direct labeling of nutrient information on products does not seem to be very effective. In one study, researchers investigated how information acquired from nutrient labeling influenced decisions.⁷ They found that even though consumers said they wanted much more information, they used only two to three percent of that available in making purchase decisions. In all of these examples cited above we are seeing very low relationships between knowledge and consumer behavior.

Actual eating behavior seems to be an outcome of a complex process involving a large number of social, psychological, biological, and economic variables which interact with each other and with nutritional information to determine a result. Researchers are working on delineating this complex process more specifically.⁸ However, one thing is already clear. Knowing what one should or should not consume is clearly not enough to determine one's behavior. The continued use of alcohol and cigarettes, despite ubiquitous information intended to warn consumers about possible deleterious effects of these products, is perhaps the most dramatic example.

Based on the current information we have in terms of the relationship between knowledge of nutritional aspects and

actual food choices, the question of whether new information, even from prestigious sources, will have a sizable impact seems overstated. The question should probably be: Will new information have any detectable impact at all? Based on past research findings, it would appear doubtful that the impact of the NAS report and the immediately following news items in the press will have much practical influence on consumers' food choices. If, however, the report leads to nationwide education efforts containing the same recommendations, some impact would more likely be observed.

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The NAS Report *Diet, Nutrition, and Cancer*: Implications for Agriculture

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I have been asked by the Council for Agricultural Science and Technology to prepare a statement reflecting my evaluation of the impact of the National Research Council report *Diet, Nutrition, and Cancer* on U.S. agriculture.

The views expressed here are my own and are not an official representation of either CAST or the Department of Agricultural Economics, University of Illinois at Urbana, Illinois.

The sections of the above report germane to this evaluation are the "Interim Dietary Guidelines" reported on pages 1-14 and 1-15, specifically the topics covered under paragraphs numbered 1, 2 and 3. These selected guidelines recommend (1) a reduction of 25% in the consumption of both saturated and unsaturated fat in the average diet, (2) "the importance of including fruits, vegetables, and whole grain cereal products in the daily diet" and (3) "the consumption of food preserved by salt-curing (including salt-pickling) or smoking be minimized."

The first two guidelines imply a change in the mix of food sources that comprise the human diet, and the third specifical-

Table 1. Per Capita Consumption, Meats, Poultry and Fish, Retail Weights, 1960-1980^a

Year	Beef	Pork	Veal	Lamb	Edible Offals	All Poultry	Fishery Products	Total
				(pounds)				
1960	64.3	60.3	5.2	4.3	10.1	34.4	10.3	188.9
1961	65.8	57.6	4.7	4.5	10.1	37.7	10.7	191.1
1962	66.2	59.1	4.6	4.6	10.1	37.2	10.6	192.4
1963	69.9	61.1	4.1	4.4	10.3	38.0	10.7	198.5
1964	73.9	60.9	4.3	3.7	10.5	39.9	10.5	203.7
1965	73.6	54.7	4.3	3.3	10.0	41.1	10.8	197.8
1966	77.1	54.3	3.8	2.6	10.3	43.8	10.9	202.8
1967	78.8	59.8	3.2	3.5	10.7	45.3	10.6	211.9
1968	81.2	61.4	3.0	3.3	10.9	45.0	11.0	215.8
1969	82.0	60.6	2.7	3.0	10.7	47.0	11.2	217.2
1970	84.1	62.0	2.4	2.9	10.9	48.9	11.8	223.0
1971	83.6	68.2	2.2	2.8	11.1	49.1	11.5	228.5
1972	85.9	62.9	1.8	2.9	10.7	51.3	12.5	228.0
1973	81.1	57.6	1.5	2.4	9.8	49.6	12.9	214.9
1974	86.4	62.2	1.9	2.0	10.7	50.4	12.2	225.8
1975	88.9	51.2	3.6	1.8	10.4	49.6	12.3	217.8
1976	95.7	54.6	3.3	1.8	10.8	52.9	13.1	232.2
1977	93.2	56.7	3.2	1.6	10.7	54.5	12.9	232.8
1978	88.8	56.5	2.5	1.5	10.4	57.2	13.6	230.5
1979	79.6	64.6	1.6	1.3	10.2	62.0	13.3	232.6
1980	78.1	69.1	1.5	1.5	10.3	62.6	12.7	235.8

^aSource: National Food Review, ERS, USDA

ly identifies food preservation methods usually associated with cured or processed meat products.

It is likely that any immediate and longer run negative impact of the above guidelines would fall on the animal sectors and the vegetable oil crops, which together supply most of the fat in the diet. To the extent that food substitutions occur in the average diet, the fruit and vegetable sectors might be stimulated, but, with the current supplies of cereal grains, the substitution effect of whole grain cereals in human diets would be minimal. The likely over-all result would be negative, as less feed grains would be used to produce meat animals.

The Changing U.S. Food Trends

Compared with world standards, the U.S. population enjoys a healthful and varied food intake that is purchased with a low proportion of the disposable personal income of consumers. In recent years there have been significant changes in food intake. Total meat consumption, including red meats, poultry and fish, retail weight equivalent, has increased from just under 200 lb per person per year in the early 1960s to over 230 lb from 1976 to date (Table 1). In addition, the per capita consumption of all fats and oils has increased from 51.8 lb in 1971 to 57 lb in 1981. The proportion of fats and oils made up by butter and lard decreased from 18% of all fats and oils in 1971 to 12% in 1981, with a corresponding increase in shortening and salad oils of vegetable origin.

Within the total meats component of the diet, there have been substantial shifts over time as well as changes resulting from the cyclical beef and hog production cycles (Table 1). One pronounced trend over the 21-year period covered by Table 1 is the near doubling of poultry products from 34.4 lb in 1960 to 62.6 lb in 1980. Because of production cycles, beef consumption reached a high of 95.7 lb in 1976 but declined to 78.1 lb in 1980. Pork consumption increased from a cyclical low of 51.2 lb per capita in 1975 to 69.1 lb in 1980.

Accepting the notion that trends and cyclical changes above and below trends in meat consumption are demand-driven, what have been the changing consumer attitudes and preferences that have caused the recent changes in mix of meat products? Several have been suggested, including an increase in meals eaten outside the home, the expansion of the retail fast-food restaurants, an increasingly "weight conscious" consumer, a preference for less "visible fat" on meat cuts at retail, demographic shifts to smaller and more one-parent households and a better educated, more nutrition-conscious consumer.

Related to the shift in pattern of meats consumed has been improved technology in production methods, especially in poultry and to a lesser extent in the hog industry. The price-conscious housewife, by her choices at the meat counter, has contributed to the change in the mix of meat sources available at retail levels.

The preceding brief review underscores the fact that food consumption patterns have been changing and illustrates some of the kinds of changes, as related to the animal sector of U.S. agriculture. The recent release of the report *Diet, Nutrition, and Cancer* will likely add momentum to the ongoing changes, although the immediate impact of the release of the report may not cause a quantum shift in food-buying habits.

Meat Demand Evaluated

If we assume that consumers will respond to the dietary guidelines contained in *Diet, Nutrition, and Cancer*, how can we measure the impact of the report on the agricultural sector of the U.S. economy? Further assume that the admonitions to reduce fat intake, consume more fruits, vegetables and whole grain cereals, and avoid meat products preserved by salt-curing and smoking are embraced by consumers. The resulting impact on the livestock sector would be felt at the retail level and would ripple through the food distribution chain to the prices received by the primary producer at the farm level.

Table 2. Price of Meat as Related to Meat Consumption and Disposable Personal Income^a

Year	Meat Consumption Per Person	Disposable Personal Income Per Person in 1972 Dollars	Weighted Average Price of Meat in 1972 Dollars	Calculated Weighted Average Price of Meat in 1972 Dollars ^b	Gross National Product Deflator ^c
	Lb	Dollars	Cents/lb	Cents/lb	1972 = 1.0
1970	223.49	3724.4	88.25	90.88	0.9145
1971	230.03	3786.7	84.25	85.32	0.9600
1972	224.94	3868.6	90.08	90.63	1.000
1973	209.70	4094.7	105.59	106.48	1.0568
1974	222.46	4071.7	99.08	94.49	1.1495
1975	215.19	4051.7	101.84	101.07	1.2552
1976	230.45	4154.6	93.10	87.77	1.3210
1977	230.04	4258.6	86.28	89.03	1.3980
1978	224.95	4390.4	94.08	94.66	1.4999
1979	223.99	4492.1	96.34	96.33	1.6276
1980	228.60	4523.0	90.06	92.30	1.7738
Mean	223.99	4129.5	93.54	93.54	1.2688
1981	231.09	4541.5	84.79	90.15	1.9174
1982 ^d	228.06	4655.0	—	93.82	2.0746

^aSource: Hieronymus, T.A. *Outlook Update*, January, 1982, page 13. Department of Agricultural Economics, College of Agriculture, University of Illinois at Urbana-Champaign.

^bCalculated from a linear equation including meat consumption (column 2) and disposable personal income (column 3) as independent variables.

^cTo obtain the actual monetary values in columns 3, 4 and 5, multiply the values given in these columns by the corresponding value for the "Gross National Product Deflator" in column 6.

^dProjected.

One simplistic but effective way to evaluate this impact is to look at generalized demand models of the meat animal complex. Hieronymus, in recent work, has developed a demand model for meats. His demand model covers the 11-year period from 1970 through 1980 and uses the weighted average retail price of beef, pork, veal and lamb plus wholesale poultry price as related to the per capita consumption, carcass weight equivalent, for red meats and ready-to-cook weights for poultry and disposable personal income, also on a per capita basis. Prices and income are deflated by the implicit gross national product deflator to remove inflation-drive price changes at retail. The resulting model accounts for 80 percent of the variations in weighted retail prices for meats over the 11-year period.

Elasticities derived from the model show that for a one percent (1%) change in per capita meat supply, the weighted retail price of meats changes by 2.21% in the opposite direction. A one percent (1%) change in per capita disposable personal income is associated with a 0.34% change in retail meat prices in the same direction (Table 2). Related work by Hieronymus also shows a fairly consistent relationship between changes in retail meat prices and farm level prices for beef and pork.

What impact, if any, the recent diet report will have in the future on a reformulated demand model is uncertain and even speculative. Accepting the demand model as shown, a one percent change in the level of meat demanded might be related to an estimated two percent change in retail prices in the short run. Further assuming that the retail, farm-level price spread remains constant, it is likely that livestock prices at the farm level may be reduced by a 1 to 3 ratio, with beef and pork producers likely to absorb nearly all of the price decline. Poultry prices may not be so greatly affected, except for the estimated 15 percent of poultry products now retailed in processed form, such as turkey hams, frankfurters and lunch

meats.

Needless to say, the exercise outlined in the preceding paragraph makes heroic assumptions and oversimplifies a complex problem, but it does serve to illustrate the major short-run impact on incomes of primary livestock producers of a quantum drop in meat demand, if one were to occur as a result of consumers accepting and following the proposed dietary guidelines.

Over the longer run, a series of adjustments would likely occur in the farming sector. Use of feed grains in livestock production would be likely to decline, adding a further burden to the present surplus carry-over of feed grains, and the livestock, feed grains, and oil seed sectors would all suffer income losses. Potential gainers might include fruit and vegetable producers. The effect of an increase in direct consumption of cereal grains as human food is likely to be overshadowed by the reduction in use of feed grains for livestock feeding.

Over time, the livestock industry would adjust to an equilibrium level of meat demand, at a considerable transitional loss of income to those producers who would be forced out of production. The greater long-run impact on agriculture would likely be borne by the feed grain producers, as less grains would be marketed through livestock leaving expanded foreign sales and government programs designed to reduce production as potential longer-run solutions to the apparent capacity of the U.S. grain sector to produce surpluses.

In summary, we know that food consumption patterns have been changing in recent years. The added impact, if any, of the recently released dietary guidelines is speculative, but if the guidelines were acted upon by the public they would likely have a negative income effect on both the livestock industry and the crop sector. We shall have to wait for history to reveal the full extent of the impact.

The Diet, Nutrition, and Cancer Report and Foods From Animals

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Diet, Nutrition, and Cancer, a report prepared by an expert Committee of the National Research Council, is a work of monumental proportions dealing with a topic of the greatest interest to humanity, so it naturally has provoked widespread attention. The Committee was given a three-fold charge: (1) to review the state of knowledge pertinent to the diet and incidence of cancer, (2) to develop a series of interim recommendations to the public and (3) to assemble a series of research recommendations related to dietary components and cancer incidence.

There can be little doubt that the review has been competently and extensively done. A wide range of pertinent literature has been examined and the data coordinated relevant to specific interrelationships in the complex cancer picture. By the same token, the very complexity of the topic makes clear-cut interpretation difficult — a fact that is not lost upon the reviewers who observe in the preface prepared by the Committee Chairman that “Controversies are inevitable whenever data are neither clear-cut nor complete.” Recommendations for continuing research are to be handled in a separate report.

Recommendations to the public constitute the area of greatest controversy and raise some important questions, particularly relating to the consumption of animal products, which have traditionally been recognized as components of the “basic four” food groups (see, for example, Alexander, M.M., and E.J. Stare, 1965. *Your Diet: Health is in the Balance*. Nutr. Found., p. 7). There are, for example, some inconsistencies in the relationship of the Report’s interim recommendations to those in similar studies by other expert groups. A case in point is the divergent opinions expressed by this Committee and the Food and Nutrition Board of the National Research Council in a 1980 report entitled *Toward Healthful Diets*. Some members were common to both of these study groups. In the earlier report, the Board stated that “...in the absence of evidence of a causal relationship between the macronutrients of the diet and cancer, there is no basis for making recommendations to modify the proportions of these macronutrients in the American diet at this time.” Yet, less than two years later, the *Diet, Nutrition, and Cancer* Committee recommended reduction in intake of dietary fat from 40% to 30% of the total calories in the diet.

Much of the controversy stems not so much from what the NAS/NRC Committee wrote, as from the way others interpret

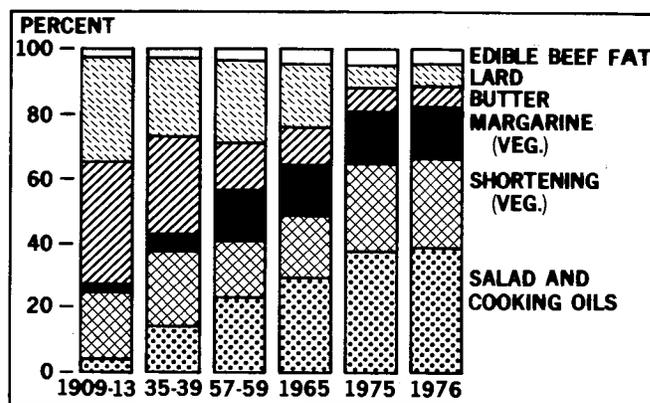


Figure 1. Civilian consumption of nutrient fat from fats and oils in the United States, 1909 through 1976. The data for 1976 are preliminary. (Page & Friend, *loc. cit.*).

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it. Thus from the Committee’s own generally cautious interim dietary guidelines, the national magazine *U.S. News and World Report* reported that the panel (Committee) had recommended, “Eat less fatty meat and high-fat dairy products, which are linked to cancer of the breast and colon.” Recent papers (Hankin, J.H., and N. Rawlings, *Am. J. Clin. Nutr.* 31:2005. 1978; Miller, A.B. *Cancer Res.* 38:3985. 1978) in reputable journals have concluded that evidence relating diet to breast cancer is circumstantial, so such a sweeping interpretation seems unjustified. Although animal fats continue to be the major lipid component of the human diet, the proportion that they make of the total has decreased over time, despite increased consumption of meat and some dairy items. U.S. Department of Agriculture data (Page L., and B. Friend. *BioScience* 28(3):192-197. 1978) (see Figure 1) show that the percentage of diet fat derived from butter and lard has decreased substantially over the last 70 years, that from beef has remained low, while that from various vegetable sources has increased.

Criticism of animal products has sometimes been levelled on the basis of their content of saturated fat, but here the *Diet, Nutrition, and Cancer* Committee recognized different effects in relation to the total dietary fat level, and suggested, “Data from studies in animals suggest that when total fat intake is low, polyunsaturated fats are more effective than saturated fats in enhancing tumorigenesis, whereas the data on humans do not permit a clear distinction to be made between the effects of different components of fat.” Again, the report has suffered in interpretation, and this statement provides no logical basis for recommending reduced animal fat consumption as protective against cancer.

In a press release issued by the National Academy coincident with publication of the Committee report, it is recommended that the public “Eat very little salt-cured, salt-pickled, and smoked foods.” This is based on the relationship of nitrates and nitrites used in meat-curing to formation of

Diet, Nutrition, and Cancer A Critical Review

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nitrosamines, some of which are known animal carcinogens. Several items impact on this interpretation. Although the chemical relationship identified is valid, nitrates and nitrites have a long history of use as preservatives and have been a useful defense against botulism. Another group from the National Academy, the Committee on Nitrite and Alternative Curing Agents in Food, concluded on the basis of an in-depth study of the literature that "...these reports do not provide conclusive evidence of a causal relationship [between exposure to high levels of nitrate or nitrite and cancer incidence] and that alternative explanations for the finding have not been ruled out." Nevertheless, the Committee on Nitrite recommended that exposure to nitrate, nitrite and N-nitroso compounds should be reduced, and this is indeed taking place, with active cooperation from the meat industry, the Food and Drug Administration and the U.S. Department of Agriculture.

This brings up the matter of incidental involvement in the situation by the animal industries and agriculture generally, which has been considerable. If excess fat in meat is, indeed, a problem, there are ways in which it may be controlled, to a very large degree. This may be by selection of genetic tendencies toward leanness, of which a classic example is the transition achieved in this country from the "lard-type" to the "meat-type" hog. The pork industry is currently vigorously continuing and intensifying such selection activity. The degree of fatness of a carcass is also generally proportional to the level of digestible nutrients in the diet. Thus, in the case of beef cattle, the higher the level of digestible nutrients in the diet, the higher the total fat content. Both federal and state beef research programs have focused attention on ways dietary control of fatness can be achieved, including shortened time in the feedlot and increasing the fiber content of feedlot rations, both of which tend to limit digestible nutrients available to the animals during the finishing period.

Beyond these actions which involve actual animal production, changes have been proposed in processing. Cattlemen's organizations have actively promoted lowering the total fat content of certain processed meats, such as wieners. Certain vendors (for example, Safeway Stores) have adopted trimming practices in preparation of their meats that reduce their fat content. Perhaps most significantly, the U.S. Department of Agriculture has proposed changes in the meat grading system that would recognize the desirability of a lowered fat content in meat. Finally, of course, there can be control by the consumer, through trimming individual portions on the plate.

People involved in the animal industries share the same concerns that motivated the authors of the NAS/NRC report on *Diet, Nutrition, and Cancer*. It should be recognized that persons in the animal industries, with government support, are taking significant actions to meet the possible problems identified in the report while retaining the positive nutritional contributions of their products as supplies of protein, calcium, certain vitamins and minerals useful in the human diet. In the face of such actions, recommendations that would limit consumption of animal products *per se* seem misdirected and would tend to condition the public against foods long recognized in official Recommended Dietary Allowances as desirable for the supply of essential nutrients.

Introduction

The report on *Diet, Nutrition, and Cancer*¹ published by the National Academy Press on June 15, 1982, is one of the most disturbing reports to come from the Academy in recent years. It is disturbing to laymen, who are told, in effect, that the American diet is carcinogenic and that current data indicate that certain quite specific and wide-reaching changes in their dietary habits should be made in order to reduce the risk of cancer. It is disturbing to scientists because it is a somewhat superficial and uncritical review of the scientific literature relating diet to cancer followed by a series of recommendations which, in fact, do not follow logically from a critical review of the scientific literature.

Even worse, was the press release² written for reporters on June 15 that inserted examples of foods to be banned or promoted that were not, in fact, discussed or even mentioned in the body of the report, including the "Executive Summary." Under the first interim guideline that recommends that the consumption of both saturated and unsaturated fats be reduced in the average U.S. diet from 40% of total calories to 30%, the press release adds "The major source of fat in the American diet are fatty cuts of meat, whole-milk dairy products, and cooking oils and fats." In the second recommendation, the Committee emphasized the importance of including fruits, vegetables, and whole-grain cereal products in the daily diet. The press release added "These foods include oranges, grapefruit, dark-green leafy vegetables, carrots, winter squash, tomatoes, and vegetables in the cabbage family such as cabbage, broccoli, cauliflower, and brussel sprouts." Finally, under the injunction to reduce the consumption of foods preserved by salt-curing, salt-pickling or smoking, the press release adds "Examples of such foods commonly eaten in the U.S. are sausages, smoked fish and ham, bacon, bologna, and hot dogs." In other words, as one goes from the body of the report to the "Executive Summary" and thence to the press release, there is an increasing hardening of the conclusions of the report. The scientific uncertainties and caveats are excised, and the pronouncements about the dietary prescriptions and proscriptions become as thunderous as the ten commandments. To call these "interim guidelines" has no meaning to the public. They have been received as authoritative rules for good health.

The "Executive Summary" of the report begins with the admission, "Scientific pronouncements are usually viewed by the public as carrying a rather high level of certainty. Therefore, scientists must be especially careful in their choice of words whenever they are not totally confident about their conclusions." But "The public often demands certain kinds of

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information before such information can be provided with complete certainty....The public is now asking about the causes of cancers that are not associated with smoking. ... Unfortunately," the report continues, "it is not yet possible to make firm scientific pronouncements about the association between diet and cancer. We are in an interim stage of knowledge similar to that for cigarettes 20 years ago. Therefore, in the judgment of the committee, it is now the time to offer some interim guidelines on diet and cancer." Does, in fact, the uncertainty of the relationship between diet and cancer justify offering *any* dietary guidelines at this time?

To compare the state of knowledge regarding smoking and cancer in 1964 at the time of the issuance of the Surgeon General's report on *Smoking and Health*³ with that regarding the role of diet and cancer today is ludicrous. In 1964 there was clear evidence that tobacco contained carcinogens effective in causing cancer as well as other substances promoting cancer in animals. Clinical observations on thousands of patients and autopsy studies of smokers and nonsmokers had shown that the many kinds of damage to body function, organ cells, and tissues occurred more frequently in smokers than nonsmokers. Cytological evidence had shown that loss of ciliated cells, thickening of the basal layer, and presence of atypical cells were more common in the trachea and bronchi of cigarette smokers than in nonsmokers. A much larger array of population studies, including 29 retrospective epidemiologic studies and 7 prospective epidemiologic studies showing a clear association between cigarette smoking and cancer, were available in the early 1960s to lead to the conclusion that cigarette smoking is causally related to lung cancer.

The committee, chaired by Dr. Stanhope Bayne-Jones and appointed by Surgeon General Luther L. Terry, set up criteria (1) for judging the value of each reviewed paper, (2) for assessing the force of epidemiologic data using the criteria of A. Bradford Hill⁴ of consistency, strength, specificity, temporality, and coherence of the associations, and (3) for determining when an agent has been shown to have such a significant effectual relationship to the associated disease as to denote it as *causal*. These same criteria were used by the Food and Nutrition Board of the National Academy of Sciences-National Research Council (NAS-NRC) in reviewing the relationship of diet to cancer in *Toward Healthful Diets*⁵.

No such criteria were set by the writers of the *Diet, Nutrition, and Cancer* report in Chapter 3 (p. 3-1) on "Methodology". The only caveat expressed in Chapter 2 (p. 2-9) on "Cancer: Its Nature and Relationship to Diet" was "It is important therefore that we prepare ourselves for a period of uncertainty, between our present realization that diet affects cancer and our *eventual* ability to offer the public a precise formula for minimizing the incidence of cancer" (*italics supplied*).

Carcinogenesis

A fundamental point, which was not made clear in the Executive Summary and was only vaguely touched on in Chapter 2, is the fact that carcinogenesis involves an alteration in the regulation of the gene expression by which the phenotype of the cell is changed. Carcinogenic agents, whether they deal with initiation or promotion, must operate through this final common pathway. Benz(α)pyrene and aflatoxin B₁ after activation derivatize DNA and cause chemical mutations. Products like phorbol esters induce new

enzyme synthesis. If dietary fat is a carcinogen, how does it work? What kind of a dose-response curve does it have? Does it derivatize DNA? What enzymes are affected? Epidemiological studies cannot settle this issue. Without some clue as to how dietary fat and chemicals present in salt-preserved and smoked food apart from nitrite enter the chain of events in carcinogenesis, the circumstantial evidence denoting them as "carcinogenic" should be rejected as artifactual.

The tone of the report is unfortunately set in the last paragraph of page 1-1 in which it is stated, "Many factors in our environment are potential causes of cancer. They include substances in the air we breathe, the water we drink, the regions in which we work and live, and the foods we eat." Nothing is said about the relationship of tumor development to age despite the fact that cancer risk is exponentially related to age. Tumors are relatively rare in human beings before the age of 45, and from age 45 to age 85 the risk of developing a malignant neoplasm increases 40-fold. Furthermore, Totter⁶ has shown that the accumulated net mortality risk for cancer in the United States from 1930 to 1975 has shown only a slight increase (not accounted for by aging) and that is due to cigarette smoking. Furthermore, the NAS-NRC report ignores the role of viruses and infections, the presence of ionizing radiation, and the effects of industrialization and pollution. Do we have in fact any rationale for cancer prevention beyond cessation of cigarette smoking and avoidance of *known* carcinogens in the total environment? The naturally occurring carcinogens in our diet are dismissed by the Committee as providing no risk to man in this country (p. 12-25).

Strategy for Cancer Prevention

The question of whether we have a rationale for cancer prevention was treated in 1979 by Dr. John Bailar, the editor of the *Journal of the National Cancer Institute*.⁷ He warned his readers about the lack of research on new strategies for cancer prevention. He defined cancer prevention as "actions taken to stop or reverse the initial development of malignant neoplasms that would at later stages threaten life or health. This definition includes, but is not limited to, the identification of high-risk persons and the reduction of their exposures, the identification and control of external hazards, and the use of measures to block or reverse the development of lesions among persons already exposed but in whom no cancer is (yet) detectable." He said that "Although the 'identification and avoidance' means of cancer prevention will reduce the incidence of the disease, we also need to consider the consequences (and the desirability) of such far-reaching social and behavioral modifications in life-style as smoking, diet, and alcohol consumption."

Dr. Bailar said, "It seems likely that substantial progress in understanding cancer prevention, as distinct from knowledge of cancer causation, will depend on increased *research support* to these fields. Of course, the work supported must be encouraged, developed, selected, conducted, and reported with the same attention to the rigors of the scientific method as work now supported in the so-called 'hard sciences.'" He went on to say that "Understanding of cancer prevention may well require fundamental theoretical studies of, for example, processes in the modification of behavior that would be of value to people to want to quit smoking. Each discipline important in cancer prevention will probably need substantial support for a spectrum of activities from basic research to

demonstration and service programs." In other words, speaking at a time not essentially different from the time of review of the literature that led to this report, Dr. Bailar emphasized the uniqueness of the strategies of prevention of cancer, the lack of attention to them, and the need for research.

Uncertainties of Knowledge About Diet and Cancer

The authors of the report *Diet, Nutrition, and Cancer* would certainly contend that they have not eliminated the need for research by their report. The need for a research program does not, however, shine through the "Executive Summary," which includes the "Interim Dietary Guidelines." In fact, the "Executive Summary" and "Interim Dietary Guidelines" sound almost pontifical in their certainty.

Frank Press, President of the Academy, said in his transmittal letter of June 15 to Dr. Vincent de Vita, Director of the National Cancer Institute (NCI), that, "As you well know, the often conflicting advice rendered in recent years has done little to strengthen the public's confidence in scientific pronouncements. Clearly there is a need for scientists to provide carefully considered and timely advice to the public."

Dr. Press continued, "It is difficult to demonstrate precise cause and effect relationships between so complex a milieu as diet in a multifactorial disease like cancer which often takes more than twenty years to become manifest. Moreover, the many variables that confound the study of diet and cancer are likely to diminish rather than enhance the statistical probability that any existing connection can be identified. The Committee was cognizant of these drawbacks and of the limited data base. Nonetheless, it viewed the evidence seriously and critically, believing that there should be no delay in the implementation of precautionary measures based on sound scientific knowledge and judgment measures that are likely to confer beneficial effects without discernible risks." The last sentence clearly does not follow from the first four. If it is difficult to identify any connection between diet and cancer, then why should measures of unknown risk and benefit be recommended to a long-lived population?

Toward Healthful Diets

In 1980, the Food and Nutrition Board of the National Research Council, a standing committee within the NAS-NRC, issued a report entitled *Toward Healthful Diets*. The linkage between diet and health was discussed within the context of five chronic diseases: obesity, cardiovascular disease, hypertension, diabetes, and cancer. With respect to cancer, the Food and Nutrition Board concluded as follows: "The Board believes that in the absence of evidence of a causal relationship between the macronutrients of the diet and cancer, there is no basis for making recommendations to modify the proportion of these macronutrients in the American diet at this time." In making this conclusion the Board was operating under an important guideline similar to that employed by the Bayne-Jones Committee which developed the first Surgeon General's report on *Smoking and Health* in 1964.³ This guideline was, "The Board believes that advice should be given to the public when the strength, extent, consistency, coherence, and plausibility of evidence from lines of investigation ranging from epidemiology to molecular biology converge to indicate that certain dietary practices or other aspects of lifestyle promote health benefits without incurring undue risks."

The difference in the conclusion of these two committees with regard to dietary advice for the prevention of cancer is *not* related to a change in the data base but rather a different standard for the interpretation of inconsistent and incomplete data from epidemiological investigations and animal experiments.

Proof of Benefit

Proper evidence to alter public health policy requires more than epidemiology, animal experimentation, and short-term tests of mutagenicity. That evidence should include clinical investigations, observational epidemiology involving groups existing under contrasting environmental conditions, and finally, and perhaps most important, an intervention trial in which diet modification is shown to affect the incidence of the disease in question and the mortality therefrom. There was no evidence of this kind in the NAS-NRC report on *Diet, Nutrition, and Cancer* proving any benefit from the diet modifications suggested by the Committee.

In announcing the report, Clifford Grobstein, chairman of the Committee, admitted, "that the committee 'does not yet think it possible to say...how much the incidence of particular cancers might be reduced by dietary alteration.'"⁸ Why, then, make these recommendations? This represents an act of faith rather than a conclusion of science.

Composition of the NAS-NRC Committee on Diet, Nutrition, and Cancer

As regards the composition of the 13-member Committee on Diet, Nutrition, and Cancer (Appendix A), four identified themselves with the subject of nutrition (Campbell, Gussow, Kritchevsky, and Mertz) but only one (Campbell) of these admitted any involvement in research activities relating diet to carcinogenesis; two were cancer epidemiologists (Kolonel and Miller); four were molecular biologists (Cairns, Prival, Slaga, and Wattenburg); and two were specialists respectively in the kidney and gastro-intestinal tract (Berliner and Broitman). No clinical oncologist or food scientist was a member. The chairman, Dr. Grobstein, lists his interests as developmental biology and biomedical technology assessment. Though distinguished in some ways, I do not consider this group a strong or balanced committee to be asked to undertake a critical appraisal of the subject of diet, nutrition, and cancer.

Critique of the Six Dietary Guidelines Proposed by the NAS-NRC Committee

1. The consumption of both saturated and unsaturated fats should be reduced in the U.S. diet from 40% of total calories to 30%.

In the judgment of the Committee, the suggested reduction of 25% of total fat intake is a moderate and practical target and is likely to be beneficial. In the Executive Summary and in the chapters dealing with a discussion of calories, fat, cholesterol, and protein there are other statements which suggest that this recommendation is based on less than secure evidence. For example, on page 1-2 it is stated that "Epidemiologists have found it relatively easy to demonstrate a correlation between diets consumed in modern affluent societies and the incidence of cancers in such organs as the breast, colon, and uterus. But it has proved to be much more difficult to establish causal relationships and determine which, if any, of the dietary components is responsible." In the "Methodology" chapter,

the Committee states that it prefers to use case-control (retrospective) and cohort (prospective) observational epidemiologic studies as contrasted to descriptive epidemiology correlating national statistics with disease incidence and mortality because of large errors in both reported national dietary intakes and vital statistics.

On page 1-4 it states that "The epidemiological data are not entirely consistent. For example, the magnitude of the association of fat with breast cancer appears greater in the correlation data than in the case-control data, and several reports on large bowel cancer failed to show an association with fat." The results of the most thorough case-control study of breast cancer yet reported involving 400 cases and 400 controls by Miller et al.⁹ showed no association of the disease with dietary fat. The average calorie intake calculated from 3 dietary histories for the cases was 1927 per day compared to 1867 for controls. The average fat intake for cases was 84.6 grams/day compared to 82.0 grams/day for controls. Both consumed 40% of their calories from fat.

It is not clear why the Committee prefers fat as the relevant dietary variable to cancer when, in both experimental and epidemiological studies, calories, fat, and protein are all intercorrelated. Nor was obesity, a condition resulting from an excess intake of calories derived from the macronutrients, excluded as a factor. On page 4-3 the report states that "...the American Cancer Society study from 1959 to 1972¹⁰...examined the relationship between mortality from cancer and other diseases and variation in weight among 750,000 men and women selected from the general population. Cancer mortality was significantly elevated in both sexes only among those 40% or more overweight. For men, most of the excess mortality resulted from cancer of the colon and rectum; for women, cancer of the gallbladder and biliary passages, breast, cervix, endometrium, and ovary were the major sites. It was not possible to evaluate the relative importance of overweight and total caloric intake or intake of other nutrients."

"Tannenbaum and Silverstone¹¹ [page 5-12] noted that tumor incidence was greater in obese mice than in normal mice and that caloric restriction inhibited mammary tumor genesis in normal mice." When Tannenbaum¹² attempted to distinguish between fat and calories he concluded that fat rather than calories was responsible, but when Lavik and Baumann¹³ attempted a study of the effect of diet on 3-methylcholanthrene-induced skin tumors, they found calories were more important than fat.

Another important consideration overlooked by the Committee is that lowering dietary fat to 30% of calories at total caloric intake of 1200 calories or less will jeopardize nutritional status with respect to iron, zinc, pyridoxine, and folate. This is because protective animal foods would have to be sacrificed because of their fat content. The issue of total fat intake vs. percent of calories from fat for health is not addressed in any section of the report.

The physiological impact of lowering dietary fats from 40% of calories to 30%, assuming that the P/S ratio remains the same after reduction, would tend to lower serum cholesterol levels in the population. There have been a number of clinical trials of diet change to lower serum cholesterol in the interest of preventing heart attacks and strokes.¹⁴⁻²⁰ What turned out, however, was that in some of them, the Los Angeles Veterans Hospital study¹⁶ for example, the serum cholesterol was reduced about 15% and coronary disease mortality was

reduced, but mortality from cancer was increased. The same happened in the WHO clofibrate study¹⁹ in which a drug was utilized to lower serum cholesterol values about 9%. In this case nonfatal coronary occlusions were reduced by 20%, but the general mortality increased, and the increase was due to cancer and biliary disease.

The question has to be asked, "Does lowering serum cholesterol predispose the subject to cancer?" Low serum cholesterol values, furthermore, were associated with total cancer mortality in 14 studies and with colon cancer in 5 studies.²¹ These data would lead a reasonable person to believe that low serum cholesterol levels may be associated with an increased risk for colon and perhaps other types of cancer.

This question is addressed in the *Diet, Nutrition, and Cancer* report on pages 5-5 to 5-9, but the Committee's conclusion is that "the data are inconclusive and do not point to a causal relationship between low cholesterol levels and risk of colon cancer" (p. 5-8). I would agree that causation has not been proved, but the strength of the data and the number of cases in which it has been reported certainly are more impressive than the negative data obtained from case-control studies attempting to relate dietary fat to breast and colon cancer. No plasma lipid fraction (like cholesterol) has been measured in studies purporting to show that dietary fat correlates with breast and colon cancer. At least one *internal* indicator, serum cholesterol, correlates inversely with the risk of some types of human cancer. Why, then, recommend a reduction in dietary fat for the U.S. population in the interest of cancer prevention?

2. Fruits, vegetables, and whole-grain cereal products should be included in the daily diet.

This is not a startling recommendation since conventional wisdom since 1943²² has been to include the four basic food groups, i.e., fruits and vegetables, breads and cereals, meat and high protein foods, and dairy products in daily diet planning. Four servings of fruits and vegetables and four servings of cereals and breads are recommended daily, with the emphasis on whole-grain cereal products. The basic four food groups need reemphasis, but why in the context of cancer prevention?

Underlying these recommendations are two major hypotheses that have been put forward by prominent investigators over the past two decades. Burkitt and Trowell²³ suggested that, for a number of chronic diseases of affluence, dietary fiber may play a role in protecting against cancer of the colon and other sites. On p. 8-5 the report states that "Both correlation and case-control studies have yielded results that either support or contradict the hypothesis that dietary fiber protects against colorectal cancer...The committee found no conclusive evidence to indicate that dietary fiber (such as that present in fruits, vegetables, grains, and cereals) exerts a protective effect against colorectal cancer in humans." On those grounds, there is no special reason to emphasize fruits and vegetables in the diet outside of the normal indications for a balanced diet.

Peto et al.²⁴ have recently put forth a hypothesis based principally on epidemiologic data that beta-carotene may be protective against certain forms of cancer. They are very careful to point out, however, that a causal relationship between beta-carotene intake and/or vitamin A intake and

cancer has not been established. It is recognized that compounds related to vitamin A, such as vitamin A acid and other derivatives, some of which do not have vitamin A biological activity, do influence the course of experimental carcinogenesis *in vitro*. From these data, one cannot conclude that vitamin A levels in the diet would in fact offer such protection within a physiological or nutritional range.

The Committee overstates its conclusion when it says on p. 9-7 "The epidemiological evidence is sufficient to suggest that foods rich in carotenes or vitamin A are associated with a reduced risk of cancer." This statement implies to me that the Committee believes that carotenes are, in fact, protective against cancer in man, which is far from established.

The anticancer effect of cruciferous vegetables is demonstrated only in conflicting epidemiological studies, most of them dealing with world-wide gastric cancer. In the United States, gastric cancer is becoming a vanishing disease (p. 17-3 to 17-6).

The epidemiologic data on vitamin C, present in many fruits and vegetables, are contradictory, some investigators finding inverse associations of vitamin C intake with cancer and others not. The conclusion of the report (p. 9-10) is that "The limited evidence suggests that vitamin C can inhibit the formation of some carcinogens and that the consumption of vitamin-C-containing foods is associated with a lower risk of cancers of the stomach and esophagus." The issue of causality is left open, but the possibility that vitamin C is antineoplastic in man is implied. In conclusion, there is no satisfactory new evidence to indicate that the U.S. population should increase its consumption of fruits, vegetables, and cereals out of proportion to that required for an adequate diet.

3. The consumption of foods preserved by salt-curing (including salt-pickling) or smoking should be minimized.

The evidence for this recommendation is summarized principally on pages 17-3 to 17-6 and deals with a possible role of salted and smoked foods in the genesis of gastric cancer. It is an unnecessary prohibition in most western countries, including the United States, in which gastric cancer mortality has declined in both men and women from an average of 25 per 100,000 population in 1930 to less than 6 per 100,000 in 1970 and is still declining. Esophageal cancer in men has been constant at about 4 per 100,000 and negligible in women since 1930.²⁵ During the same period of time, the consumption of processed meats has gone from 42 pounds per capita per year in 1930 to 61 pounds per capita per year in 1980.²⁶

Data to support this recommendation (p. 17-3 to 17-6) have been taken almost exclusively from populations studied outside the United States where conditions are dramatically different from those encountered in North America.

Gastric cancer mortality rates are high in Japan (ca. 35/100,000), but come down 80% to U.S. rates in second-generation migrants to the United States.²⁷ To say the effect is dietary is purely speculative, although Hirayama suggests the protective element is milk.²⁸ Nonetheless, the western environment is protective against gastric cancer. In Colombia and Chile, South America, the high incidence of gastric cancer is blamed on nitrate in diet and drinking water. In Iceland, the high incidence of stomach cancer is blamed on the high consumption of smoked fish (p. 17-4). None of these studies is pertinent to U.S. populations. In the summary, the report alludes to unidentified carcinogens produced in foods by

preservation treatments and cooking and to nitrates and nitrites used in salt-pickling as possible carcinogenic factors in these foods (p.17-6).

This summary conflicts with the summary on p. 12-25, where it is stated "There is some inconclusive epidemiological evidence that nitrate, nitrite, and N-nitroso compounds play a role in the development of gastric and esophageal cancer;...." "...however, there is no evidence that any of these substances individually makes a major contribution to the total risk of cancer in the United States."

The independent report of another NAS-NRC Committee on "The Health Effects of Nitrate, Nitrite, and N-Nitroso Compounds" chaired by Maclyn McCarty of Rockefeller University²⁹ concluded on pp. 1-11 to 1-13 that "Nitrate is neither carcinogenic nor mutagenic,.... Nitrite is not a direct acting carcinogen in animals,...." and that "N-nitroso compounds are carcinogenic in laboratory animals, mutagenic in microbial and mammalian test systems and some are teratogenic in laboratory animals.... These data are of limited value for predicting quantitative risk in humans." The final recommendation was that, "In view of the possible but unquantified risk resulting from the use of nitrite as a curing agent, the Committee recommends that the search for alternatives and alternative approaches for the use of nitrite be continued. However, no new agent or combination of agents should be substituted for nitrite until adequate testing has ensured that it does not present a hazard to human health."

In view of this testimony by the two NAS-NRC Committees, and the decline in gastric cancer in this country in the face of increased consumption of processed meats, the prohibition of salt-cured and smoked foods is incomprehensible.

4. Efforts should continue to minimize contamination of foods with carcinogens from any source.

This recommendation refers to nonnutritional additives (both intentional and inadvertent) and is to be applauded. In Chapters 12 and 14, the Committee concluded that both additives which are suspected human carcinogens (vinyl chloride and acrylonitrile) and naturally occurring carcinogens (aflatoxins, safrole, cycasin, and pyrolyzed tryptophane) in the amounts consumed do not increase the total risk of cancer in the United States.

5. Mutagens in foods should be identified and tested for carcinogenicity. If possible they should be removed without jeopardizing the nutritive value of the foods.

This recommendation is redundant, since it is largely covered by recommendation 4, which the Committee has made of minor importance by declaring that existing known trace carcinogens in our diet do not constitute a public health problem. Mutagenesis and carcinogenesis are not, furthermore, identical biological processes, and much more research is needed to make short-term mutagenesis tests more applicable to the identification of direct-acting carcinogens or precarcinogens. Furthermore, detection of significant promoters of carcinogenesis will not depend on perfection of tests for mutagenesis.

6. If alcoholic beverages are consumed, they should be taken in moderation.

There is no argument about this recommendation except to question "What is moderation?" Nowhere in Chapter 11 is moderation defined. Tuyns³⁰ has said that if the population of Ille et Vilaine in France were to cut their cigarette consumption to 10 cigarettes and their alcohol consumption to one half

liter of wine (equivalent to 4 whiskey ounce equivalents) per day, their incidence of esophageal cancer would be cut by 85%.

Summary and Conclusions

The NAS-NRC report on *Diet, Nutrition, and Cancer* is not a scholarly or critical review of the literature bearing on this subject. Individual papers were not evaluated for the competence of the investigator, adequacy of design, freedom from bias, adequacy of resources, adequacy of controls, and the logic and justifiability of the conclusions. Most of the conclusions and recommendations were based on epidemiologic studies and animal experiments, most of which bore little or no resemblance to the environmental and nutritional conditions prevalent in the United States today. Studies of observational epidemiology and clinical trials in which diet change or modification is studied for a change in cancer incidence were conspicuous by their absence. The Chairman of the Committee admitted "that the committee 'does not think it possible to say...how much the incidence of particular cancers might be reduced by dietary alteration.'"⁸ An appraisal of the confused state of knowledge of diet and cancer could have been written without recommendations. Why then, were the recommendations made? Of the six recommendations made, numbers 1 and 3 are not justified by the data available and number 2 is redundant.

Recommendation 1 advises the U.S. public to cut its fat consumption from 40% of calories to 30%. This recommendation is not justified because (1) the case-control studies carried out in the United States and Canada do not show a biologically significant gradient in fat intake, (2) no animal studies were cited that showed an effect of a 25% reduction in dietary fat upon either a spontaneous or chemically induced tumor, (3) diets low in calories which contain 30% of calories from fat are likely to be inadequate in iron, zinc, pyridoxine, and folate, (4) excess caloric intake and obesity were not distinguished from the fat content of the diet either in terms of absolute amounts or percent of calories, and (5) hypocholesterolemia, which will develop in some individuals on diets containing 30% of calories from fat, was rejected as a risk factor for colon and other forms of cancer.

Recommendation 3 advises the U.S. public to minimize its consumption of food preserved by salt-pickling, salt-curing, or smoking. Specifically mentioned in the press release were "sausages, smoked fish and ham, bacon, bologna, and hot dogs." This recommendation is not justified because (1) gastric cancer, which is most closely associated with salt-cured and smoked foods, has decreased 80% in the United States since 1930 and is still declining, (2) gastric cancer in migrants to the United States from countries with a high incidence of gastric cancer (Japan, Chile, and Iceland) shows a marked decline by the second generation, (3) processed meats, including sausages and frankfurters, have increased in per capita consumption in the United States by 150-200% since 1930 coincident with the decline in gastric cancer, (4) both this Committee and another NAS-NRC Committee on Nitrite and Alternative Curing Agents in Food (1981) pronounced current levels of nitrates, nitrites, and N-nitroso compounds in our food supply as constituting no significant risk to the health of Americans.

Recommendation 2 advises the U.S. public to include fruits, vegetables, and whole grain cereals in the daily diet. This recommendation is redundant because since 1943 all

professional nutrition educators have emphasized the basic four food groups as the backbone for an adequate diet. These groups include fruits and vegetables, cereals and bread, meats and high-protein foods, and dairy products. Special emphasis on the two food groups mentioned because of their content of fiber, carotene, vitamin A, vitamin C, or isothiocyanate is not justified by the current state of knowledge.

Recommendations 4, 5, and 6 dealing with trace carcinogens, mutagens, and alcohol in the American diet are not controversial.

What is particularly regrettable about this report is the emphasis put on diet, as opposed to smoking, as the major risk factor for cancer in this country. It is substituting counterfeit metal for sterling silver, and it is causing unneeded economic distress. The second Surgeon General's report on *Smoking and Health* (1979)³¹ substantiates and extends the conclusions of the first Surgeon General's report on *Smoking and Health* (1964)³. No rational person can escape the conclusion that cigarette smoking is the single most important health risk factor, not only for cancer, but for a variety of other diseases as well. What the NAS-NRC report on *Diet, Nutrition, and Cancer* has done is to envelope the classic documents on *Smoking and Health* in a cloud of confusing, contradictory, unsubstantiated, scientifically unconvincing assertions about diet and cancer. The public is poorly served by such reckless behavior, particularly by a committee of the National Academy of Sciences-National Research Council.

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Comments on NAS Report *Diet, Nutrition, and Cancer*

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This report summarizes and brings together the literature dealing with cancer and diet, which was a tremendous and worthwhile exercise. The information, although generally not conclusive, points out the lack of understanding of the relationship between dietary constituents and cancer. The report, however, will be useful as a guide for future research to help in clarifying the role of nutrition and diet as etiological agents in carcinogenesis. The Committee is to be commended for its effort in putting together this monumental publication. Members of the scientific community, especially those involved in nutrition and those with a fundamental interest in carcinogenesis and its prevention, are indebted to the Committee for its review of this important health issue.

Controversy in Nutrition

The Committee not only reviewed the relationship of diet to cancer but unfortunately, in my opinion, made specific recommendations for altering dietary patterns of the U.S.

public. The report very cautiously states (p. 1-1), "Scientific pronouncements are usually viewed by the public as carrying a rather high level of certainty. Therefore, scientists must be especially careful in their choice of words whenever they are not confident about their conclusions." And it continues later (p. 1-2) to say that "For most factors, however, the measurement of the exposures and the assessment of their effects are neither precise nor straightforward. Among the factors whose precise effects are difficult to assess are the diets consumed by different groups of people. The measurements are difficult not only because it is hard to learn what people eat but also because the foods comprising their diets are so complex." Then the report states later (p. 1-14), "The evidence reviewed by the committee suggests that cancers of most major sites are influenced by dietary patterns. However, the committee concluded that the data are not sufficient to quantitate the contribution of diet to the overall cancer risk or to determine the percent reduction in risk that might be achieved by dietary modifications."

The committee then, however, ignored its own cautious statements and made some strong recommendations for dietary alterations as follows:

1. Reduce the consumption of fat in the average U.S. diet to 30% of calories from the present 40%.

2. Include fruits, vegetables and whole grain cereal products in the daily diet.

3. Minimize consumption of foods preserved by salt-curing (including salt pickling) or smoking.

4. Minimize contamination of foods with carcinogens from any source, either natural or as food additives.

5. Identify mutagens and, where feasible and prudent, remove them from the food supply or minimize their concentration.

6. Alcoholic beverages, if consumed, should be taken only in moderation.

Calories from Fat

There is little argument with four of the six recommendations (2, 4, 5 and 6), but the first one recommending a marked reduction in the percentage of calories from fat is quite in contrast to another report from the prestigious Food and Nutrition Board, which in 1980 in its publication *Toward Healthful Diets* carefully avoided making recommendations for major changes in the diet until scientific evidence would support such dietary alterations. This earlier report states:

- Sound nutrition is not a panacea. Good food that provides appropriate proportions of nutrients should not be regarded as a poison, a medicine, or a talisman. It should be eaten and enjoyed.

- In view of these premises, the Board makes the following recommendations to adult Americans. It believes that these guidelines will improve general nutritional status, may be beneficial in preventing or delaying the onset of some chronic degenerative diseases, and incur no appreciable risks....

- Select a nutritionally adequate diet from the foods available, by consuming each day appropriate servings of dairy products, meats or legumes, vegetables and fruits, and cereal and breads.

- Select as wide a variety of foods in each of the major food groups as is practicable in order to ensure a

high probability of consuming adequate quantities of all essential nutrients.

- Adjust dietary energy intake and energy expenditure so as to maintain appropriate weight for height; if overweight, achieve appropriate weight reduction by decreasing total food and fat intake and by increasing physical activity.

- If the requirement for energy is low (e.g., reducing diet), reduce consumption of foods such as alcohol, sugars, fats, and oils, which provide calories but few other essential nutrients.

- Use salt in moderation; adequate but safe intakes are considered to range between 3 and 8 g of sodium chloride daily.

The Food and Nutrition Board of the National Academy of Sciences might well have prefaced the foregoing recommendations with the statement from the NAS report *Diet, Nutrition, and Cancer* (p. 1-1) that the incidence of all types of cancer, except for those of the respiratory tract, which are primarily related to cigarette smoking, have remained relatively stable during the past 30 to 40 years. The same report further states (p. 1-3): "The dietary levels of most nutrients have changed relatively little over the last 80 years." With these two facts in mind, one may well ask, how can lowering the percentage of calories from fat reduce the incidence of cancer?

Perhaps the most serious question confronting persons attempting to limit calories from fat to 30% is how this can be achieved on a practical diet. It is almost impossible to meet the recommended daily allowances (RDAs) for all nutrients on a diet with 30% of calories from fat. This diet would preclude most animal products and would not meet the RDAs for some of the minerals (iron and zinc), certain B-vitamins (riboflavin, vitamin B₆ and vitamin B₁₂) and certain other nutrients. This is not meant to say that some reduction in calories from fat may not be beneficial for the average person in the United States. However, the goal of 30% is not realistic while still meeting the RDAs by using a practical diet.

Saturated vs. Unsaturated Fat

The report *Diet, Nutrition, and Cancer* wisely recommends the reduction in all dietary fat, both saturated and unsaturated. This is an important point that has largely been ignored in the past, when emphasis was given to reduction of only saturated fats (the term "saturated fats" is a misnomer, since all fats contain varying proportions of saturated and unsaturated fatty acids).

The report *Diet, Nutrition, and Cancer* suggests that on a low fat diet polyunsaturated fatty acids may enhance tumorigenesis more than do saturated fatty acids. Although this has been shown with experimental animals, data for humans are not clear. Nevertheless, this finding would suggest that low fat diets should generally have a higher percentage of saturated fatty acid.

Obesity

The report fails to address adequately the problem of obesity and its relationship to cancer. Perhaps more important than the percentage of calories from fat is prevention of obesity, which has been shown to be linked with certain types of cancer, especially in women. The best advice to prevent

cancer associated with obesity is to "Adjust dietary energy intake and energy expenditure so as to maintain appropriate weight for height," as recommended by the Food and Nutrition Board in *Toward Healthful Diets*.

News Releases

Unfortunately, the news releases on the report *Diet, Nutrition, and Cancer* make stronger and more conclusory statements than the report *per se*. Particularly damning is the premature news release (June 3, 1982) made by T. Colin Campbell (a member of the Committee) in Ithaca, N.Y., which states:

- Diet appears to be associated with most human cancers and is the most important environmental cancer risk factor. According to recent estimates, it is even associated with a higher number of cancers than tobacco use or specific carcinogens in air, water, and food.

To minimize the risk for cancer, Campbell recommends the following:

- Low overall fat intake: 'Many studies indicate that when dietary fat accounts for more than 35 percent of the total calorie intake, cancer of the breast, colon, prostate, and large bowel significantly increases,' Campbell said. On the average, Americans obtain 40 to 45 percent of their calories from fats.

- 'As a practical target, dietary fat should be reduced to 20 to 30 percent of one's calorie intake.'

- Low protein intake: 'Many Americans consume two to three times too much protein,' Campbell said. 'Low protein diets inhibit cancer development in animals, and human studies show a high intake of dietary protein associated with increased risk for cancers of the breast, endometrium, prostate, large bowel, pancreas, and kidney.'

This news release goes beyond the original report, making controversial claims not only greatly exaggerating the effects of fat but also denouncing protein as a factor associated with increased risk of cancer. Although the original report (p. 1-6) suggests that a high protein intake "may be associated with an increased risk of cancers at certain sites," it goes on to say, "the committee is unable to arrive at a firm conclusion about an independent effect of protein." Neither the Executive Summary (Chapter 1) nor the news release from the Committee makes any recommendations about limiting protein levels.

Salt-Cured and Smoked Foods

My major criticism of the news release from the Committee (dated June 15, 1982) other than the recommendation to decrease calories from fat to 30% of the total calories deals with eating "very little salt-cured, salt-pickled, and smoked foods. (Examples of such foods commonly eaten in the U.S. are sausages, smoked fish and ham, bacon, bologna, and hot dogs)." The statement in parentheses was apparently added by the news writer and may well not reflect the opinion of the Committee, but merely be an opinion of the press agent. It is pointed out that the criticism of salt-cured and smoked foods comes from reviewing data on consumption of such foods in China, Japan and Iceland where the populations consume large quantities of salt-cured and smoked foods (p. 1-15).

The news release, which equates salt-cured (including salt-pickled) and smoked foods to "sausages, smoked fish and ham, bacon, bologna, and hot dogs," indicates a lack of

understanding of modern meat processing. With the possible exception of smoked fish and hams (specifically, country-cured hams which are preserved by salt), the other products are preserved by refrigeration, with salt and smoke being added only to enhance their keeping qualities and flavor. Thus, the examples of salt-cured or smoked products are poorly chosen and probably of little significance in relation to cancer and diet.

To reiterate, the report summarizes a most important issue, namely, the relationship between diet, nutrition and cancer. The information provided by the report is generally useful, although I personally take issue with two recommendations of the report, i.e., reducing total calories from fat to 30% and limiting the use of sausages, conventional packer-cured hams and bacon, bologna and hot dogs.

In conclusion, it may be well to re-emphasize the advice of the Food and Nutrition Board in its report *Toward Healthful Diets*:

Sound nutrition is not a panacea. Good food that provides appropriate proportions of nutrients should not be regarded as a poison, a medicine, or a talisman. It should be eaten and enjoyed.

Sociological Implications of the Dietary Guidelines in the *Diet, Nutrition, and Cancer* Report

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Introduction

This discussion of the sociological implications of the dietary guidelines, pages 1-14 and 1-15, presented in the *Diet, Nutrition, and Cancer* report from the National Research Council was done at the request of the Council for Agricultural Science and Technology upon the recommendation of the Rural Sociological Society's representative to the CAST Board of Directors. My background, interests and experiences serve as the basis for the issues I have identified. I have an M.S. degree in food and nutrition and a Ph.D. in sociology. My work experience includes five years in nutrition and biochemistry laboratory research with some teaching experience in nutrition. As a Ph.D. rural sociologist, I have pursued my interest in attitudes and values related to food behavior and the meaning of food to specific groups of people, and I have developed an interest in the relationship of the structure of agriculture to quality of life, with emphasis on the world food supply.

The discussion is divided into five major areas: the nature of the report and related publicity; the danger of over-reaction to the report; the agricultural market goals and health goal conflict; potential production shifts in the agricultural sector; and the difficulties in implementing the recommendations.

The Nature of the Report and Related Publicity

Even though I was asked to address the sociological implications of the recommendations, I feel compelled to express my opinion about the report. The National Cancer Institute and the National Research Council are to be commended for undertaking such a project. The report is invaluable in its review and synthesis of the research literature. However, I strongly agree with those who believe that it should have been reviewed and approved by the Food and Nutrition Board of the National Academy of Sciences prior to release, especially since the conclusions regarding diet and cancer conflict with those of the 1980 report, *Toward Healthful Diets*. I recognize that the report was done by capable scientists, but it is possible that an equally capable, but different group would *not* have reached the same conclusions. The committee used sound procedures, but the complexities of measuring food intake and the lack of knowledge of what happens in the body both contribute to a lack of definitive answers. A sorting out of all the physiological interaction effects does not seem to have been adequately accomplished for making strong promises of cancer prevention through changed dietary habits.

The specific dietary guidelines of the committee are probably not harmful, and if followed, would probably lead to improved nutritional status by decreasing the total number of calories in the diet through decreased fat consumption and by increasing the consumption of two nutrients — vitamin A and ascorbic acid — that are at lower levels than recommended in the diets of many people. Even though I think we would be wise to decrease fat consumption, it does *not* necessarily follow that a reduction in fat consumption by one-fourth would lead to a reduction in the incidence of cancer since increasing consumption levels in the United States have not raised the incidence.

No recognition is given to differences in risk levels for specific groups of people such as subcultural groups or those with different physiological statuses such as young children, pregnant women and the elderly.

The media have already gone beyond the report with interpretations such as stated in *Science News*, "research indicates that most common cancers can be prevented by following certain dietary guidelines" (don't we wish!). Campbell's quotes in the Cornell news release went well beyond the guidelines in saying that "a diet low in protein and fat, etc. is recommended to reduce the likelihood of developing cancer." The *Science* article brings out the protein relationship as well as other possible but unproven ties, and the *U.S. News and World Report* article says "Eat less fatty meat and high-fat dairy products" (American consumption of both of these has decreased since the early 1900's).

Already, we can see that the media interpretation and possibly those of individual members of the committee have gone beyond the guidelines.

Danger of Over-Reaction

Although the specific guidelines as stated on pages 1-14 and 1-15 of the report are reasonable enough, I am concerned that the expected results from following the guidelines will be overly emphasized and the application of the guidelines will be faulty.

Americans are looking for easy answers and possibly salvation through diet and dietary supplements. The popularity of "health food" stores demonstrates these concerns. Many people frequently misinterpret nutrition recommendations in their quest for perfecting their lives. For example, they may assume that vitamin A from a pill is the same thing they get from vegetables. Even though the writer(s) of the section on vitamins stresses that the cancer-incidence level is associated with vegetables high in that nutrient, this point will probably be generally overlooked, and many people may choose to take overdoses of vitamin A, which can be very dangerous, instead of eating vegetables that contain many other substances, any one of which may be the actual tumor inhibitor. The same is true for ascorbic acid even though the dangers of overdoses are not quite as great.

The dangers of recommending decreased protein consumption are a particular concern since protein needs as well as other nutrients vary by physiological status. Pregnant women and growing children are two groups that are particularly sensitive to protein consumption levels. To reduce the level for these two groups below that needed for optimum growth (as done in reported research) just because it may reduce tumor formation seems totally unreasonable.

A reduction in protein consumption could also reduce the amount of iron and other nutrients consumed by these two previously mentioned high-risk groups as well as for adolescent girls, who often have inadequate intakes of iron. The dark green vegetables could make up for some of the iron losses, however.

Certainly these recommendations and interpretations lean toward recommending vegetarian diets which are difficult to balance nutritionally, and particularly so for children. We must keep in mind the needs of specific groups of people with any set of dietary guidelines.

Conflict Between Health Goals and Segments of the Agricultural Sector

If we know, or even have strong evidence, that certain foods are responsible for certain types of cancer, then by all means we need to put the health goals of our people above the goals of certain segments of the agricultural market, no matter how painful it may be to them.

If we focus strictly on the guidelines and not on the interpretations of the media and individual members of the committee, there may still be some unfairness in the guidelines toward certain segments of the meat industry that use salt and smoke curing. The process as used in most of the American food industry and consumption rates are quite different from those reported in countries with greater incidences of esophagus and stomach cancers. The American product is not dependent on salt preserving (hams must be refrigerated except for local specialty items), and we use these items along with many other nonsalt- and nonsmoke-treated meats. In other words, consumption levels in the United States are not nearly so concentrated as in the countries in the reported research. Apparently, the meat industry is further reducing the salt and nitrite used in preserving meat. Therefore, these recommendations may be unnecessary except for selected ethnic groups.

The reduction of total fat in the diet including that from plant sources affects the producers of soybeans and other vegetable sources of oil. However, there is a world market for

these products. Fat, at the level consumed by Americans, provides mostly "empty" calories and should be reduced even if these producers and related industries do suffer. "Empty" calories are those that do not provide other nutrients. Sugar is another example of "empty" calories. Measuring consumption rates of fats and oils is particularly difficult unless we analyze samples of food actually consumed. If the rates are based on "disappearance data," much of the oil sold is actually discarded after it becomes undesirable for frying food. Most supermarket meat is trimmed of most fat now, also. Unfortunately, lower priced ground beef contains more fat than do the more expensive kinds. The maximum fat level could be legislated to a lower level, however.

To summarize, health goals should be more important than market goals of specific groups. However, consumers and the food industry should not be frightened or penalized with inappropriate guidelines.

Potential Production Shifts in Agriculture

In general, the guidelines recommend a balancing of food items and moderation in all respects.

The meat industry could actually gain from the guidelines. Low-fat meat is less expensive to produce, and if grades are changed to reflect health concerns, then there can be a net gain to the industry unless later guidelines recommend reduced protein consumption. The main concern to the meat and dairy industry should be more the misinterpretation of the guidelines than the guidelines themselves.

Corn producers could suffer on the U.S. market due to decreased grain needs for fattening animals and reduced corn oil usage. The need for grain on a worldwide basis is great, but worldwide politics makes this market less stable.

An increase in demand for fruits and vegetables high in ascorbic acid and vitamin A precursors would possibly shift more of the agricultural production to the southwestern parts of the United States where we already have critical water shortages. However, it is possible that this potential demand could lead to more production of fruits and vegetables for local markets, which could be an advantage in terms of transportation costs and in supporting the small farmer.

The possible shifts in production could affect the lives of many persons in the food industry if the American public did follow the guidelines, but these shifts are not a matter of life and death as is cancer. However, a greater problem would be encountered in motivating people to change their food habits in an appropriate way than in making the adjustments within the food industry.

Difficulties in Implementing Dietary Guidelines

Assuming the guidelines are sound and that agricultural producers could adjust to the recommendations, we still have the major problem of changing food habits. There are two major reasons for this. First, people have many misconceptions about the composition of specific foods. For example, they do not know how to cut their fat intake by 25 percent. Second, but probably more important, food meets many needs other than nutritional ones. These needs are both social and psychological, and attitudes toward food are deeply entrenched in basic values and beliefs.

Food habits do change, but they generally do so very

slowly, and changes are often associated with other societal and cultural changes such as when a shortage occurs or when women enter the labor force. Very seldom does a person say, I am going to change the way I eat and then does so. The emotional security associated with doing things in traditional ways is closely related to food habits. In addition, specific foods are associated with other needs and beliefs in varying ways. Some of these needs are related to cost, convenience, health, creativity, sharing, social status, tradition, the pleasure of eating, psychological rewards, and emphasis on physical size.

For example, if we wish to decrease fat consumption, a logical place to start would be with the fast food restaurants who fry potatoes, chicken, fish and pies by the ton, not to mention selling ice cream desserts and beverages and dressings as other sources of fat. Immediately we would lose an inexpensive, convenient food source. In addition, millions of dollars in advertising have convinced us that these are great places to go with our friends and family. In fact, there are strong suggestions that we are all one big happy family when we eat in these places and we deserve a reward by eating there. We like these feelings and we like the satisfied feeling we have in our stomachs when we walk out after consuming high levels of fat. The actual "bad" meat may be a lean mixture of beef and soybean extender that is cooked in a microwave or broiled and may in fact be the least harmful source of fat on the menu, while providing most of the nutrients. Most of us have no idea that we have just added a significant amount of fat to our bodies, but we can see the fat around an untrimmed ham, so we carefully trim that away and blame pork for our cancers and heart problems. That is easier to do because pork is more likely viewed as a low-status food for low-income people in the rural South, and it takes more preparation time, unless we buy it precooked. Then we do not know what has been done to it. (I have to admit that I strongly associate bacon or sausage with my mother's breakfasts, and I feel something is missing without one of them at breakfast.) I could give other examples, but my point is that food habits are difficult to change unless we can meet these other needs of people through the recommended dietary changes.

We also have to educate people to what is "low fat" or "high fat." The possible misinterpretations presented in a previous section are a more likely outcome than are sound practices, because people want easy answers.

The guidelines raise other questions, such as, are we going to label target foods as being hazardous to health such as cigarettes, or are we going to take them off the market entirely? How much knowledge do we need to do these more drastic measures? Certainly the ability to isolate the relationship of cigarettes to cancer is much easier than it is to isolate any one nutrient or food as a contributor.

Summary

Without question, health goals should take priority over market goals of specific groups. The recommended guidelines are probably not harmful, nutritionally, but some of them may be unwarranted and even unfair to parts of the food industry and the consumer. Further review of the guidelines is needed before any attempt is made to implement them. Members of the committee and the media should be very careful when interpreting the guidelines.

If upon further review the guidelines are judged to be sound, then programs for implementing dietary changes should be planned to minimize problems for the food industry and consumers. Changing food habits is a very difficult process; therefore, consideration needs to be given to underlying values and beliefs of the total population as well as to those of specific subcultural and physiological groups. Not all segments of our population are at risk. These differences must be taken into account.

Review of the National Academy of Sciences *Diet, Nutrition, and Cancer* Report

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It is an honor and privilege to have been asked by the Council for Agricultural Science and Technology (CAST) on the recommendation of the American Institute of Nutrition, to review the National Academy of Sciences-National Research Council (NAS-NRC) Committee's report on *Diet, Nutrition, and Cancer*. Although the concept that diet and nutrition might influence cancer is not a new one, this relationship has received surprisingly little detailed attention. During the 1930s, a number of laboratories were interested in the possible influence exerted by nutritional factors on susceptibility to cancer, but the question soon lost the interest of both scientific and lay communities. Now, there is a growing belief that dietary factors play a predominant role in the causation of cancer in humans.

I have followed closely the previous suggestions and/or reports by the NRC's Food and Nutrition Board entitled *Toward Healthful Diets*, the American Heart Association's *Prudent Diet*, and the Senate Select Committee's *Dietary Goals for the United States*. In the last few years, remarkable advances have been made in our understanding of nutrition as it relates to the risk of certain types of cancer. Much has been learned with respect to the natural history and basic understanding of nutrition-related cancer. Whereas these prior dietary suggestions were directed mainly toward reducing the risk for cardiovascular disease, the present suggestions are directed toward the prevention of certain types of cancer. This should provide even more incentive for the public to heed the recommendations since there would be benefits in terms of lower risk for important types of cancer as well as for coronary heart disease.

This scientific review pertains to the NRC's report on *Diet, Nutrition, and Cancer*. First, let me comment on the members of the NRC's Committee on *Diet, Nutrition, and Cancer*. These committee members are highly qualified experts in their field and competent to assess the scientific evidence.

In my opinion, scientific endeavor involves attacks on problems from many viewpoints. The purpose of this commit-

tee was to evaluate the current state of research on nutrition and its relationship to cancer, to determine the possible causes that have been established, to question when inconsistencies remained and to propose preventive measures on the basis of present evidence. This report, in contrast to the previous report *Toward Healthful Diets* by the NRC's Food and Nutrition Board, is, indeed, a comprehensive assessment and detailed appraisal of the current knowledge concerning the dietary components as they relate to certain types of cancer.

It is my belief that the Committee has evaluated the evidence from all types of studies, namely, human epidemiological and experimental animal model studies. It made a careful evaluation of all parameters whereby our diet does or could influence cancer development. It has discussed in detail the limitations of each procedure and arrived at the conclusion that the results of the epidemiological studies in humans and the experimental animal model studies provide convincing evidence as to the role of dietary and metabolic factors in the development of certain types of cancer. Particularly within the last decade, epidemiological evidence supported by extensive experimental studies has steadily advanced the concept that nutrition, in many ways, affects human carcinogenesis. When the animal model studies complement the epidemiological observations of human risks, there is no reason, in my view, to doubt the validity of the evidence. The NRC made recommendations to the scientific community and the public based upon the Committee's findings. These findings conclude that, of all the nutrients affecting the development of certain types of cancer in man, the most convincing evidence is at hand for the effect of total dietary fat — an effect that the report called "causative." This report reflects the majority opinion of experts in nutritional, experimental and human carcinogenesis. It is quite obvious to those in the area of nutrition and cancer that it represents a significant document and a valuable resource to everyone concerned with this subject. It is likely to serve as a significant impetus to future progress in an important area of cancer prevention. Thus, as discussed in the Committee's report, many of the gaps in our knowledge could be eliminated.

The following review considers certain aspects relating to the Committee's report and the conclusion reached. It focuses on those aspects that pertain to my area of interest and research.

1. With regard to nutritional studies that assess the relation of certain dietary components to cancer, the Committee realized that the nutritional intake within a given population cannot readily be studied because of inherent difficulties with nutritional surveys. The problem is enhanced by various dietary components being inter-related. When evaluating one nutrient parameter, it is difficult to isolate it from other dietary factors because of the complex interactions among them. Thus, people who get most of their calories from fat are likely to have a low intake of starches, and vice versa. It also has been recognized that it is difficult to relate diet to cancer since cancer has a long latency period and current diet histories might not represent what people ate in the distant past. We are interested in learning not only what people consumed recently, i.e., during the previous week, but also what they ate in the more distant past. The belief that individuals can report accurately not only what they usually eat but also

what they actually consumed is untested. However, recent information suggests that recall of a diet consumed in the more distant past may closely reflect present food choices. Conclusions were reached by comparing nutritional intakes, not only from one population group to another, but also from migrant populations, from special groups within the population, and from case-control and cohort studies. The relationship between dietary factors and cancer has been investigated by correlational, case-control and cohort studies. The Committee placed more emphasis on the data from case control and cohort studies which, in my opinion, were more definitive and reliable. The results obtained from these reliable human studies were complemented by the convincing evidence in animal model studies that have been reproduced in different laboratories.

2. With respect to overnutrition and cancer risk, the NRC Committee concluded that the evidence from human and animal model studies linking total caloric intake to the risk of certain types of cancer is largely indirect and does not permit a clearcut interpretation of the direct involvement of caloric intake. It has long been suspected that being overweight is associated to some degree with the risk of death from certain types of human cancer and this recently was confirmed by the American Cancer Society study. However, there is little information relating total caloric intake to cancer risk. In several of these studies, it was not possible to evaluate the relative importance of obesity and total caloric intake. Human studies that have compared both caloric and fat intake suggest that fat intake is more important than the caloric intake. In the middle 1940s, Tannenbaum and Silverstone were engaged in a series of elegant studies demonstrating the effect of diet in terms of total calories on breast tumor growth in animals. Studies in animal models indicate that restricting the intake of food (calorie restriction) without modifying the proportion of the individual nutrients reduces the cancer incidence. Because the intake of all nutrients was simultaneously reduced in these animal model studies, the observed reduction in tumor incidence might have been due to the reduction of other nutrients, such as fat. Thus the Committee's conclusion that neither the human nor the animal model studies permit a clear interpretation of the effect of total caloric intake on the risk of cancer is, in my opinion, reasonably accurate.

3. One of the most important facts revealed by the NRC's Committee is the relationship between dietary fat and the risk for certain types of cancer, mainly cancer of the large bowel, breast, prostate and pancreas. Evidence for the importance of total dietary fat as a risk factor for cancer of the large bowel, breast and pancreas comes from both human and animal model studies, whereas the evidence for the prostate cancer emerges from human studies. Available evidence also suggests that high dietary fiber (mainly from whole grain cereals) acts as a protective factor in populations consuming a high amount of total fat. Case-control studies indicated an elevated risk for those with an increased intake of total fat and saturated fat. In animal models, high-fat diets enhance the development of colon, mammary and pancreatic tumors. Polyunsaturated fats enhance mammary tumors and stimulate tumor growth more effectively than do saturated fats. However, diets

containing small amounts of polyunsaturated fat and a high level of saturated fat increase mammary tumors as effectively as do diets containing a high level of polyunsaturated fats. Animal model studies provide some evidence that, at low dietary fat levels, diets high in polyunsaturated fats are more effective colon tumor promoters than diets rich in saturated fats irrespective of the source of the saturated fat. In general, these results support a role for total dietary fat in the incidence of certain types of cancer. Both migrant studies in humans and animal model studies clearly suggest that the stage of carcinogenesis at which the effect of dietary fat is exerted definitely appears to be during the promotional phase of carcinogenesis, rather than during the initiation phase. However, no clearcut experiments have been conducted in animal models to indicate that the dietary fat has no effect during initiation. The fact that ubiquitous environmental carcinogens are present at very low concentrations suggests that promoting factors may have a preponderant influence on the eventual outcome of the cancer process in humans. Due to the wide variety of initiating agents and the possible difficulties in removing them from the environment, the promotional phase of carcinogenesis may be a more promising area for the development of preventive measures. In practical terms, this suggests that reducing fat intake should decrease cancer of the colon, breast, prostate and pancreas, regardless of whether it is achieved by eliminating fats of animal or vegetable origin.

4. With respect to the relationship between the dietary cholesterol and cancer, data from several studies equivocally suggest that decreased serum cholesterol may be associated with increased mortality from colon cancer in man. Whether low serum cholesterol levels in these patients precede or follow colon cancer is not completely determined. One also wonders if decreased serum cholesterol may be linked with increased cholesterol excretion. This might be a more accurate indication of total cholesterol burden imposed by diet and actual body production. Thus, excess cholesterol excretion could be the link between low serum cholesterol levels and an increased risk of colon cancer. Additional studies are warranted to settle this issue.

5. In spite of evidence from human and animal model studies on the inverse relationship between dietary fiber and colon cancer, the NRC Committee concludes that there is no conclusive evidence for the protective effect of certain dietary fibers against colon cancer in humans. Dietary fibers comprise a heterogeneous group of carbohydrates, including cellulose, hemicellulose and pectin, and a noncarbohydrate substance, lignin. The composition of fibers differs from one source to another. Vegetable fibers, which are highly fermentable, have little indigestible residue; whole grain cereal brans are less fermentable and have more indigestible residue. Thus, cereal grain, vegetable and fruit fibers have different percentages of cellulose, hemicellulose, pectin and lignin. The major problem with several human studies on dietary fiber and colon cancer is that there is no published information on the total dietary fiber content of various food items. Most of the information was obtained using crude fiber values, which are useless. In other studies, most fiber analyses have been based on total fiber consumption calculated by grouping foods such as fruits,

vegetables and cereals according to their fiber content. Thus, the results often appear confusing because of general misuse of fiber terminology and lack of analysis of various fiber sources.

In conclusion, the NRC's report on *Diet, Nutrition, and Cancer* is a significant document. It may also be concluded that dietary deficiencies or excesses of certain nutrients could play an important role in cancer causation. The human data are particularly plausible because extensive animal model studies have demonstrated the effect of nutrition and nutrients on experimental carcinogenesis. Thus, we frequently have been surprised at the relative lack of attention given to this field when, in fact, the relationship had considerable biological plausibility, rationale, and internal consistency from the very beginning.

Review of the Report *Diet, Nutrition, and Cancer* of the Committee on Diet, Nutrition and Cancer, Assembly of Life Sciences, National Research Council

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The National Academy of Sciences — National Research Council report, *Diet, Nutrition, and Cancer*, was obviously written by a committee. The sections on specific nutrients, or substances occasionally accompanying food, are, for the most part, well balanced analyses of available data on the subjects. The various editorial sections and chapters attempting to synthesize a consensus from them are, however, replete with contradictions, hedgings, maybes, suggestive of's, appears to be's, and broad unsubstantiated statements. What emerges is exceedingly long, ambivalent, and confusing. The news media might be excused for extracting the "man bites dog" newsworthy sentences, leaving the general impression that food causes cancer.

The effort to review food:cancer relationships has, inadvertently, resulted in accentuation of the positive. "Seek and you shall find." The very publication of a report to the public as a basis of official public policy with the title *Diet, Nutrition, and Cancer* by this prestigious group raises the specter of, and gives credence to, their positive relationship.

The report is clearly premature. Although written for the public, the publication of the guidelines at this time is contradictory to the conditions for scientific reporting given in the "Executive Summary": "Scientific pronouncements are usually viewed by the public as carrying a rather high level of certainty. Therefore, scientists must be especially careful in their choice of words whenever they are not totally confident about their conclusions." That the writers of the report were

not "totally confident about their conclusions" is evident from the accompanying statement that "...it is not yet possible to make firm scientific pronouncements about the association between diet and cancer." In a rationalization to justify this departure from its own criteria, the second paragraph of the "Executive Summary" states: "The public often demands certain kinds of information before such information can be provided with complete certainty. For example, weather forecasting is often not exact; nevertheless, the public asks that the effort be made, but has learned to accept the fact that the results are not always reliable." The public does not view weather forecasting as "carrying a high level of certainty." Furthermore, errors in weather reporting are forgotten in a few hours. Errors castigating beef and sausage have long-lasting effects, and, once fixed in the public mind, such errors are almost impossible to correct.

Also in the "Preface" is the statement that "Although the committee decided that the data base is not yet adequate for firm recommendations to be made, it did conclude that there was sufficient justification for certain interim guidelines...." The committee has forgotten the lesson of the parable of *The Boy Who Cried Wolf*.

The proponents of the diet recommendations for control of the incidences of both cancer and coronary heart disease are concerned with the population as a whole, while opponents are more concerned with individuals. Insurance companies and epidemiologists are concerned with statistics and chance, but many individuals have a problem accepting the principle of asking 100% of the American people to change their lifestyles, and important branches of agriculture and the food industry to make drastic readjustments, if only a statistically significant number of people, which could be a small minority, may enjoy the questionable benefits. The report itself stated that "The committee recognized at the start the current state of knowledge is insufficient to permit a precise quantification of the effect of diet on the incidence of cancer...or to determine the percent reduction in risk that might be achieved by dietary modifications." Should the majority of the population, those not affected, be asked to make the changes undesirable to them? The premium on the insurance policy, or the cost:benefit ratio, may well be too high. In our system the individual is more important than the state.

It is significant that it is mainly epidemiologists and others impressed with statistics who are the proponents of the diet:cancer and diet:heart relationships, and biochemists and nutritionists who are more conservative or actually opponents. Since the mechanisms by which diet fat might cause cancer have not been more than guessed at, most scientists consider broad recommendations to be premature.

It is questionable whether this report would have been written, were it not for the epidemiological data relating to fat. After more than 400 pages of detailed examinations of diet-cancer relationships, the report concludes that, "of all the dietary components it studied, the combined epidemiological and experimental evidence is most suggestive for a causal relationship between fat intake and the occurrence of cancer." There is no claim that even that relationship is more than "suggestive." As will be examined below, even that "suggestive" evidence is questionable.

The charge to the committee was to make interim dietary guidelines likely to reduce the incidence of cancer. These

guidelines are given at the end of the "Executive Summary," Chapter 1, pages 14, 15, and 16.

With the exception of those relating to diet fat and to cured meats and fish, the guidelines can be objected to by no one. It hardly seems necessary for the National Cancer Institute, the National Academy of Sciences, a prestigious scientific committee of 13 and their advisor, as well as a National Research Council staff of 5, to spend endless hours, more than 400 pages, and the required large sums of money to finally recommend "that efforts continue to be made to minimize contamination of foods with carcinogens," or that "further efforts be made to identify mutagens in food." It is not novel to recommend "that if alcoholic beverages are consumed, it be done in moderation" or to emphasize "the importance of including fruits, vegetables, and whole grain cereal products in the daily diet."

The chapters on nutrients, Section A, "The Relationship between Nutrients and Cancer," make it clear that none are carcinogenic, either in initiating tumors or promoting those initiated by chemical carcinogens. On the contrary, several are credited with being protective. With slight change in emphasis in wording and in organization of the data, the report could make a strong case against food carcinogenicity.

Section B, "The Role of Nonnutritive Dietary Constituents," by its size (154 pages) and the more positive carcinogenic nature of the substances discussed, gives a disproportionate impression of the possible carcinogenicity of our diet. It gives food guilt by association. It should be presented in a separate report.

The report might better have been organized by foods than by food constituents, and even that would be misleading. Any report to the public on the effect of a single food constituent as contributing to a disease would be misleading because of unknown and even unmeasurable interrelationships in the real world. Thus, in the present report, possible carcinogenic effects of protein and fats were found impossible to isolate, and some vitamins, minerals, and fibers were found to be protective. The problem is reminiscent of the difficulties with the diet:heart recommendations. Polyunsaturated fats are said to neutralize saturated fats. Plant sterols balance out dietary cholesterol, and some plant fibers balance out other hypercholesterolemic factors. A mixture of food constituents, no matter how carefully balanced, cannot substitute for normal foods. Purified diets with cholesterol always produce higher plasma cholesterol than do normal mixed diets of the same composition. It is predictable that the same is true of carcinogenic dietary constituents versus normal mixed diets.

The only diet that should be recommended to the American people as public policy is a mixed diet of the various food groups as taught to school children. A proper mixed diet would have neither too much nor too little of anything, and the "protective" constituents would balance the adverse constituents. Additives and contaminants are a different problem.

The nutritive minerals were reported to be free of carcinogenicity or to be protective, except for some compounds of arsenic and lead, and for abnormally large amounts of selenium. These should not have been included with nutritive minerals, but are special situations belonging in the section on nonnutritive constituents.

The vitamins are thoroughly discussed, and the conclusions are similar to those concerning minerals. Some vitamins were

reported as protective against chemically induced cancers, especially vitamin A, and, with less certainty, vitamin C. None are carcinogenic. The probability is discussed that the protective effect of vitamin A is nonspecific but due to its contribution to maintenance of healthy tissue and that in this way it may resist abnormal activity.

The experimental studies involving the effect of calories *per se* were found to be "few and...difficult to interpret." The committee found it impossible to separate the effect of calories from the effects of nutrients which supply and accompany calories, their relationship to obesity, and the relationship between calories, age, and cancer. This subject is an example of the ambivalence of many sections of the report. If included at all, it should have been limited to the possible effects of obesity on cancer.

A possible role of proteins presented a problem similar to that of calories: it was not possible to separate possible protein effects from those of accompanying nutrients, especially fat. Therefore: "the committee is unable to arrive at a firm conclusion about an independent effect of protein."

Carbohydrates were found free of any carcinogenicity. The same was true of all fibers, some being found suggestive of exerting "a protective effect against colorectal [colon and rectal] cancer in humans."

Special consideration must be given to the report on fat. As has been quoted above "The committee concluded that of all the dietary components it studied, the combined epidemiological and experimental evidence is most suggestive for a causal relationship between fat intake and the occurrence of cancer."

Contrary to even the "suggestive" data on a direct relationship between fat intake and colon cancer, are equal data indicating an inverse incidence of colon cancer with fat and cholesterol in the diet from studies testing diet and coronary heart disease. The anomaly is illustrative of the illogic of conclusions of cause and effect relationships from epidemiological data. It makes such relationships suspect rather than strengthening them.

That the committee recognized the weaknesses in the fat:cancer relationships is evident from statements in the report. The second sentence in Chapter 5 on "Lipids" states that "...since dietary fat is highly correlated with the consumption of other nutrients that are present in the same foods, especially protein in Western diets, it is not always possible to attribute these associations to fat intake *per se* with absolute certainty. The Executive Summary makes a strong statement about the repetitive positive data on the fat:cancer association, mainly breast, prostate, and large bowel cancer. It then hedges, pointing out that the data are not consistent, and that the association is greater in correlation than case-control data. The chapter on "Lipids" points out on page 5-1 that the correlation between diet fat and breast cancer in the United States disappears when the southern states are excluded and, on page 5-3 for gastrointestinal tract cancer, that "The contrast between the strong international correlations and the lack of associations within countries is striking."

In spite of the above, the committee found that the diet fat:cancer relationship is the most "suggestive" of the entire report, thus making all other diet:cancer relationships very weak indeed.

On the basis of the admittedly questionable fat:cancer relationship, the committee's guideline is to reduce the average disappearance of fat (confused with consumption)

from 40% of calories to 30%. One should be puzzled how this could possibly be effective. On a 2500 calorie diet the difference would be 250 calories or about 26-28 grams. That is, the guideline would reduce dietary fat intake from about 111 grams to about 83 grams per day. Can that be the difference between the quantities of fat that are carcinogenic on the one hand or innocuous on the other?

A fact often overlooked in the diet:fat disease relationship controversies is the fact that human tissues produce large amounts of fat. Mammary tissue is excellent for the study of fat and cholesterol synthesis and can metabolize fat without difficulty. How, then, can it be intolerant of diet fat, especially animal fat which it closely resembles? A case for atherosclerosis might be made for the infiltration of levels of plasma low-density lipoproteins above a critical level, but it is an enigma how such lipoproteins could promote breast cancer.

The committee must be congratulated on a thorough and professional review of the literature and discussions of the pros and cons. However, the report is very premature as the basis of public policy and for the formulation of dietary guidelines for the American people.

Review of Report: NAS-NRC Committee on *Diet, Nutrition, and Cancer*

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I am impressed by the vast amount of information assembled by the Committee on the subject studied. I am not familiar enough with all of the many aspects covered to be in a position to judge the thoroughness of the review, but all subjects discussed are generally documented with data from a wide variety of sources. The charge from the National Cancer Institute in commissioning the study to "review...the state of knowledge and information pertinent to diet/nutrition and the incidence of cancer" seems to have been fulfilled. It is clear that there are many gaps in this knowledge and that much more research will be necessary before a clearer understanding is reached. As expected, it was the second charge, to "develop a series of recommendations..." that generated the most controversy. As Chairman Grobstein stated in the Preface, this is especially likely "when data are neither clear-cut nor complete."

I have confined my assessment largely to reading those sections that deal with aspects with which I am somewhat familiar and to examining statements in the summaries and conclusions in reference to the accounts of the epidemiological and experimental findings prepared by the authors of the report. A thorough consideration of the relationships involved would require a more detailed study of the original reports. I did not have the time nor the kind of expertise such an effort would require. While my own research interests include aspects of soil-plant-animal interrelationships, none of the

studies have been concerned directly with cancer incidence.

There are some differences in the recommendations made in the report of the Committee on *Diet, Nutrition, and Cancer* and those made in the 1980 National Research Council (NRC) Food and Nutrition Board report. Most notable, particularly from the standpoint of possible impact on consumer buying, is the recommendation that consumption of foods preserved by salt-curing or smoking be reduced. The basis given is data showing a higher incidence of esophageal and stomach cancer amongst populations where use of such foods is greatest, and the detection of aromatic hydrocarbons and N-nitroso compounds that have been shown to be mutagenic or carcinogenic in some organisms (and thus are suspect for similar effects on humans). While in the summary and conclusions the Committee states that the evidence is "largely circumstantial" and uses such terms as "hypothesis" and "may be associated" for defining the relationship of exposure to high levels of nitrate and/or nitrite to incidence of stomach and esophageal cancer, the Committee chose to recommend reduced intake of salt-cured and smoked foods, citing the recommendation of another National Academy of Sciences (NAS) report (1981) by the Committee on Nitrite and Alternative Curing Agents in Food that exposure to nitrate, nitrite, and N-nitroso compounds should be reduced.

Another of the "Interim Dietary Guidelines" proposed by the Committee on *Diet, Nutrition, and Cancer* dealing with a component to which only passing reference is made in the 1980 NAS-NRC report, is avoidance of excessive consumption of alcohol, particularly combined with smoking of cigarettes. In the 1980 report, use of less alcohol along with less sugars, fats and oils is only recommended "If the requirement for energy is low (e.g., reducing diet)." Likewise, the 1980 report recommends a reduction of fat intake only for the overweight, while in the Guidelines of the *Diet, Nutrition, and Cancer* report it is suggested that use of fats be reduced generally, from the present level (approximate) of 40% to 30% or less of the caloric intake. Both reports acknowledge the importance to health of daily intakes of fruits, vegetables and cereal grains, and according to the 1980 NRC report, dairy products and meats or legumes should be included as well.

It appears that at least some of the negative reactions to the report are generated by statements made subsequently with reference to material contained in the report. The kind of overstatements that have been made in reference to findings described in the report can be exemplified by the statements about effects of protein intake. The conclusion in the Committee's report that "evidence from both epidemiological and laboratory studies suggests that protein intake *may* be associated with an increased risk of cancers at certain sites" and, that "the committee is unable to arrive at a firm conclusion about an independent effect of protein" is at odds with a press release issued independently by T. Colin Campbell, one of the Committee members. Campbell took a much more positive view, stating that "Low protein diets inhibit cancer development in animals, and human studies show a high intake of dietary protein associated with increased risk for cancers of the breast, endometrium, prostate, large bowel, pancreas, and kidney."

The manner in which some of the findings are presented favors the possibility of misuse of the data. A case in point is

the discussion of selenium in Chapter 10. Generally, the statements made are well documented, and an appropriate distinction is made between findings at different levels of selenium. However, the first sentence under "Antitumorogenic Effects" on page 10-4 reads "A large accumulation of evidence indicates that supplementation of the diet or drinking water with selenium protects against tumors induced by a variety of chemical carcinogens and at least one viral agent (Table 10-1)." No mention is made there nor, with one exception (indicating that N-nitrosomethylurea was used on rats), is it indicated in the table that these results are with laboratory animals. While subsequent statements in that section make reference to the use of various animals, nevertheless, the likelihood of use of material from the report out of context and with reference to effects on humans is enhanced by this manner of presentation.

Although, as described in the report, there are some indications from epidemiological and laboratory studies that selenium does have some antitumorogenic effects, specific metabolic roles by which this might be accomplished have not been defined. No evidence was reviewed to support the notion that selenium prevents the formation of carcinogenic substances, as might be construed from statements quoted in a recent research report in *Science*.

But the negative response to the Committee's report also can be faulted for misinterpretation. Members of the Committee on Agriculture of the U.S. House of Representatives criticized the Committee on *Diet, Nutrition, and Cancer* for not looking into the relationships of diet to health in other countries. Data are cited from the *Congressional Record* obtained by the Population Reference Bureau, showing higher life expectancies at birth in more developed countries, the implication presumably being that the quality of our foods must be better than those of less developed countries. Such correlations may be invalid if account is not taken of sociological and economic factors, and of large differences in medical services. If my memory serves me correctly, I believe I have seen recent statistics indicating that life expectancy in the United States is not as high as in some other so-called developed countries.

In summary, I believe the Committee has made an important contribution in assembling a vast amount of information from published reports regarding diet, nutrition and cancer. Whether the recommendations were proper in view of the available evidence is debatable. Certainly in some cases, interpretations made can be criticized as premature, but in view of the constraints limiting the obtaining of needed data from human experimentation it is likely that more conclusive data will be slow in coming. As an agriculturist and layman, I too am concerned, as others have stated, about economic injuries that the agricultural enterprise may sustain as a result of the Committee report, and that we as consumers will feel as well. As a scientist, I am concerned when damage to credibility may result from unwarranted, hasty interpretations made from too limited observations. My hope is that those serving in these capacities, and having educational responsibilities as well, can do a better job of keeping members of the public better informed so that they can, with greater enlightenment or more balanced perspective, cope with the sometimes confusing and contradictory information appearing in communication media. At this point in time there are

certainly more questions than answers on the subject, and few statements to allay concern can be documented with irrefutable evidence.

Great caution needs to be exercised in the rendering and dissemination of information from reports dealing with such sensitive and controversial issues as that addressed by the Committee on *Diet, Nutrition, and Cancer*. Otherwise, the public is presented a picture even more confused than need be.

Statement on the Report on *Diet, Nutrition, and Cancer*

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The opportunity to review, evaluate, and comment on the report *Diet, Nutrition, and Cancer* is appreciated. The document is a comprehensive review of past research relevant to this most important topic. It is obvious that the committee and staff invested a tremendous amount of time and expertise in reviewing and assessing the large number of reports. In my judgment their recommendations are reasonable and provide a basis for sound advice to the public. The following more specific comments are offered in the way of analysis.

1. The fact that this committee has an opinion different than that of the Food and Nutrition Board is not surprising. The statement in the 1980 edition of the Recommended Allowances was clearly not the outcome of a comprehensive review of the potential relation between food and cancer. The task of the committee on diet and cancer was to provide this review and recommend appropriate changes. All reviewers should recognize the imprecise nature of nutrition, the myriad factors which may influence man's response to food ingredients, and the sometimes mysterious causes of cancer. It seems likely that we cannot sort out with any degree of precision the relationships between nutrition, health, and a disease such as cancer. Clearly, current knowledge permits at best the statement of rather tentative guidelines for the consumption of food and the prevention of cancer. There will not be acceptance by all members of the nutrition community. Neither the public generally nor the press should expect consensus in this area.

2. Recommendations by the committee about reductions in the intake of fat seem appropriate in the light of evidence that fat is an enhancer or promoter of tumor development. Moreover, this recommendation is in general concert with other suggestions that the fat intake of the U.S. population should be reduced. In my judgment, most nutritionists would agree with the suggestion that fat be reduced to provide about 30 percent of total daily energy. However, strong statements about the role of fat in causing cancer appear somewhat misleading in the light of current evidence.

Evidence that protein is either a direct cause or a promoter of tumor development is not strong. The committee was not convinced enough to arrive at a firm conclu-

sion, although there have been reports to the contrary.

3. The statement in the news release that "The committee recommended against high-dose supplements of individual nutrients" seems appropriate. Information in the report about the amounts of vitamin C used in food products suggests that the U.S. population may be consuming much more of this nutrient than most nutrition surveys identify and report. The apparent protective effect of vitamins A, C, and E argues for intakes of the recommended dietary allowances from food sources.

4. Evidence linking cancer to different methods of curing and treating foods, such as smoking, pickling, etc., appears to be primarily epidemiological information. This evidence may not be sufficiently strong to warrant a dietary guideline, but it should serve as a warning and result in much more research in this area.

In summary, the tone of the report is rather cautious but reflects current understanding and evidence about the role of nutrition and diet in cancer prevention. In my opinion the committee has presented reasonable conclusions. Moreover, in my judgment, most nutrition scientists would agree with the recommendations which support moderate intakes of a wide variety of foods.

Review of the *Diet, Nutrition, and Cancer* Report by the National Academy of Sciences

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I can appreciate the complexity of the challenge to the committee and staff in developing this very difficult report when in many circumstances the scientific information is not sufficient to provide clear-cut, definitive recommendations. At the same time, the committee and staff have a very great responsibility to provide appropriate perspective to the general public and not to get expectations for improved health beyond what can be delivered as judged by the best scientific evidence to date. It is recognized that throughout the report the reader is reminded that the data are either incomplete or not conclusive; however, the summary and highlighted items in the news release tend to minimize this point relative to the dietary alterations recommended.

The following specific points are intended to provide some additional perspective.

1. The committee emphasizes the nutritional and health aspects of various dietary consumption patterns. While this is most appropriate, it should be recognized that foods have several other quality attributes in addition to nutritive value and safety. These attributes include sensory properties — flavor, texture and appearance, microbiological as well as chemical safety, functional properties (emulsifying and waterbinding capacities as examples), convenience and price. It is important to recognize for the reader that food

preferences and cultural food habits are major determinants in food selection and need to be considered along with the other quality attributes, including nutritive value referred to above. These features, as well as further awareness of food composition, would have materially strengthened the report.

2. The reader would have greatly benefited if the report had considered other changes that occur when an increase or decrease in the consumption of various food commodities is recommended. For example, the key role that meats provide in the diet as sources of highly available iron, minerals and B vitamins needs consideration. Also if visible fat is trimmed from muscle meats, the caloric consumption per serving is markedly reduced, but the serving still provides the available iron, minerals and vitamins essentially unchanged from the untrimmed meat serving. I am sure that dieticians could have contributed materially to clarifying this phase of the report.

3. The basis for estimating the intake of various food constituents, such as fats, is clarified in the glossary of terms, where it is noted that food disappearance data and per capita intake were used interchangeably. Obviously, the comment made above on trimming visible fat from meat cuts is one factor to make these two items quite different in actual practice. It also would be extremely valuable to have the dietician's advice as to the satiety value and acceptability from a flavor and texture standpoint when the fat content of the diet (available for consumption, I presume) approximates 30% of the total calories.

4. Additional input by food scientists and dieticians would also be helpful to edit such phrases as in paragraph one of Section A, page 6: "If, as is often the case, changes in food processing methods are poorly monitored, the extent of exposure to substances resulting from these processes will not be known." This statement needs clarification, documentation or additional explanation, as I simply do not perceive what is meant. Obviously, many chemical reactions occur in fresh and processed foods during storage and handling. If what is meant is that we do not know all the chemistry of what is going on, that is correct. If it is meant to imply that the food distribution system does not monitor the food supply with respect to good handling from a microbiological standpoint or can prevent oxidative and other changes due to improper temperature and packaging, obviously there is some room for improvement. The statement as it stands does not possess the scientific rigor and credibility I would associate with a National Academy of Sciences report.

A second example is in Section A, page 10, paragraph 3: "The effect, if any, of the marked increase in the consumption of cooked (and often burned) tomatoes is also unclear, as is the effect of the documented decline...." Here again the phrase "and often burned" simply is not clear, nor is it documented. From my following of the scientific research in the field of processing, storage and handling of tomato products, I am not aware that they are often burned. As stated, this particular sentence again does not have the scientific clarity and credibility I would associate with a National Academy of Sciences publication.

On an overall basis, I consider the publication developed by the National Academy of Sciences entitled, *Toward Healthful Diets* much more meaningful and useful in connection with considering the relationship of diet to health than the present

document. I recognize that we had a group of committee members and staff who came to different conclusions with the present publication. In retrospect, the publication would have been materially improved in my opinion if consultation and input from the Food and Nutrition Board had been obtained and if committees of the Board such as the Food Protection Committee and their staffs could have assisted in the review of this publication. I do not have first-hand knowledge that they were not consulted, but I would be quite surprised if statements such as those that I have referred to as well as some of the conclusions in the summary would not have been recommended for alteration.

Comments on the *Diet, Nutrition, and Cancer Report* With Supplementary Comments on Related Reports

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I have reviewed with great care the very lengthy, verbose and often contradictory tome on *Diet, Nutrition, and Cancer*, prepared by a Committee on Diet, Nutrition, and Cancer, Assembly of Life Sciences, National Research Council.

This is one of the most unscientific reports I have ever read.

Authors admit (1) in the third paragraph of Chapter 1 that, "Unfortunately, it is not yet possible to make firm scientific pronouncements about the association between diet and cancer"; (2) in the third paragraph on page 2-5 that "In fact, a bewildering array of agents and treatments have been shown to influence the incidence of cancer in animals"; (3) in the second paragraph on page 3-7 that "much of the research on the relationship between diet and cancer has been based on hypotheses" (hypotheses are preconceived notions of the way the situation *may* be); in the second paragraph on page 3-8 that "epidemiological studies present some special difficulties. To begin with, such research is limited by its need to rely primarily on observational data, because it is difficult and often unethical to conduct experiments (i.e., intervention studies) on groups of humans. Furthermore, observational epidemiological studies are open to errors or bias. For example, persons...may not comprise truly representative groups of subjects.... Furthermore, it is often difficult to determine the specific dietary (or nondietary — my comment) constituents to which study participants have been *exposed*" (italics supplied); and, in the fourth paragraph on page 3-8, "Another difficulty inherent in epidemiological studies of diet and cancer is the long latency period between first exposure (whatever *that* is — my comment) and overt manifestation of illness.... This delayed onset makes it necessary for investigators to learn what the subject ate...long before the study began" (How many people can remember what they ate 20-30 years ago and what carcinogens they may have encountered during that period that would have nothing whatever to do

with diet? — my comment).

In spite of all of these cautions concerning the unreliability of the studies they reviewed, the authors state in the second paragraph on page 3-9, "Therefore, the results of epidemiological studies may often be assumed to represent conservative estimates of the true risk for cancer associated with the dietary *exposures* of interest" (italics supplied).

What this says to me is that we, the Committee, have the preconceived idea that diet is the cause of cancer. If the facts don't prove our contention, it is because there are too many variables.

True scientific nutrition experimentation requires that all variables in the control diet and the experimental diet be rigidly controlled to the same level except for the factor under investigation. The level of actual ingestion of this factor must be known.

As indicated by the Committee, in no instance has it been possible to control the "bewildering array of agents and treatments (which) have been shown to influence the incidence of cancer in animals" (including humans — my comment). Even the level of consumption of the particular food which the Committee chooses to term "exposure" is based in some instances not on known intake, but upon "disappearance" at the national or group level.

Then on page 5-17 the Committee boldly states, "There is *some* epidemiological evidence for an association between dietary fat and cancer at a number of sites.... In various populations, both the higher incidence of and mortality from breast cancer have been *shown to correlate strongly* with higher per capita fat intake" (italics supplied).

Now in spite of all above, the Committee goes on as if the epidemiological association observed between dietary fat and cancer has proved the notion to be entirely correct. The Committee chooses one variable among the "bewildering array," and because the one chosen correlates, that proves the Committee is right. On page A-10, the Committee states, "Given the multitude of other chemicals present in the diet, it is *notable* that epidemiological studies have *found* significant relationships between the occurrence of cancer and *estimated* intakes of such nutrients as *fat*, vitamins A and C, or protein" (italics supplied).

This is not *notable*. Rather, it is *incredible*, meaning that the entire "pitch" lacks credibility, not because of the studies, but because of the positive statements made by this Committee, knowing and admitting the unreliability of the methods used.

I repeat. This is *not scientific* reporting at all.

The authors are so intent on "proving" their contentions that they have contradicted many of their own statements.

On page 1-4, fourth paragraph, the Committee states, "it is not possible to identify specific components of fat *as being clearly responsible* for the observed effects, although total fat and *saturated* fat have been associated most frequently" (italics supplied). On page 5-5, last paragraph, "422 and 424 men were fed a conventional diet or one containing high levels of polyunsaturated fat (to lower cholesterol levels), respectively. Incidence of cancer deaths in the groups on the experimental diet was higher. In a similar experiment conducted in Finland, Miettinen et al. (1972) also found more carcinomas in the test group."

On page 5-8, third paragraph, the Committee states, "This observation is not compatible with the mechanisms normally proposed for the carcinogenic effect of dietary lipids."

In experiments with animals, the Committee states, in the last paragraph on page 5-12, "it was apparent that the yield of tumors per group was also influenced by the level of essential fatty acid — linoleic used — present in the fat. Groups of rats fed tallow or coconut oil...had significantly fewer tumors...."

In the second paragraph on page 5-15, "When beef fat was fed to rats, the number of tumors induced was the same.... Feeding of polyunsaturated fat (corn oil) before and after induction resulted in a 100% tumor yield.... The authors concluded that unsaturated fats increase the tumor yield more effectively than do saturated fats...."

At the bottom of page 5-17, "total fat and saturated fat have been associated most frequently."

In the fifth paragraph on page 5-19, "Diets containing 20% polyunsaturated fat enhance tumorigenesis more effectively than saturated fat...."

Now the statements are becoming absolutely positive. No true scientist would dare make such statements from this type of evidence.

On page 5-21, "Data from studies in animals suggest that when total fat intake is low, polyunsaturated fats are more effective than saturated fats in enhancing tumorigenesis...."

Finally, under the heading "Contribution of Diet to Overall Risk of Cancer" (p. 8-10), the authors begin by stating that "Higginson and Muir (1979)...believed that precise proportions of cancer incidence could not be attributed to diet, but they did include dietary factors among the general heading 'Lifestyle.'"

Later, in the third paragraph on page 18-11, the Committee states that "Jain et al. (1980) estimated that 41% of the risk for males and 44% of the risk for females was attributable to saturated fat intake." They go on to say that "Both of these estimates are probably too low...."

How does it happen that the Eskimos who consume largely saturated blubber and unsaturated fish oils, proteins, and practically no vegetables, haven't all died of cancer long ago? Or the Masais who consume a diet high in blood and very high-fat milk? Were these populations included in the survey?

The second paragraph on page A-8 appears to state the situation quite clearly. In this, the authors say that "It is not clear whether all the changes in the food supply have increased, decreased, or had no effect on the incidence of cancer. Overall U.S. cancer rates at most sites other than lung and stomach have remained relatively stable for several decades."

Lung cancer, says the Committee, has increased due to cigarette smoking, while stomach cancer has decreased. The authors have discussed a multitude of different suggestions as to this decrease. Some say less salt; others, less smoked foods, less nitrate, flour from different cereals, more milk drinking, or more citrus fruits; and two groups, Acheson and Doll (1964) and Wynder et al. (1963), found no association of diet with gastric cancer.

Nevertheless, the Committee states, "Protective factors may include consumption of milk, raw and green vegetables, especially lettuce, and other food containing vitamin C. How can the Committee possibly arrive at such a definite conclusion based upon the wide variety of guesses as to the cause?"

In contrast to its virtual certainty that fat causes cancer, the Committee spent some time on the possibility that selenium may have beneficial effects. This research is much more

plausible because (1) selenium is a required nutrient, (2) selenium levels in soil, and therefore in foods, have varied greatly in different parts of the world, (3) selenium is known to be an integral part of an enzyme which destroys hydrogen peroxide, and (4) hydrogen peroxide is now known to be formed in the body during normal metabolism and, unless it is destroyed, this hydrogen peroxide can result in the formation of highly reactive free radicals capable of breaking down the normal defense system against disease and other insults, possibly including cancer.

Selenium action is closely associated with that of vitamin E. Even though there is excellent evidence in animals for an increased need for vitamin E as the level of dietary polyunsaturated fatty acids increases, the Committee chose to ignore vitamin E almost entirely, and at no time did it indicate that the possible detrimental effects of fat may not be due to the fat, but rather to a deficiency of vitamin E and/or selenium in the diets of those consuming the fats.

The Committee mentions New Zealand on several occasions (pp. 2-5 and 2-7). The Committee states that "the incidence of both cancers (large intestine and breast) in an industrialized country like Czechoslovakia is not nearly as high as it is in New Zealand, which has one of the highest rates for both cancers despite its lack of the oil and coal required for chemical and manufacturing industries and its dependence on dairy and agricultural products for income."

The Committee doesn't mention that New Zealand, until 1958, was one of the most selenium-deficient areas of the world. Now the diets of all of New Zealand's domestic animals are supplemented with nutritional levels of selenium. An as yet unpublished paper showing an association between (a) decreases in death rates from cancer and other diseases in the United States and (b) time intervals in which increasing levels of selenium were present in the diet is available from Joseph E. Bittner, 33 Crest Circle, Yakima, Washington 98908.

Comments on Related Reports

First, I shall comment upon a paper by Doll and Peto entitled *The Causes of Cancer: Quantitative Estimates of Avoidable Risks of Cancer in the United States Today*. It was published in the Journal of the National Cancer Institute, Volume 66, pages 1193 to 1308 (1981).

These authors are much more cautious than are the authors of *Diet, Nutrition, and Cancer*. They state that "Diet is a chronic source of both frustration and excitement to epidemiologists." However, they also state, "because this science of diet and cancer is immature, we shall adopt, as a framework of paragraph headings within which to review current and future research directions, the list of mechanisms in table 12" (italics supplied).

Table 12 lists "Some currently promising hypothetical or actual ways or means whereby diet may affect the incidence of cancer" (italics supplied). These are:

1. Ingestion of powerful, direct-acting carcinogens or their precursors. (This certainly is true.)
2. Factors affecting the formation of carcinogens in the body: nitrites, etc. may alter bacterial flora of the intestines so that they produce more or less carcinogens (possibly from bile salts or other products).
3. Factors affecting transport, activation or deactivation of carcinogens: (a) altering concentration in or rate of passage of feces (fiber), (b) altering transport of carcinogens to the stem

cells (alcohol, fat), (c) induction or inhibition of enzymes (such as cytochrome-p-450-dependent hydroxylases) which may convert compounds such as aflatoxin B₁ into carcinogens or may detoxify certain ingested carcinogens, and (d) deactivation or prevention of free radicals, etc. (by use of selenium, vitamin E, β -carotene and antioxidants).

4. Factors affecting "promotion" of cancer cells already initiated: for example, this appears to occur in vitamin A deficiency.

5. Overnutrition: adipose-tissue-derived estrogens.

They state that "laboratory research and observational epidemiologic research should be seen as generation of about a dozen most promising hypotheses" (italics supplied).

They also state that "it may be impossible to find two reasonably similar populations whose diet has differed for decades only in the one factor of interest."

This statement demonstrates that these workers understand the necessity of the true, scientific approach, and know that this has not been possible up to now.

They finally state that "Diet may prove to have a material effect on the incidence of cancers of the breast and pancreas and, perhaps through the anti-carcinogenic effects of various micronutrients (vitamins A, C, E, selenium — my comment), on the incidence of cancers in many other tissues. If this is so, it may be possible to reduce U.S. cancer death rates by as much as 35% ('guestimated' as stomach and large bowel, 90%; endometrium, gall bladder, pancreas, and breast, 50%; lung, larynx, bladder, cervix, mouth, pharynx and esophagus, 20%; other types of cancer 10%)... The degree of uncertainty of the total should be obvious, and we make no pretense of its reliability" (italics supplied).

This type of reporting is an excellent assessment of the situation. It is far different from that of the Committee on *Diet, Nutrition, and Cancer*, which makes every pretense of already having plenty of facts to allow very definite statements as to what people should and should not eat.

One notes that the Committee on *Diet, Nutrition, and Cancer* included several epidemiologists, several microbiologists, and many experts on cancer, but only three of the eighteen members were nutritionists in very specialized areas of nutrition. It is a general feeling these days that "nutrition is much too important to be left to the nutritionists." Almost everyone, including Dr. Linus Pauling (a theoretical physicist), now fancies himself a nutritionist, whether he has the years of basic training required to understand the entire science of nutrition or not.

In marked contrast to the report of the Committee on *Diet, Nutrition, and Cancer*, the National Academy of Sciences' Food and Nutrition Board, which is chaired by a nutritionist and which includes a preponderance of highly reputed nutritionists, also prepared a report in 1980 entitled *Toward Healthful Diets*. This Committee summarized the situation regarding diet and cancer as follows: "Clearly, a nutritious diet providing adequate amounts of all nutrients and the proper energy content to achieve desirable weight is important for general health and for vigorous defense mechanisms against cancer as well as other diseases" (italics supplied). This is the true statement of positive nutrition.

Some General Comments

Those not trained in nutrition tend to become polarized with "mystic" ideas concerning detrimental effects of this or that

element of food. Certainly, some people eat bizarre diets — and suffer.

Epidemiology is an important area of investigation. In cases such as that under consideration here, the results may provide “leads” (clues) for those working on the basic mechanisms of the disease. Epidemiological findings can be used to eliminate certain possibilities. For example, consider the finding that the average selenium concentration in human blood in Rapid City, South Dakota, is 0.26 ppm, and the mortality from cancer in that city is about 90 per 100,000 population/year. The average selenium concentration in human blood in Lima, Ohio, is about 0.1 ppm, and the cancer mortality is about 190 per 100,000 population. There are vastly too many variables to say that a higher selenium level protects against cancer (although the data quoted may be a clue that it does). But these data and other similar data taken at the same time do strongly indicate that within this range of blood levels selenium *does not cause* cancer.

Many, many people consume too many calories, both as carbohydrates (which are readily converted to excess fat) and as fat itself, both of which cause obesity. If the Committee on *Diet, Nutrition, and Cancer* means to be speaking to these people about the dangers of being over-weight, it should make this clear. But it does not. It indicates in the news release that all persons should eat less fatty cuts of meat and less whole-milk dairy products and should eat very little meat that is salt-cured, salt-pickled, or smoked — advice bordering on nutritional quackery.

Unfortunately, epidemiologists are not always content to use their data simply as negative evidence or as clues for basic research. Too often, they immediately cry “wolf! wolf!” when their data only *suggest* that a wolf may be in the vicinity.

One tremendous disservice to society in the United States and around the world was initiated and promulgated by epidemiologists. This was the claim that because the United States had the highest incidence of coronary heart disease and also the highest intake of dietary cholesterol, this intake of cholesterol was the major cause of coronary heart disease. Every *controlled* experiment conducted in an attempt to verify this hypothesis (which has now been repeated so often as to become a fact in the minds of almost everyone) only demonstrated that the hypothesis was wrong. Millions and millions of dollars were spent trying to prove this epidemiological notion which now is known to have no truth. Since that has fallen through, it appears that epidemiology now has turned to “diet and cancer.” If the millions spent trying to prove the cholesterol bug-a-boo had been spent on studies of the enzymes responsible for elevated blood cholesterol levels and the causes of the intimal lesions, etc. we might already have saved many, many lives that have been lost to coronary heart disease.

Nutrition is the process of furnishing all of the cells inside the animal body with all of the nutrients in proper amounts and proportions to each other for optimum functioning of the many metabolic processes involved in growth, maintenance, work, production, reproduction, and optimum formation of the body's defense mechanisms against disease and cancer.

Man is an omnivorous animal. His tooth structure, his digestive system and his entire metabolism are suited to obtaining the needed nutritional elements from both vegetable and animal sources.

We now have discovered, isolated and identified all of the

important nutritional elements. We have determined the nutritional requirements of man and of many domestic animals. We know how much of each of these nutrients is present in most of our foods. The Food and Nutrition Board of the National Research Council — National Academy of Sciences has published updated reports of these requirements. They are no mystery. All evidence points to the fact that the most healthful diets are those that follow the recommendations of this Food and Nutrition Board.

Unfortunately, many people, particularly in the United States and some other nations, over-consume food and become obese. These people are in trouble from many directions. Perhaps the report on *Diet, Nutrition, and Cancer* is meant to be aimed only at these obese people. But it reads as if it were meant to frighten everyone to death.

I repeat, it is a very poor example of scientific reporting, and should not be allowed to get out to the general public.

Comments on *Diet, Nutrition, and Cancer*

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The Assembly of Life Sciences of the National Research Council assumed responsibility for preparation of this report with two primary purposes. The first was to advise the National Cancer Institute and the public whether or not dietary habits influence the risk of developing cancer. The second purpose was to identify for the National Cancer Institute and the scientific community “useful directions research might take to increase knowledge in this area.” The current report is addressed to the first of these two objectives and provides a background for the second.

The committee which was appointed to undertake this task has been appropriately constituted and has representation from scientific disciplines which are most pertinent for the evolution of a broadening base of understanding of the nature of neoplastic cell growth and the origin and control of cancer as a disease. The report is timely, since over-all cancer death rates in the United States are unchanging. With the demonstration of decreasing mortality from heart disease and the resultant increase in life expectancy, it must therefore be anticipated that the proportion of deaths due to cancer will increase in the future.

As is true of most fields of biomedical research, the relative and pertinent literature concerning neoplasia and cancer in humans and experimental animals is enormous. The committee has reviewed this large body of knowledge in a workman-like manner and has afforded a potentially useful background document for scientists in the field. The report should also be useful as a digest of current knowledge for public information and for guidance of administrators in public health programs.

It should be noted that in its approach to derivation of dietary guidelines for public information the committee designates them for *interim* use but considers them to be wholly consistent with more general good nutritional princi-

ples and practices. It was recognized that much of the support for the guidelines derives from epidemiologic studies in contrast to laboratory investigations. The report states very clearly that such information does not constitute proof of etiology for specific forms of cancer but more importantly affords leads for definitive investigative efforts. It indicates that epidemiologic evidence is most soundly based when it involves the use of cohorts or case controls. These considerations are integral to an understanding and acceptance of this report. They account for variances in scientific opinions and the recorded guidelines for public dietary change between this report and a prior report also emanating from the National Research Council and entitled *Toward Healthful Diets*.

The dietary guidelines of most significance for individuals are those which call for a reduced and controlled consumption of fat and moderation in intake of alcoholic beverages. These have pertinence also for the control of other common disorders such as diseases of the heart and liver. They are not, therefore, new proposals, but are noteworthy in that they may also be helpful in limiting the occurrence of cancers at several organ sites.

It is not a new proposal either that all of us should include fruits, vegetables, and whole grain cereals in our daily diets. What is new is that these practices may reduce the occurrence of cancers at various sites according to the committee.

More newsworthy may be the recommendation that we should limit our consumption of salt-cured and smoked foods.

The report also carries three recommendations which are directed more to the scientific community, food industry, and regulatory agencies than to the public. These are: (1) Contamination of foods with carcinogens from any source should be carefully controlled, (2) Intentional additives should be evaluated for carcinogenic activity before approval for use in foods, (3) There should be enhanced efforts to identify mutagenic substances and to remove these from foods.

In my opinion, the report should be useful and helpful. It affords a basis for ongoing review of scientific advances in the field with transmission of updated information to the public for guidance in food practices best adapted for avoidance of a major cause of disability and death in this country.

Comments on *Diet, Nutrition, and Cancer*

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In recent years the American public has become more concerned with its dietary habits and practices in fear of becoming ill than ever before in our history. A number of responses have been made to this concern.

In 1980, the National Academy of Sciences' permanent Food and Nutrition Board (FNB) published a series of dietary guidelines for the American public which, if followed, would ensure, to the best of present knowledge, optimal nutritional status. The report also dealt with the subject of dietary habits and practices and how they may influence the onset of various

diseases, with particular emphasis on the two major leading causes of mortality in our country, heart disease and cancer of various organs.

The FNB expressed its concern over the public's excessive hopes and fears about many current attitudes toward diet and foodstuffs and rightfully pointed out that nutrition is not a panacea. For the healthy American, the FNB suggested, quite wisely, that he/she select a nutritionally adequate diet from the foods available, consuming each day a serving from the basic four. Most good high school, junior high school, and kindergarden teachers have been teaching their students this good and wise principle for a great many years.

The National Academy of Sciences in 1980 convened another Committee, one on Diet, Nutrition, and Cancer (CDNC). At first glance, one would think that the second committee was convened to satisfy those who perhaps were unhappy with the recommendations of the first committee. Nonetheless, after much deliberation and work, as would appear from the size and weight of the report, this latest committee agreed with much of what the FNB recommended, but made some additional recommendations and suggested other guidelines based on data which are still highly controversial and are being researched.

Two other so-called guidelines suggested by the CDNC are not applicable to the American public at present, and one wonders whether they should have been addressed solely to agencies funding research in cancer cause and cancer prevention. For example, the CDNC suggested that it may be useful to tell members of the American public to be *more* aware of carcinogens in their diet and to be on the alert to identify chemicals or agents that may cause cancer. Absurd! The American public is needlessly bombarded constantly about the hazards of living, let alone by eating, by the news media. The CDNC also suggested that the American public lower its consumption of fat from 40% to 30% of total calories, a reasonable suggestion and one with which no one would argue. However, whether such a reduction will bring about any change in cancer rates is very questionable, even to those on the committee.

The FNB suggested that we lower our intake of fat and other nonnutritive, empty-calorie foods (e.g., sweet drinks) as a way of decreasing total energy intake when necessary or advisable, as in losing weight; this is also a reasonable suggestion. The FNB, however, does not equate high fat diets or diets which provide 30 or 40% of the total calories as fat with increased cancer rates or increased risk of cancer of the breast or colon, as does the CDNC.

The CDNC suggestion that reducing one's intake of dietary fat from 40 to 30% of total calories will decrease one's risk of cancer is without support, unjustified and unwise. There is no evidence to suggest that lowering one's fat intake from 40 to 30% of the total calories will have any effect on cancer rates. Indeed, studies in both animals and humans suggest that significant changes in the quality and quantity of dietary fat may *increase* the risk of cancer of the colon as well as of the breast.

The CDNC also makes some reference to smoked meats and nitrates as causes of cancer of the stomach and esophagus. Yet, the same committee admits, correctly, that the incidence of these two cancers has been declining in the face of an increased intake of smoked meats and nitrates. The real epidemic in cancer is probably in lung cancer which may or

may not have anything to do with diet or nutrition.

One has to wonder what the National Academy of Sciences had in mind when it convened this latest committee on Diet, Nutrition, and Cancer. The FNB and the CDNC both recognize that people are living longer, are more healthy and, more and more, are "dropping dead" as Oliver Wendell Holmes' "One-Hoss Shay" did. We should heed the words of Sir Robert Hutchison (1871-1960), as perhaps the FNB did. He wrote in the *Newcastle Medical Journal*, volume 12, 1932: "One swears by whole meal bread, one by sour milk; vegetarianism is the only road to salvation of some, others insist not only on vegetables alone, but on eating those raw. At one time the only thing that matters is calories; at another time they are crazy about vitamins or about roughage. Scientific truth may be put quite briefly; eat moderately, having an ordinary mixed diet and don't worry."

I must add that while the only sensible advice we may give the healthy public is that already given by the FNB, the medical profession does have a great deal of knowledge about the use of diet and nutrition in approaching the *patient* who will benefit by dietary modifications. "When it is not necessary to change, it is necessary not to change" (Lucius Cary, Falkland, Viscount, 1610-1643: Died in Battle).

Comments on the National Academy of Sciences Report, *Diet, Nutrition, and Cancer*

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I have been asked by CAST (Council for Agricultural Science and Technology) to comment on the recent National Academy of Sciences report entitled *Diet, Nutrition, and Cancer*. I was nominated by the Rural Sociological Society, of which I am a member. My statement is my own and does not necessarily reflect the views of CAST or the Rural Sociological Society.

My expertise is in food behavior and social psychology. I shall not comment on the technical merits of the report or the plausibility of its conclusions, but rather I shall provide some observations on the sociological implications of the report. My approach will be to offer short summaries. To save space, I shall not provide references to document my points.

It is my judgment that this report *per se* will have little effect on the food behavior of the American public. Consumers are not likely to reduce their consumption of meat, salted or smoked cured foods, dairy products, etc. as feared by the agricultural industry or as promoted by the authors of this report. I base my conclusion on the following observations:

1. Studies have shown that the public is confused about the linkages between nutrition, diet, and health. The level of nutritional knowledge among consumers is not particularly high, and many find nutrition and diet information to be too technical or unclear to understand. When statements about links between food and health are made, the public

has little basis to evaluate these claims. Further, as counterclaims appear, the public often becomes even more confused. Studies have shown that consumers react by dismissing or ignoring the statements, by assigning little credibility to those who made the claims, or by becoming fatalistic (e.g., "it seems like they say that everything you eat can give you cancer"). Since the evidence presented in this report has been labeled "incomplete" and the guidelines considered "interim," counterclaims are easy to develop, and the public most likely will ignore the advice the report offers.

2. Even if the evidence was substantial, change would be very slow in coming. Lifestyles are very difficult to alter. Studies of food behavior, cigarette smoking, preventive health behavior, etc. have consistently shown that it is difficult to alter behavior. These studies have shown that people will change their behavior only when they are convinced that harm will come to them if they don't change what they have been doing. A recent study done by my colleagues and myself has shown that changes in diet are most likely to occur primarily when a person has had a health problem or a weight problem. It is very unlikely that this report will have a strong enough impact to alter people's beliefs to the point they are willing to change their lifestyle.

3. A third reason for not expecting much public response to this report is that some of the recommendations are not easy to implement. How, for example, does a consumer reduce the proportion of calories provided by fats in his or her diet from 40 to 30 percent? This suggestion assumes the consumer knows how to define fats, how to calculate what proportion of the calories dietary fats constitute, and how to reduce fat consumption to 30 percent of the calories. Studies have consistently shown that preventive health behavior occurs only if the person clearly sees the benefits, knows how to change his or her behavior, and believes the changes are worth it. The advice on fat reduction, in its present form, is likely to be too complex to encourage change.

4. Finally, all of these recommendations have been made in the past, albeit in other contexts. Reduction of fats has been suggested as a way to reduce the risk of heart disease, caution has been raised in the past concerning salt-cured and smoked foods, and the suggestions about fruits, vegetables, whole-grain cereals and alcohol are standard nutritional and health advice. In short, most consumers have heard these suggestions before. The context may be different, but the advice is basically the same. Thus the familiarity of the message is also likely to dampen consumer response.

Several things would have to occur before it is likely that there would be a significant change in diet as suggested by this report. First the evidence would have to be much more persuasive than it is now. Specifics of diet change would have to be spelled out, such as comparisons of actual diets before and after, to show consumers what they would need to do to follow the guidelines. Consumers would have to be convinced that diet and cancer are really linked, that they are susceptible to cancer because of what they eat, and that if they change how they eat they will truly reduce the risk of getting cancer. I suggest that it will be some time before this scenario is likely to be realized.

Comments on the National Academy of Sciences Report *Diet, Nutrition, and Cancer*

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These comments on the report, *Diet, Nutrition, and Cancer*, recently released by the National Academy of Sciences (NAS), will be restricted to the report's first and third "interim dietary guidelines," and to the subject of dietary recommendations for cancer prevention in general.

Dietary Fat and Cancer

In its first interim guideline, the NAS report states that there is sufficient evidence that high fat consumption is linked to increased incidence of breast and colon cancer (and that low fat intake is associated with lower incidences of these cancers) to justify recommending a substantial decrease in the fat content of the American diet. I disagree with this conclusion. While some evidence indicates that fat intake and the risk of certain cancers may be linked, there is also considerable evidence that does not support this conclusion.

In an international comparison, Enig et al. (1978) did not find a consistent relationship between dietary fat levels and breast cancer rates. For example, Greece was reported to have less than one-fourth of the breast cancer rate of Israel, yet the total fat intakes in these two countries are essentially the same. Spain had one-third the breast cancer rate of France and Italy, yet the total dietary fat intake in Spain is greater than in the other two countries.

Lawson et al. (1956) were unable to find any authenticated cases of breast cancer in Eskimos, yet this population consumed a diet in which approximately 50 percent of the calories were derived from fat. This is a higher-fat diet than that of the United States, where breast cancer is relatively common.

The National Cancer Institute (1977) found that native Americans (American Indians) in the Southwest had high animal fat intakes and low breast cancer rates.

In a number of studies, high dietary fat intake was more closely correlated with breast cancer rate than any other nutritional factor. It is possible, however, that this association may not reflect a cause-and-effect relationship. Some third factor, associated with both breast cancer risk and dietary fat intake, might be responsible for the association. Economic status is one possible third factor. The findings of Armstrong et al. (1975) indicated that Gross National Product (GNP) is more strongly associated with breast cancer risk than any nutritional factor, including dietary fat. In this study, GNP was also highly correlated with dietary fat. It is possible, therefore, that the association between fat intake and breast cancer in this and other studies is spurious, and really reflects an association of breast cancer with economic variables.

Studies of the Mormon population in the United States also suggest that other factors may be more important than dietary fat intake in determining the risk of both breast cancer and colon cancer. Mormons have substantially lower rates of cancer at both of these sites than do members of the general

U.S. population, yet their total fat intake is similar to that of other Americans (Lyon et al., 1978).

Some international and regional comparisons of colon cancer rates have shown an association with total dietary fat intake. Others have not. For example, in India, cancers of the colon and rectum are more common in the southern part of the country than in the northern part, yet dietary fat intake is higher in the north (Malhatra, 1967). In Australia, recent increases in colon and rectal cancer were not associated with changes in total fat intake (McMichael, 1979). And, as the NAS report mentioned, a study comparing a low colon cancer incidence population in Finland with a high incidence group of people in Denmark disclosed no significant difference in total fat consumption (MacLennan et al., 1978).

Several case-control studies (in which the dietary habits of colon cancer patients were compared with those of otherwise similar individuals who did not have the disease) have also failed to show a relationship between total fat intake and colon cancer risk (Wynder et al., 1967; Wynder et al., 1969; Haenszel et al., 1980; Higginson, 1966).

The evidence associating total dietary fat intake with cancer of the prostate and cancer of the uterus is even less consistent than that relating dietary fat intake to breast and colon cancer. Also, dietary fat consumption is highly correlated with consumption of other nutrients found in the same foods, and with nonnutritional factors such as socioeconomic status. In light of the inconsistencies in the data, and the difficulty of directly associating dietary fat intake with cancer risk in humans, I do not believe that a recommendation for a reduction in fat consumption is warranted.

Salt-Cured, Salt-Pickled, and Smoked Foods

The evidence backing up the NAS committee's recommendation that Americans decrease their intake of salt-cured, salt-pickled, and smoked foods is very weak.

Some evidence associates consumption of large amounts of these foods with relatively high rates of esophageal and stomach cancer in parts of the world other than the United States. This evidence, however, applies to populations with dietary habits quite different from those of Americans. I do not believe that it justifies a recommendation that Americans further decrease our already-limited intakes of those foods.

The epidemiology of esophageal cancer is complex and poorly understood. Current evidence indicates that the foods singled out in this guideline may influence esophageal cancer risk in some parts of Asia and Africa, as the NAS report states (pp. 17-1 to 17-3). In Western countries, however, as the report also states, the pattern seems different, with cigarette smoking and alcohol consumption most often implicated as risk factors for esophageal cancer. It would seem more appropriate for guidelines aimed at reduction of the U.S. esophageal cancer rate to focus on these factors, rather than smoked, cured, and pickled foods.

The incidence of stomach cancer in the United States declined substantially between the 1940s and the 1970s, and since then has remained stable at one of the lowest rates in the world (American Council on Science and Health, 1980). The cause of this decline is unknown, but it may be related to the increased use of refrigeration to preserve food, and the decreased use of salting, pickling, and smoking as food preservation methods.

As the NAS report points out, stomach cancer rates in certain parts of the world where one or more of these preservation methods are still common are higher than that of the United States. This does not mean, however, that further decreasing our intake of foods preserved in these ways would have any additional impact on our already remarkably low stomach cancer rate.

Dietary Guidelines for Cancer Prevention

Our understanding of the relationship of diet and nutrition to cancer is in a very early stage of development. The scientific evidence in this area is a mass of complex, confusing, and often contradictory information. The NAS committee was specifically charged to make dietary recommendations that could be used in the formulation of public policy. Its members may have felt obligated to issue some sort of guidelines, even though, as the report states, the data base is not yet adequate for firm recommendations.

It appears to me that the NAS committee looked at the very preliminary, conflicting maze of data on diet and cancer and basically came to the conclusion that, well, it wouldn't hurt for people to change their diets, and it just might help.

That isn't good enough, however. Public health professionals should not make recommendations until they have firm evidence that the lifestyle changes they advocate will really improve health or prevent disease. In the case of diet and cancer, the evidence simply isn't adequate. The study of this subject is in its infancy. At this time, we should be emphasizing further research in this field, rather than promoting premature recommendations for dietary change.

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Comments on the Chapter on Lipids in the *Diet, Nutrition, and Cancer* Report From the National Research Council

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The report represents, for the most part, a thorough examination of the literature with regard to the possible

relations between diet and cancer. This represents a good starting point for experiments that can be focused on some areas where a causal relationship between a dietary component and cancer appears to exist. This report does not contain the hard data necessary to make recommendations to members of the general public on the type of diet they should eat.

Although the epidemiological studies indicate a higher incidence of breast and colon cancer with high fat intakes, this does not establish a causal relationship. The committee did not present a single piece of evidence to show that dietary fat is a carcinogen. The experimental evidence obtained with carcinogens and high fat diets illustrates that high levels of fat in the diet, especially polyunsaturated fat, improve the effectiveness of the carcinogen. This is not surprising since most of the carcinogens used were fat soluble. Fat acts as a vehicle to solubilize and transport such carcinogens. This explains why the polyunsaturated fats were more effective than the saturated fats. The carrier or vehicle hypothesis of fat can also be used to explain the association between incidence of breast and colon cancer and high-fat diets, as found in certain epidemiology studies. A natural or unnatural carcinogen could be more effective if it was fat soluble. The report contains information that supports this notion. The epidemiological data by Gaskill *et al.* (1979) showed a direct correlation between breast cancer and fat intake for all states, but the correlation disappeared when the southern states were excluded. These data should have alerted the committee that the causative agent was not the amount of fat in the diet, but some other factor. A more logical explanation is that the warm and humid conditions of the South are conducive to the growth of microorganisms that produce carcinogens, such as mycotoxins, that are fat soluble. This reasoning is supported further by the work of Miller *et al.* (1978) who could find no evidence of a dose-response relationship between total fat consumption and breast cancer incidence in a study of 400 cases and 400 matched neighborhood controls in Canada. The colder and dryer Canadian climate may not permit the growth of the suggested carcinogen-producing organism of the South.

Since the turn of the century, fat consumption per capita has increased more than 25%. This increase has resulted from the increased consumption of vegetable oil; the quantity of animal fats has remained unchanged (Rizek, R.L., *et al.*, *J. Amer. Oil Chem. Soc.*, 51, 224. 1974). If there was a causal relationship between fat intake and the occurrence of cancer, as suggested by the authors of this report (page 5-20), then there should have been a proportional increase in the incidence and mortality rates of cancer. This is clearly not the case. As the "Executive Summary" of this report states on page 1-1, "The age-adjusted total cancer incidence and mortality rates for sites other than the respiratory tract...have as a whole remained stable during the last 30 to 40 years." There must be an explanation for this apparent discrepancy.

The recommendation by the committee to reduce the consumption of fat from 40% to 30% of total calories as a possible means of reducing the risk of cancer is unworkable, unnecessary, and unwise. First of all, most people have no means of determining what percent of their calories is made up of fat. Secondly, there is absolutely no evidence that a 10% reduction in fat calories, even if it could be easily measured, would reduce the risk of any type of cancer. If the carrier or vehicle hypothesis stated earlier should be correct, reducing the fat in the diet would have no effect. The diet would still

contain more than enough fat to solubilize and transport any natural or unnatural fat-soluble carcinogens that might find their way into the food supply. Finally, public concern is again being raised needlessly. Some individuals may even take steps to change their diets to less nutritious ones and maybe even harmful ones. This recommended reduction of fat consumption following the previously recommended avoidance of foods containing cholesterol and saturated fats will only add further confusion and fear in the public's mind about fat, a perfectly good, nutritious, and necessary part of any diet. It seems unnecessary to make recommendations before we know all the facts. It should be clear from both this report and from previous reports that making recommendations without com-

plete information is risky business. The committee members probably recalled the previous call for increased consumption of polyunsaturated fat to reduce the risk of atherosclerosis when they discussed the data in this report which indicated repeatedly that diets high in polyunsaturated fats increased the incidence of carcinogen-induced cancer in experimental animals.

If we look at the recommendations made over the years regarding diet and nutrition, at least two lessons should have been learned: (1) You don't make recommendations to the whole population to solve the ills of a few who need medical attention. (2) You don't make recommendations without having adequate data to back them up.