The surveillance of food contamination in the United Kingdom : the first report of the Steering Group on Food Surveillance.

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

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Food Surveillance Paper No. 1

LONDON
HER MAJESTY'S STATIONERY OFFICE
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This is the first of a series of papers to be published for the Ministry of Agriculture, Fisheries and Food on various aspects of food surveillance.

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SUMMARY

1. The Steering Group on Food Surveillance is an inderdepartmental expert committee whose function is to keep specific food contamination problems under review, assess the needs for analytical surveys of food, and where appropriate make arrangements for these surveys to be carried out. This Report, which is the first of a series, describes the background to the establishment of the Group; its approach to problems; and methods of operation. It also describes some of the problems which the Group has investigated, together with summaries of the results obtained and the conclusions reached.

2. The Steering Group considers all the problems referred to it, but some may be examined in depth by specially convened sub-groups. After consideration of all the relevant information, the Group may decide that no further action is needed, or that a practical survey with appropriate analytical investigation is required. For any chemical substance under consideration, the procedure adopted has been to determine the amount consumed on average using total diet studies, the amounts present in the major foods of the national diet, whether any foods showed special features with respect to the substance, whether localised areas of environmental pollution affected food, and to assess the exposure of 'at risk' groups in the population.

3. The largest section in the report is devoted to the work carried out on the heavy metal content of food. Lead, mercury and cadmium have received the most attention and detailed reports by the Working Party on the Monitoring of Foodstuffs for Heavy Metals have been published. This report summarises these findings together with some of the work which has been carried out more recently. An outline is also given of investigations into various minor incidents involving these substances in food. A major survey on arsenic in food is currently under way and some preliminary results from this study are reported. Summarised findings on the levels of copper, selenium, nickel and zinc in total diet samples are presented. The initial results of an investigation into the tin, zinc, iron, copper, manganese and nickel contents of some individual food commodities are also included. Studies of the possible effects on the trace metal content of food from the use of sewage sludge on agricultural land are also described. Of all the trace metals which may be present in sewage sludge it is concluded that the uptake of cadmium into crops, particularly vegetables, might give cause for concern in the context of food produced on sludge treated land.

4. The nitrate and nitrite content of food has aroused interest because of the possibility of an anaemic condition (methaemoglobinaemia) occurring in certain individuals and in particular in young babies and infants, and because nitrites can act as precursors in the formation of nitrosamines in certain foods. Sufficient information appeared to be available on the amounts of nitrate and nitrite present in vegetables, and studies on meat products were being carried out elsewhere. There seemed to be relatively few data on the amounts present in baby foods and on the effects of processing and storage on the amounts present in food. The preliminary results of a small survey to determine the nitrate and nitrite levels in certain foods are described.

5. An unusual finding of taint in poultry meat arising from the use of wood shavings as deep litter in poultry houses was investigated. From the information and analytical data obtained it was concluded that there was no risk to the consumer.

6. There is a small but significant usage of organic wastes in animal feeds in the UK. This is almost entirely confined to the use of dried poultry waste. It is not apparent whether any of the substances which might occur in such wastes, and this could include a wide range of chemicals which are either used as additives in poultry feeds or are contaminants in this feed, could find their way into food products from animals consuming such wastes. Of all the substances considered, it appeared that least was known about the carry-over of residues of certain drugs used in poultry husbandry from the poultry feed into the wastes. The Steering Group has recommended that a study be mounted to examine the possibility of whether such residues occur in meat when dried poultry manure is consumed by cattle as part of their rations.

7. The presence of polychlorinated biphenyl (PCB) residues in food is discussed and some results on the PCB content of fish are presented.

8. For the reasons set out in paras 100 to 103 below, a new Working Party on Pesticide Residues in Foodstuffs has been formed and will report both to the Steering Group and to the Scientific Sub-Committee of the Advisory Committee on Pesticides.

9. The work being carried out by other bodies on chemical residues in food such as nitrosamines and certain nutrients is described briefly.

10. The Steering Group is currently considering the need for further information on the presence in food of mycotoxins, antibiotics and veterinary and related products. Summaries of the background to these considerations are given.

11. The formation of a Special Survey Unit within the Food Science Division of MAFF is described. This will have the task of organising *ad hoc* food surveys of a special nature such as that described for studying the lead intake of young babies.

INTRODUCTION

12. The quality and safety of food in the United Kingdom, particularly in relation to the contamination by certain chemical residues, is constantly reviewed, assessed and where necessary investigated by programmes of monitoring, organised by the Steering Group on Food Surveillance. This report describes its major activities since its inception in 1971 with particular emphasis on chemical contaminants in food; relates these activities to programmes of work undertaken by other bodies and describes some of the priorities for the future work of the Group.

BACKGROUND

13. All food offered for sale in the UK is subject to the safety and quality controls provided by the Food and Drugs Act 1955 (England and Wales), the Food and Drugs (Scotland) Act 1956 and the Food and Drugs (Northern Ireland) Act 1958, and these provide protection against the contamination of food. Enforcement is the responsibility of Local Authorities although, of course, the food industry plays a major part in ensuring that the food reaching the customer is of a high standard and safe. The endeavours of Local Authorities and the food industry are sufficient to take care of practically all the traditional problems associated with the maintenance of the required food standards. In addition there are regulations which lay down maximum permitted levels for certain contaminants. A summary of the provisions of the Acts is in Appendix I.

14. The Food Additives and Contaminants Committee (FACC), an independent body of experts in their particular fields, advises the Minister of Agriculture, Fisheries and Food, the Secretary of State for Social Services, the Secretary of State for Scotland; for Northern Ireland, the Head of the Department of Health and Social Services on matters relating to contaminants, additives and similar substances which are or may be present in food or used in its preparation. The FACC refers questions of the safety-in-use of food additives to the Toxicity Sub-Committee (TSC) of the Committee on Medical Aspects of Chemicals in Food and the Environment (COMA) under the auspices of the Department of Health and Social Security. The Toxicity Sub-Committee may, where appropriate, seek advice from other specialist bodies (e.g., the Carcinogenesis Sub-Committee) also coming under COMA. The FACC recently reviewed the Lead in Food Regulations 1961, as amended, and its report, which recommended reductions in some limits, was published in December 1975. The FACC and TSC are at present considering evidence for a review of the Arsenic in Food Regulations 1959 (as amended), and are reviewing the levels of nitrites and nitrates permitted in the Preservatives in Food Regulations 1975 for use in cured meats and certain cheeses.

15. In the case of animal products, the consumer is also indirectly protected by provisions concerning animal feedingstuffs. The basic legislation in this field is Part IV of the Agriculture Act 1970, and the Medicines Act 1968. Regulations made under the first of these Acts control the use of certain non-medicinal additives in feedingstuffs, set limits for certain undesirable substances and products and provide general safeguards as to the safety, quality and wholesomeness of the feed. The Medicines Act, and Regulations made under it, similarly provide safeguards for medicated feedingstuffs by applying a licensing system for medicinal products which are intended for incorporation into feeds and safety controls over the labelling and marketing of these feeds.

16. The manufacture, sale and supply of veterinary medicinal products in the UK are controlled through a licensing system under the Medicines Act 1968. Medicinal products are assessed against three criteria laid down in the

Act: safety, quality and efficacy. The former embraces safety of produce from treated animals for consumers, and in assessing the acceptability of a medicinal product for licence, account is taken of the possibility of residues and their effect on the consumer.

17. In recent years incidents were reported in which food had been affected in circumstances not traditionally encountered by enforcement authorities. Examples were the presence of radioactive substances, of pesticides, and of certain heavy metals in food. The main characteristic of these incidents was their association with environmental pollution rather than with the traditional aspects of food contamination, e.g. contamination with micro-organisms during the manufacture, handling and storage of food. Other factors were involved such as new agricultural practices, but of particular importance was the development of improved methods of analysis of chemical residues and of further information on the health risk of certain contaminants. When food has been accidentally contaminated by chemicals, Government has quickly investigated and where necessary taken action to ensure that there is no risk to the public. In the case of radioactive substances in food, special measures involved new legislation, the Radioactive Substances Act 1960, and the setting up of a centre by the Agricultural Research Council, the Letcombe Laboratory, to study the problem. In other cases, such as for pesticides and for heavy metals, appropriate measures could be implemented through existing machinery within Government departments and their associated laboratories, and by Food and Drugs Authorities. So far as the Ministry of Agriculture, Fisheries and Food is concerned, various surveys, investigations and monitoring activities into incidents of food contamination grew up largely on an *ad hoc* basis and a variety of committees have been established to deal with particular problems. The more important of these committees are listed in Appendix III. As problems arose, it became apparent that an organisation was required which had general responsibility for the co-ordination, planning and overview of the Ministry's food monitoring activities. Consequently in 1971 the formation of an inter-departmental standing committee called the Steering Group on Food Surveillance was announced(1).

THE SCOPE OF THE GROUP'S WORK

18. The activities of the committee have so far been primarily confined to the surveillance of chemical residues; matters related to the presence of microbial or of radioactive material in food are largely the concern of other bodies. The essential responsibility of the Steering Group is to maintain a close watch for the presence in food of chemical residues where these are relevant to the safety and wholesomeness of food, and where necessary organise investigations. The findings of the Steering Group are submitted to the expert committees (FACC and TSC) who advise Ministers on any action that might be needed.

19. All problems are referred to the Steering Group but particular problems requiring examination in depth are first referred to specially convened panels or Working Parties which gather information from all the relevant sources

and report back to the Steering Group. Such reports may recommend that no further action is required by the Steering Group; that the problem is receiving sufficient attention from enforcement authorities or other bodies; or may recommend an analytical survey or other course of action in order to provide more data with which to assess the extent of any potential hazard.

20. Since its formation, the Steering Group has considered a variety of problems but a few problems of food contamination have been dealt with elsewhere, and on these the Steering Group has only maintained a watching brief. For example a special project was organised by this Ministry to look into the question of nitrosamines in food. The results of those studies will be reported elsewhere. Similarly the possible occurrence of pesticide residues in food as well as the possible contamination of meat by antibiotic residues were receiving attention before the formation of the Steering Group and are only referred to briefly in this report.

21. An essential feature of the work of the Steering Group is to organise food surveillance for those contaminants which:

(a) are present in food in very low amounts;

(b) require specialised analytical techniques for their detection, and for which there is little or no information available of their distribution throughout the food chain.

Separate mechanisms exist for dealing with the very occasional accidental contamination of food which usually renders it unfit for consumption, although the Steering Group does keep a watching brief on all such incidents.

FOOD SURVEILLANCE—THE APPROACH TO THE PROBLEM

22. The Steering Group has adopted a systematic approach to problems on the following lines:

(a) to assess the daily intake on average from food and drink of the substance in question by the consumer;

(b) to determine how much of the substance is contained in the major foods in the national diet;

(c) to determine whether any class of food might present special features with respect to the nature and content of the substance;

(d) to identify any local areas of potential contamination or particular circumstances which might affect the amount of the substance in food and make special checks on these;

(e) to assess the dietary intake of individuals whose patterns of consumption are atypical or who might be more at risk.

This approach gives a general picture of the position for any substance in food whether chemical or radioactive substance, additive or nutrient, including residues resulting from environmental factors about which there is little previous

history. Where statutory limits are in force for a particular contaminant, the results may also indicate the usefulness of those limits. Such information is however likely to be complementary to that obtained by Food and Drugs Authorities.

Concepts of Residue Intake

23. Medical advisers need estimates of the intake of residues as well as biological data to determine whether a risk to the consumer exists. The yardstick used by the World Health Organisation in assessing the health risk of food additives for example has been based on the 'acceptable daily intake' (ADI). This was redefined in 1973 by the Joint FAO/WHO Expert Committee on Food Additives([2]) as 'the amount of a food additive expressed on a body weight basis that can be taken daily in the diet even over a lifetime without risk'. The ADI concept was intended for and has been applied primarily to food additives for use in allocating the acceptable amounts of an additive to specific uses where it would serve necessary technological purposes and would be employed in accordance with recommended manufacturing practices. However that Committee concluded that such concepts were inapplicable to certain trace contaminants, mentioning specifically heavy metals([3]). A new approach was therefore needed and in its sixteenth report the Joint FAO/WHO Committee introduced the concept of a provisional tolerable weekly intake (TWI) for certain heavy metals. The basis for this approach was that, as certain contaminants are able to accumulate within the body at a rate and to an extent determined by the level of intake and the chemical form of the contaminant present in food, the basis of assessing a tolerable intake should be based on a period greater than one day. A weekly basis was felt to be most appropriate. The use of the term 'provisional' was necessary if there was felt to be a paucity of reliable data on the consequences of human exposure to the substance under evaluation.

The TWI is based on the maximum intake of the substance consumed over a period of time which is found not to produce any toxicological effects in experimental animals. This intake is then scaled down by an arbitrary safety factor, taking into account where possible both exposure and dose-effect data arising from human exposure to the contaminant.

24. To estimate the average intake of a particular residue in the diet, data on the food consumed over a period of time (usually a minimum of 14 days up to a period of one year) are obtained. From these the daily intake of either individual food commodities or composited food groups is computed. Analysis of the residue concentration then allows an average daily or weekly intake of the residue to be calculated. Approaches to the assessment of average daily intake of particular food contaminants vary from country to country. The UK, United States, Canada and Australia have used a total diet procedure in which major items of the national diet are mixed into food groups which are analysed after preparation and cooking as for consumption. The origin of total diet studies lies in the work carried out in the United States on radioactive substances in the 1950s([4]). In countries such as Germany and Japan the approach

has been to obtain mean values for contaminants in individual food items and estimate average daily intakes from information on the relative contributions of these foods to the national diet.

Total Diet Studies

25. So far total diet studies have played a central role in the investigations organised by the Steering Group. In the UK total diet studies were first used in surveys of the pesticide content of food organised by the Panel for the Collection of Residues Data and the details have been published(5).

26. In summary the study involved the purchase of various food items from retail outlets throughout the country at quarterly intervals throughout the year. The types and quantities of food purchased were based on information contained in the National Food Survey Reports(6). The foods were prepared and cooked if appropriate and then divided into eight groups—cereals, meat and fish, fats and oils, fruits and preserves, root vegetables, green vegetables, milk, and water. A recent modification of the survey introduced a separate fish and shellfish group and more recently a beverage group in order to investigate the contribution which these classes of foods make to the intake of heavy metals from the diet. In each food group the foods are blended together in the proportions in which they are consumed on the basis of national habits in each of the four quarters of the year. The groups are analysed separately for residue content and from this information a figure for the average daily residue intake is arrived at.

27. It is impossible from total diet samples to identify the residue contents of individual food commodities, therefore all the main food items in the diet are also examined individually. As an example, particular attention has been paid to the staple items such as bread, milk, meat and vegetables as well as concentrated foods with respect to the contamination of food by lead.

28. Although total diet and related studies give a picture relative to the average situation they give no indication of the range in contaminant intakes of the population as a whole (this of course applies to other substances). Certain sections of the community such as those engaged in strenuous physical activity may consume considerably more food than average. The joint FAO/WHO Expert Committee on Food Additives has suggested(7) that as much as 10 per cent of the population may consume from three to four times the average amounts of food. Studies in educational institutes in Sweden and the United States have shown that variations in food consumption of such a magnitude do occur in practice. However these extreme variations are usually allowed for in the safety factor as incorporated into the recommended TWI.

29. Nonetheless special studies are needed on those sections of the community who might be exposed to greater than the average risk. For example in the case of exposure to lead present in the diet there is some evidence that infants, children and pregnant women would be more vulnerable to any adverse effects than other sections of the population. However for most contaminants there is still insufficient information to establish separate TWIs for these groups. Other groups may be at great risk in special circumstances, for example, in

the case of mercury, people who consume large amounts of fish. Others may be affected by industrial exposure because of the locality in which they live. Studies of these sections of the community are difficult to organise. A pilot survey has examined the diet of a small group of people consuming large amounts of fish and another small-scale survey was done in an area near a lead smelter. One problem in studying the dietary intakes of such groups is in obtaining samples of the food eaten. The Steering Group is arranging a pilot trial in which exact duplicates of the meals consumed by individuals in such a group are analysed.

30. The analytical work is done in the Ministry's own laboratories and other government laboratories. The main ones involved so far have been the Laboratory of the Government Chemist, the MAFF Plant Pathology Laboratory and the Fisheries Laboratories of MAFF and DAFS. Because contaminant residues in food are usually at such low concentrations methods of analysis and their sensitivity are particularly important (see para 45) and cross-checks are made between laboratories on methods of analysis.

31. Food surveillance studies are aimed primarily at examining the safety and wholesomeness of food supplies but information from such studies can be of use in establishing data banks on chemical substances in food. Such information can:

(a) indicate the need to look more closely at the uptake of certain chemicals by plants and at the effects of crop husbandry practices on such uptake;

(b) identify areas where environmental pollution may be causing problems, and can help to indicate trends in pollution;

(c) help to ensure that non-tariff barriers to international trade are not set up unreasonably.

HEAVY METALS

32. Heavy metal contamination of food has received publicity in recent years, and the 'tuna fish scare' which was first reported in the US in 1970 led to the formation in the UK of the Working Party on the Monitoring of Foodstuffs for Heavy Metals. That Committee, which reports to the Steering Group, has done extensive surveys of mercury, lead and cadmium in food, [8] [9] [10] [11] [12]. Other elements are now being investigated.

Mercury

33. The Toxicity Sub-Committee recommended in 1973 that monitoring for mercury should be confined to total diet studies carried out periodically during the next five years and that areas of mercury contamination should be sought, particularly discharges into water where fish might be affected. The present monitoring programme has therefore been organised with these objectives in view. The reports of the Working Party contain the full details of the surveys on mercury. The more recent findings are summarised.

34. The mercury contents of total diet samples for the years 1972–75 are shown in Table 1. The overall picture is much the same for each year with the exception of above average results for the 1974 cereals group in which two samples contained mercury concentrations of 0·13 and 0·11 mg/kg. Further tests showed that this was mainly inorganic mercury. Occasional high results were also obtained for other food groups; for example, the 1972 root vegetable group, and the fish group generally. Although the mercury content of fish in the total diet found in 1974 appears greater than usual this difference is not statistically significant. From the data obtained in the 1975 study the majority of people in the UK are not likely to consume more than 22 micrograms of mercury per day.

Table 1 *Comparison of the mercury contents of total diet samples surveyed in the years 1972, 1974 and 1975 (Results expressed in mg/kg)*

Food Group	1972		1974		1975*	
	Mean	Range	Mean	Range	Mean	Range
Cereals	0·01	<0·005–0·03	0·02[2]	0·005–0·13	0·005	<0·005–0·01
Meat and fish ...	0·017	<0·005–0·79[1]	0·023	0·005–0·09	0·011	0·005–0·03
—fish only ...	0·05	0·02–0·14	0·14	0·04–0·43	0·09	0·025–0·39
Fats	0·005	<0·005	0·005	<0·005–0·005	0·006	<0·005–0·02
Fruits and preserves	0·005	<0·005	0·005	<0·005–0·005	0·005	<0·005–0·01
Root vegetables ...	0·01	<0·005–0·13	0·01	0·005–0·015	0·005	<0·005–0·01
Green vegetables ...	0·005	<0·005–0·01	0·01	0·005–0·02	0·007	<0·005–0·04
Milk	0·005	<0·005	0·002	<0·002	0·002	<0·002

(In estimating means, all values at less than the reporting limit are taken to be at the reporting limit)

[1] An atypical result of 0·79 mg/kg has been excluded from the mean since it was probably inhomogeneity in the single food group analysed which gave this result.
[2] This mean is 0·01 if two higher than average values of 0·13 and 0·11 mg/kg are omitted.
*Based on data for the first three quarters of 1975 only. The basis of the study was altered subsequently.

35. The Steering Group also considered data which were obtained from special exercises mounted because of known cases of the misuse of mercury. These incidents are commented on below.

36. The treatment of cereal seeds with organomercurial dressings to control plant diseases is a necessary agricultural practice. Data for 1974 supplied by the Department of Agriculture and Fisheries for Scotland have shown that wood pigeons and other game birds which are eaten may, at certain times of the year, eat cereal seeds which have been dressed. Studies on these animals showed that they were able to accumulate mercury in muscle tissue. A mean mercury level of 0·05 mg/kg was found in 207 samples of muscle tissue. Higher levels were found in 1973 when 235 samples were analysed and a mean mercury content of 0·15 mg/kg was obtained. These higher results were attributed to the particularly wet weather at the time of sowing which created difficulties in sowing and exposed above-average quantities of seed; however the levels found were judged not to present an undue hazard because of the limited extent of the contamination.

37. Reports from Japan in 1973 indicated that some fishing populations were exposed to high levels of mercury in fish from industrial discharges. As a result an immediate investigation was made of imported canned Japanese fish and shellfish purchased from retail outlets in this country. In addition, samples of frozen fish and shellfish from Japan were sampled by Port Health Authorities for analysis. The results obtained showed levels which ranged from 0·01 to 0·34 mg/kg. These levels are within the range of mercury levels found in other fish and shellfish sold in the UK.

38. In July 1974, an incident occurred on the continent in which calves were accidentally poisoned by a mercurial compound. In all some 30 000 calves in Holland and 50 000 calves in Italy were affected. The cause of the poisoning was ascribed to the accidental inclusion into the feed of a starch based material meant for use as a wallpaper adhesive. The adhesive contained an organomercurial compound added to inhibit fungal growth. An immediate survey was begun in which representative samples of veal shipped into the UK from these countries were analysed for their mercury contents. Although most samples of calf liver and kidney contained low concentrations of mercury, the levels in one or two samples were found to be high. The low incidence of high residues was considered by the Expert Committees (FACC and TSC) who concluded that there was no appreciable risk to health.

39. An organomercurial dip is recommended for use in the control of Aspergillosis in egg hatcheries. Incubator clears (infertile eggs) treated in such a way could find their way into the food chain since they may be processed into dried egg preparations for use in confectionery. Analysis of treated eggs indicated that the mercury contents were higher than in untreated eggs although still sufficiently low to present little risk to the consumer. Nonetheless, this practice is being further evaluated by the Ministry's Pest Infestation Control Laboratory to determine the need and extent of such practices, and the effects produced in eggs for consumption.

40. It was reported from Germany that certain field mushrooms contained levels of mercury which were higher than those found in other vegetables, and this was attributed to the uptake of mercury naturally present in the soil. In the UK eight bulked samples of fresh mushrooms were found to possess a mean mercury concentration of 0·03 mg/kg ranging from 0·01 to 0·08 mg/kg. Dried mushrooms and other edible fungi contained a mean of 0·13 mg/kg fresh weight and levels ranged from 0·01 to 0·23 mg/kg. These levels are roughly one order of magnitude greater than the level found in most other vegetable products but even so the levels of mercury present are so low that they are not a health hazard.

Lead

41. The first survey of the levels and the distribution of lead in the diet was undertaken in 1972(9). The survey showed (i) that there was no evidence of harm to health from the levels of lead in the food which comprised the diet of the average consumer; (ii) that surveillance should be continued with particular emphasis on situations where the diet could be subject to localised contamination and that (iii) young babies were exposed to higher lead intakes

from the diet than on average if a major part of their diet consisted of canned baby foods. As a result the Lead in Food Regulations were amended to create a separate category for foods specially prepared for infants and young children, and a limit of 0·5 mg/kg of lead was set for this category.

42. Sufficient new data were available in 1975 to enable a further set of survey results to be published(12). This survey showed from total diet studies that the weekly intake of lead from food by the average person was in the region of 1 milligram and that in comparison with the previous survey the levels of lead in food did not appear to be increasing. Beverages were estimated to account for a further intake of 0·2 milligram. Lead was present in most staple foods in low amounts, and with a few exceptions levels were within the statutory limits of the Lead in Food Regulations 1961, as amended. Some foods such as herbs, liver and some canned fruits did exceed the limits and ways of overcoming this latter problem are under investigation by the food industry. In addition it was found that people who consumed food which had been grown in areas with high environmental lead levels could be exposed to above average amounts of lead in the diet.

43. Data on the levels of lead in certain water supplies showed that individuals in some households in the country could be exposed to lead because of the lead plumbing systems which were still in use. The results of a national survey of the level of lead at the tap in households in the UK conducted by the Department of the Environment in 1975–1976(13) have confirmed that 4 per cent of households sampled contained lead concentrations exceeding 0·1 mg/l in daytime samples of tap-water due to the lead plumbing systems present. This source of lead could be important in raising the overall dietary intake of lead.

44. The Toxicity Sub-Committee recommended that the monitoring should be continued and also that information should be obtained on the levels of lead intake from food by children of different ages and by individuals whose diet might contain an unusually high proportion of food with greater than normal lead contents. The FACC, which had been reviewing the Lead in Food Regulations, endorsed the Toxicity Sub-Committee's recommendations and in its Report(14) recommended that the maximum permitted lead levels in food, other than for specified foods, should be reduced from 2 mg/kg to 1 mg/kg.

45. Table 2 gives figures for lead intakes determined by total diet studies in other countries. The United States data illustrate clearly how the estimated intake figure depends largely on exact measurement of the amount of lead in the food samples. Accurate analysis of traces of lead is difficult in any food and is even more difficult in food groups such as total diet samples when foods containing measurable quantities of lead are mixed with foods containing lead levels below the limit of analytical detection. The USA has attempted to use neutron activation analysis in order to overcome the limited level of detection by atomic absorption spectrophotometry when the latter is used to analyse foods containing 'trace' or 'nil' amounts of lead but this technique is difficult to apply routinely. The approach in this country where residues below the

limit of detection of the method are assumed to be at that level, i.e. the worst case assumption, tends to produce high estimates and presents difficulties in comparing results.

Table 2 *Comparison of average daily intakes of lead from food estimated from total diet studies in various countries*

Country	Amount of Lead Ingested (μg)	Estimated Food Consumption (kg)	Lead Intake based on 1·5 kg food consumed (μg)
USA[1]	57·4(a) 159 (b) 233 (c)	2·92	29·5 81·6 120
UK	200 (d) 170 (e)	1·5	200 (c) 170 (d)
Australia	221	3·43	97
Canada	115	1·78	97

(a) Levels quoted as 'trace' or 'zero' omitted.

(b) Intake estimated on the basis that all results quoted as 'trace' contained 0·09 μg Pb.

(c) Intake estimated on the basis that all results quoted as 'trace' contained 0·09 μg Pb and results quoted as 'nil' contained 0·05 μg Pb.

(d) Based on results of data obtained up to 1971.

(e) Based on all total diet samples analysed up to 1974.

[1] Reference 15.

46. The Royal Commission on Environmental Pollution has commented on the lack of information on intakes of pollutants by specific sections of the community([16]). Similar comments have been made by the TSC and FACC (para 44) who mentioned two groups in particular who might be more sensitive to the toxic effects of lead, children under one year of age and pregnant women. One approach to this problem, which the Steering Group is investigating, is the use of duplicate diet studies, and a small pilot trial is in hand to examine the diets of infants in areas where lead piping predominates and the water is more plumbosolvent than normal, since the principal source of lead for the non breast-fed infant may be the water used to prepare reconstituted foods. Medical checks, and tests on the water will also be made. The information obtained will be compared with that from a control population.

Cadmium

47. The recommendations of the FACC in considering the data produced in the Survey of Cadmium in Food([11]) were that there was no further need to monitor for cadmium on the scale that had been carried out for the survey, but that periodic analyses should be carried out on total diet samples, on babyfoods and on shellfish. The programme of monitoring has continued along these lines.

48. A summary of the results obtained from the 1974 total diet study is shown in Table 3. From these figures the average weekly intake of cadmium from the diet over a period of time is estimated to be in the region of 0·15 milligrams and is between 40–50 per cent of the TWI for cadmium, provisionally set by FAO/WHO as 0·3 to 0·4 milligrams per person per week. This is comparable with the estimate obtained in the first total diet study on cadmium. Milk contained negligible quantities of cadmium. Levels of cadmium were reasonably similar in all the other food groups. Because cereals tend to be the major food group in quantity terms in the diet, it has been estimated that the contribution which cereals made to the daily cadmium intake may be in the region of 30–40 per cent.

Table 3 *Cadmium contents of total diet samples in 1972 and 1974 (expressed as mg/kg)*

	1972		1974	
	Mean	Range	Mean	Range
Cereals	0·03	<0·01–0·08	0·02	<0·01–0·08
Meat and fish	0·02	<0·01–0·09	0·02	<0·01–0·09
—fish only	0·02	<0·01–0·06	0·01	<0·01–0·02
Fats	0·03	<0·01–0·03	0·02	<0·01–0·07
Fruits and preserves	0·01	<0·01–0·02	0·01	<0·01–0·02
Root vegetables	0·02	<0·01–0·07	0·02	<0·01–0·06
Green vegetables	0·01	<0·01–0·03	0·01	<0·01–0·03
Milk	0·002	<0·001–0·007	0·006	<0·006–0·01

(In estimating means, all values less than the reporting limit are taken to be at the reporting limit)

49. Recently studies of the dietary intake of cadmium in other countries have shown that cadmium intakes are close to the tolerable weekly intake and this has prompted the Steering Group to look at cadmium levels in food in detail once more.

50. The total diet studies reveal that almost 50 per cent of the cadmium present in the diet is contributed by the cereal and vegetable food groups, and this suggests that cadmium present in soil may be taken up by plants, since the levels of cadmium in air are very low[17].

51. The question of cadmium uptake by food crops in agriculture and horticulture is being studied. A survey of the levels of cadmium present in cereals and horticultural crops grown on land not known to be polluted by cadmium is being carried out in order to give some indication of what are the background levels of cadmium in various food crops. This survey is being run in conjunction with other programmes which are looking at the uptake of cadmium into food crops grown on land with higher than usual soil cadmium levels (see paras 64 and 65).

52. The FACC has recommended that checks should be made on those sections of the community who may consume higher than average amounts of cadmium in the diet. One such group should include people consuming

large quantities of vegetable produce from land treated with sewage sludge containing high levels of cadmium. A small pilot trial has therefore been organised to look into this question using techniques similar to those used in the duplicate diet study for lead.

53. The survey of cadmium in food also showed that there could be higher than average exposure to cadmium in the diet from the consumption of shellfish, particularly crabs, which had the ability to accumulate high levels of cadmium. It is hoped to undertake studies on communities of high fish consumers who could be exposed to such levels, if individuals can be identified in the local areas affected.

54. It is expected that the data obtained from these investigations will be sufficient to publish a second report on cadmium in the near future.

Arsenic

55. Considerable difficulties arise in the analysis of food for arsenic. The difficulties encountered result in part from the fact that in some foods, especially fish, the arsenic is very firmly bound in an organic form([18]), and is not available for measurement by the analytical detection systems used unless very vigorous digestion procedures are adopted. Extensive inter-laboratory checks have been necessary to ensure reproducible results.

56. Total diet studies on the distribution of arsenic in the diet show that it is principally present in the fish portion of the diet. Most other food groups contain arsenic levels at or below the detection limit of the analytical method used which is usually 0·05 milligrams per kilogram. The values shown in Table 4 indicate that the mean dietary intake of arsenic by the average person is not more than 0·8 milligrams per week. The amount contributed by fish and shellfish amounts to roughly 0·4 milligrams. Over a period of time, therefore, it seems likely that about 50 per cent of the arsenic consumed on average arises from fish but this is mostly in the form of organically bound arsenic which does not accumulate in human tissues and is rapidly excreted. The overall estimate of arsenic intake is however comparable with estimates of intake made in other countries.

Table 4 *The arsenic content of 1975 total diet samples* (expressed as mg/kg)*

	Mean Concentration	Range of values obtained in individual food groups
Cereals	0·05	<0·05
Meat and fish	0·28	0·05–0·45
—fish only	3·6	1·7–5·9
Fats	0·05	<0·05
Fruits and preserves	0·05	<0·05
Root vegetables	0·05	<0·05
Green vegetables	0·05	<0·05
Milk	0·02	<0·02

*Based on the analysis of samples from the first three quarters of 1975.

57. Arsenical pesticides used to be widely used in agriculture but this practice has almost entirely ceased. A little Paris Green (copper aceto-arsenite) is still used as an insecticide on soil or on glasshouse staging where tomatoes or cucumbers are grown. Organoarsenicals can be used as feed additives in some poultry rations but only against a veterinary prescription and if used as recommended they should not give rise to residues in food. The Steering Group has however organised a small survey of the arsenic contents of certain foods with particular emphasis on those foods which could be affected by arsenic residues and this will include meat and meat products. The MAFF and DAFS Fisheries Laboratories are also undertaking a special survey of fish and shellfish.

58. The Arsenic in Food Regulations 1959, as amended, which limit the amount of arsenic in most foods to not more than 1 mg/kg, are currently being reviewed by the FACC.

Other Elements

59. Several other elements have been reported to be involved in various incidents of environmental pollution both in this country and abroad and there is always the possibility that these elements may find their way into food. A number of these elements are essential nutrients in the diet and are required in small amounts for the maintenance of normal health, but at higher concentrations these elements can produce adverse effects. For example, zinc, sodium, chromium, magnesium, cobalt, calcium, iron, copper, molybdenum, manganese, potassium and selenium are required in a number of mammalian enzyme systems if cellular metabolism is not to be impaired. However, zinc, chromium, copper, cobalt and selenium have been implicated in particular incidents of food poisoning. Little is known about the amounts which, if present in the diet, could produce symptoms of toxicity. The Steering Group thus felt that it would be prudent to make some preliminary studies and total diet samples are being examined for copper, zinc, manganese, chromium, nickel, tin and selenium.

60. Some initial results for zinc, selenium, copper and nickel in total diet samples are shown in Table 5. The estimated daily intakes of the various elements shown are comparable with figures obtained in Canadian studies[19] when allowances are made for differences in the amount and type of food consumed in the two countries. In general it appears that the meat and fish group contains more of these elements than does any other food, although this group may not necessarily make the major contribution of these elements in the diet. Cereals seem to contain greater amounts of copper and selenium than do other food groups. The amounts of selenium in fruit and vegetables, milk and fats are negligible. Nickel appears to be equally distributed over the whole diet. Copper and zinc are present in the cereal and meat and fish food groups in greatest amounts followed by the vegetable food groups.

Table 5 *Mean concentrations of copper, selenium, nickel and zinc in 1974 total diet samples (expressed as mg/kg)*

	Copper	Selenium	Nickel	Zinc
Cereals	2·5[1]	0·11	0·17	8·5
Meat and fish	2·6	0·12	0·20	28·0
—fish only	0·9	0·32	0·20	11·0
Fats	0·4	0·01	0·14	8·5
Fruits and preserves	0·8	0·01	0·16	1·9
Root vegetables	1·3	0·01	0·15	2·5
Green vegetables	1·7	0·01	0·20	4·0
Milk	0·1	0·01	0·05	4·1
Estimated mean daily intake (mg)[2]	1·7	0·06	0·02	11·0

(In estimating means, values less than the reporting limit are taken to be at the reporting limit)

[1] The mean is 1·7 mg/kg if one abnormally high value of 23·0 mg/kg is excluded.

[2] Estimated from the contribution which each food group makes to the diet of the average person.

61. The contents of certain metals in some individual food commodities are shown in Table 6. These results show that zinc, iron and tin occur at higher concentrations in these foods than do manganese, copper and nickel. Preservation of food in cans is certainly responsible for enhanced tin contents of these foods since tin levels in the materials before preservation are significantly lower.

Nickel occurs at much the same levels as those observed in the total diet samples. Manganese concentrations were greatest in tea, liver and kidney and infant foods. The studies are continuing into the metal contents of other foods.

Table 6 *Mean concentrations of tin, zinc, iron, copper, manganese and nickel in various food commodities (expressed as mg/kg)*

	Tin	Zinc	Iron	Copper	Manganese	Nickel
Meat	20	21	16	1·6	0·6	0·2
Meat products ...	20	19	43	2·3	1·4	—
Liver and kidney ...	10	38	81	11	3·2	0·2
Canned fruit juices ...	100	2·5	7	0·6	1·7	0·2
Infant foods ...	29	15	48	3·7	7·0	0·4
Canned vegetables ...	57	4·8	10·5	1·2	1·2	0·3
Canned fruit[1] ...	80	5·6	11·2	1·0	1·7	0·2

(In estimating means, all values less than the reporting limit are taken to be at the reporting limit)

[1] These values refer to the metals found in the solid fruit and not the syrup.

TRACE ELEMENTS IN FOOD GROWN ON LAND TREATED WITH SEWAGE SLUDGE

62. Trace elements in sewage arise from a number of sources such as domestic waste, industrial effluent and leaching by rainfall and these trace elements can be concentrated in the sludge produced from the sewage treatment works.

The levels of trace elements vary considerably depending on the nature of the discharges. Of the large number of trace elements which can occur in sewage sludge, lead, cadmium and mercury are of greatest concern to human health, but zinc and copper, often present in appreciable quantities, are also phytotoxic. However, other elements which are present include vanadium, chromium, arsenic, nickel and selenium and the effects on the uptake of these elements into crops grown on such treated land must be considered.

63. Of the total arable and grazing land in the United Kingdom, only a small proportion is regularly treated with sewage sludge, probably of the order of 1 per cent. The effects of this practice on raising the levels of trace elements in the total food supply would be very small. There is however a tendency for the small proportion of sludge treated land to be confined to a limited number of areas usually in the vicinity of large sewage works where disposal to land is the most economic method of disposal. There are still a few 'sewage farms' which are primarily used as places to treat sewage or dispose of sewage sludge. These are sometimes associated with market-gardening and to a much lesser extent with livestock activities. It is possible therefore that a limited number of individuals in certain localities might consume more than average amounts of food from such areas.

64. In 1973 the Steering Group formed a Working Party whose terms of reference were to consider the effects on food of the use of sewage sludge on agricultural land, to assess the surveillance needs, and to make recommendations. The Working Party highlighted the evidence which was accumulating on the uptake of cadmium from sewage sludge treated land and proposed in collaboration with the Agricultural Development and Advisory Service to undertake a survey of the trace element content of food from land treated with sewage sludge. This survey began in 1974. Results are now coming forward but have not yet been fully evaluated.

65. Particular attention is being given to market gardens which have received applications of sludge over many years and it is planned to undertake a study of the dietary intake of those sections of the community who consume food produced from such land.

66. The Department of the Environment in conjunction with the National Water Council set up a Standing Technical Committee on the Disposal of Sewage Sludge in 1975. The terms of reference of the group were to 'review the economic, technical, public health and environmental aspects of the disposal of sewage sludge and to recommend good practice for the effective disposal of sewage sludge'. Since this Standing Committee called on wider resources than the Steering Group's Working Party and, in making recommendations, was to consider as its primary task the protection of public health, the latter group is in abeyance and a watching brief over developments is being maintained by the Steering Group. The views of the Steering Group are being taken into account in drawing up a Code of Practice for sludge disposal.

NITRATES AND NITRITES

67. Interest in the nitrate and nitrite content of food has arisen recently for two main reasons:

(a) excess nitrate in the diet could present a risk to health for two particular sections of the community. These include young infants who together with some adults produce low amounts of gastric acid. The consequence of this hypoacidity is that bacteria which are usually present in the lower intestinal tract may proliferate and colonise the gut. These bacteria are capable of reducing the nitrates which may be present in water and food, to nitrites which when absorbed into the blood stream oxidise the iron in haemoglobin from the ferrous to the ferric state. The resulting methaemoglobin is incapable of transporting oxygen and if sufficient haemoglobin is inactivated normal respiration is impaired. Nitrites may also be present in food where they can be produced naturally by storage of certain nitrate-rich vegetables or by the direct addition of nitrite to cured meat products, but the levels found in the diet as a whole are very low. No other sections of the community are at risk as their normal gut flora are incapable of reducing nitrates to nitrites as described;

(b) there is a possibility that the presence of nitrates and nitrites in food might result in their interaction with certain amines or amides also present in the diet, and result in the production of nitrosamines or nitrosamides. Certain members of these classes of chemicals have been shown to be carcinogens in experimental animals. The work carried out to detect the possible presence of nitrosamines in the diet, to assess the possibility of their formation after the ingestion of food, and to assess the health significance of this class of compounds is reported on in more detail in paragraph 94.

68. Nitrates may be present naturally in edible crops which take them up from the soil where they are also naturally formed. Different species of plants show a wide variation in nitrate content even when grown under apparently identical conditions. There is some evidence that spinach, beet, radishes, celery, lettuce and turnip green accumulate relatively more nitrates than do other vegetables but there is little evidence on varietal variations in the nitrate content of plants. The application of excessive quantities of nitrogenous fertilisers to plants, i.e., in excess of those necessary for high yields, greatly increases their nitrate content whereas addition of other elements appears to have little effect on nitrate levels. Soil type also appears to have little influence. There is some evidence that the nitrate content of vegetables decreases on storage, processing and cooking but detailed information is lacking.

69. Nitrates and nitrites have traditionally been used, with salt, to cure certain meats. Although they assist in the production of the characteristic cured meat flavour and produce the traditional red colour of cured meats, their most important function is that of preservation whereby the potentially severe hazards associated with the possible growth of *Clostridium botulinum* in these foods is eliminated.

70. In this country the foods to which nitrates and/or nitrites can be added in restricted quantity are controlled by the Preservatives in Food (Amendment) Regulations 1975. These regulations specify the foods and the amounts of preservative permitted as follows:

Specified Food	Permitted Preservative	Not exceeding (mg/kg)
Meat, cured (including bacon or ham)	Sodium nitrate or	500
	sodium nitrite	200
Cheese, other than cheddar, cheshire, Grana-	Sodium nitrate or	100
padano or provolone type cheeses or soft cheese	sodium nitrite	10

These regulations are currently under review by the Food Additives and Contaminants Committee.

71. The major source of nitrate in the diet of the average person is vegetables. Apart from these components of the diet there is little detailed information on the nitrate and nitrite content of the rest of the diet. For nitrate an estimated intake of 500–810 mg per person per week, comprising 300 mg from vegetables, 110 mg from meat products and 100–400 mg from water has been reported[21]. There do not appear to be any reports of the direct analysis of diets perhaps because of the instability of nitrates and nitrites on storage.

72. Information on the nitrate and nitrite content of infant foods is limited. That which is available on canned food intended for infants is summarised in Table 7. From these figures it appears that the maximum average nitrate concentration of canned infant foods (savoury types) is in the region of 60–90 mg/kg. So far as nitrite levels are concerned average values for most savoury types are less than 5 mg/kg.

Table 7 *Nitrates and nitrites in canned infant foods (expressed as mg/kg)*

Food Type	Number Samples	Average*		Range*	
		Nitrate	Nitrite	Nitrate	Nitrite
Broths (meat and vegetable) ...	16	<63	<4	0–181	0–20
Meat dinners	18	69	<3	0–217	0–7
Meat and vegetable dinners ...	37	74	<10	0–320	0–85
Meat and cereal	6	15	<4	0–35	0–<8
Meat and egg	2	141	<4	140–141	0–<8
Fish dinners	1	53	<1	—	—
Cheese dinners	1	85	20	—	—
Cheese and vegetable dinners ...	1	230	<5	—	—
Vegetables	9	85	<5	27–200	0–<8
Fruits and sweets	15	<34	<7	0–130	0–10

* The average values represent maximum average values since figures below the detection limit for a particular method have been taken to be equal to this limit.

73. There is more information on cows' milk. It appears that nitrate together with nitrite is present at a level of less than 1 mg/kg even in milk from cows grazing pasture treated with abnormally high levels of nitrate fertiliser.

74. There has recently been some interest in the nitrate content of drinking water supplies which appears to be increasing in some areas. A survey of potable water in the UK carried out by the Department of the Environment in 1967–68 showed that out of 600 samples the nitrate concentration exceeded 22·5 mg/l (as nitrate NO_3) in 100 samples, and levels exceeded 90 mg/l (as NO_3) in four of these. Continued attention is being paid to those areas which were shown to have higher than average nitrate concentrations. The overall tendency has been for nitrate concentrations in raw water sources to rise although the extent of this increase has varied throughout the country. However water authorities have been able to continue to supply water of acceptable quality. During 1976 although a severe drought was followed by heavy late autumn rain there were very few instances of water being put into public supply with a nitrate concentration in excess of 100 mg/l NO_3 and in these cases the concentration was only a little above 100 mg/l. The present recommended limit for nitrate in European potable water recommended by the World Health Organisation[20] is 50 mg/l expressed as nitrate ion with an acceptable level varying between 50–100 mg/l. These limits are based on a level which will not generally produce infantile methaemoglobinaemia. In areas where there is a possibility of increased levels of nitrate in drinking water supplies all attempts are made to reduce these levels by blending with low nitrate water. When sources such as private wells cannot be treated in this way, an alternative temporary supply of bottled water is provided for the production of infant feeds.

75. After considering the data available the Steering Group felt that sufficient information on the nitrate and nitrite content of vegetables and water already existed, and information concerning nitrates and nitrites in meat products would emerge from the current FACC review. The areas in which the Group felt it would be useful to have more information were:

(i) the nitrate and nitrite content of baby foods, including canned, bottled and packeted varieties;

(ii) the effect of storage (both short and long term), processing or cooking on the conversion of nitrates and nitrites in food with particular reference to vegetables, fruit juices, meat products and cheese products;

(iii) amounts of nitrate and nitrite in the diet as a whole.

76. Some studies were therefore commissioned by the Steering Group to obtain more information regarding these questions. These studies are still in progress but some results are shown in Table 8.

Table 8 *Nitrate and nitrite content of selected food items (expressed as mg/kg)*

	Number samples	Range	
		Nitrate	Nitrite
Cheese	5	33–117	<1–4
Baby foods	21	20–177	<1–3
Canned meats	21	38–435	3–21
Canned vegetables			
—in the vegetable	2	76–92	<1
—in the juice	2	76–98	<1–1
Canned spinach			
—in the vegetable	1	2000	1
—in the juice	1	2100	1
Speciality sausages	8	65–169	4–93
Canned tomatoes	4	32–42	<1
Canned celery hearts	1	1240	1
Canned beetroot	1	440	<1
Canned rhubarb	1	620	<1
Dried baby food (apple)	1	18–28	<1
Milk powder	4	30–62	2

The pattern which emerges is similar to that revealed in the published literature. Certain vegetables such as spinach, celery etc. appear to contain the highest levels of nitrate although levels of nitrite in these are generally less than 1 mg/kg. Meat products contain less nitrate than the specified vegetables, but more than in other food generally. None of the meat products examined contained nitrate or nitrite in excess of the permitted levels.

TAINT IN POULTRY MEAT

77. It was reported from the Food Research Institute in 1972 that 'off-flavour', or 'musty taint' as it was termed, in poultry meat could be related to the use of wood shavings as deep litter in poultry houses. The chemical agents responsible for the taint were identified as chloroanisoles which were capable of producing the off-flavour at extremely low concentrations (a level of 4 milligrams of 2,3,4,6–tetrachloroanisole in one million litres of water can be detected by smell). The origin of the chloroanisoles was traced to the tetra- and penta-chlorophenols in wood shavings which were converted to chloroanisoles by microbial action in the poultry litter. The chlorophenols were present in the wood shavings from their use in the preservation of timber[22].

78. Since at the time there was little information on the problem, evidence was obtained by the Steering Group on the extent of the reported incidents and whether any risk to the consumer existed. The advice received was that the incidents appeared to be isolated and sporadic and that the levels of chloro-phenols and chloroanisoles found in the poultry were unlikely to present a risk to the health of consumers. However it was considered that a limited amount of work should be carried out to determine the levels of chlorophenols and chloroanisoles which might be present in chicken meat. It was also considered that any food in contact with wood packaging materials might be similarly affected but the information obtained indicated that plastic packaging had replaced many of the traditional wooden carriers and packs. In samples

of chicken meat purchased from retail outlets in the London area and examined by the Laboratory of the Government Chemist, chloroanisoles were detected in only three samples, the levels being about 0·002 mg/kg. Traces of chlorophenols were found in all the samples examined the levels ranging from 0·005 to 0·012 mg/kg. These results were generally similar to those found in the Food Research Institute studies. The main conclusions reached were that no health risk to the consumer appeared to exist and that the problem was essentially one of food quality. The latter was considered to be a matter for the Advisory Committee on Taint, a committee composed of representatives from the Agricultural Research Council, the Laboratory of the Government Chemist and MAFF.

FOOD AND THE USE OF ORGANIC WASTES IN ANIMAL FEEDS

79. The present day cost of animal feedingstuffs has stimulated interest in new sources of material which might be suitable for use in animal feed. This interest has extended to waste materials such as dried poultry waste (DPW), cattle and pig slurry, sewage sludge, cellulose products and other miscellaneous materials. Organic waste materials of this sort have considerable potential as feed ingredients since they contain a variety of nutrients which are re-usable, in the case of manures not only by the animals which voided the material, but by other species. However of the many kinds of novel waste material DPW is the only one known to be in general use.

80. DPW consists either of the waste from poultry managed in batteries or waste from broilers consisting of droppings mixed with the floor litter. Both types have been used in a variety of animal feeds both for ruminants and non-ruminants. The main application however is for ruminants since these are better able to make use of the non-protein nitrogen present in poultry waste. At the peak of production in 1974 it was estimated that 100 000 to 150 000 tonnes of DPW were produced from 70 manure drying plants in the UK. This quantity is about 1 per cent of the total UK feedingstuff production. However the increased cost of fuel for drying and legal action taken by Local Authorities over odours produced by the drying process have tended to depress the production of DPW and have led to the closure of some plants. In commercial cattle rations the normal inclusion rate is around 5 per cent up to 10 per cent, but exceptionally may increase to 50 per cent.

81. In theory poultry waste could contain a wide range of drugs, pesticides, hormones and their metabolites. The DPW from broilers is likely to contain more adventitious substances than that from battery birds but any residues present will be diluted in the compounding of the feed in which it is used and further reduced by the metabolism of the animal to which it is fed. The chemicals which may be present in poultry wastes are considered in the following paragraphs particularly in relation to the possible carry-over of residues into meat products.

Coccidiostats and other anti-protozoal substances

82. A variety of these products are licensed for use at the present time but

little information is available on levels in DPW or in tissues of animals which have been fed DPW. The Steering Group has recommended that a study should be carried out to evaluate the possible carry-over of residues.

Antibiotics and antibacterial substances

83. Antibiotics have considerably reduced the losses in livestock and production due to bacterial diseases and the introduction of antibiotic feeding in pigs and poultry has resulted in better growth rates and a reduction in chronic and sub-clinical disease. Examination of tissues from cattle fed DPW containing antibiotic residues at rates up to 50 per cent of their rations showed negligible tissue concentrations after a five-day withdrawal period([23]). Tetracyclines have been reported in muscle meat at levels corresponding to 0·02 per cent to 0·1 per cent of the level in the feed. However no residues were detected after a five-day withdrawal period and chlortetracycline residues were destroyed on cooking([24]).

Hormones

84. The use of hormones in poultry feeds is very limited and there appears to be little danger to human health from consumption of animals fed on DPW. Since humans already produce hormones and consume considerable quantities of hormones which occur naturally in plant and animal foods there is little danger to health since any residues in food are likely to occur at levels several orders lower than the levels which occur naturally.

Arsenical compounds

85. The use of arsenical compounds in poultry feeds was phased out by 30 June 1976 to comply with the provisions of EEC Directive 70/524 on additives in feedingstuffs, and now they can only be used against a veterinary prescription. Several studies into the fate of arsenicals in organic manures recycled into animal feeds suggests that they do not accumulate in tissues other than liver, and the levels fall rapidly to normal if a short withdrawal period is observed.

Other residues

86. Copper may be found in DPW but this is more a concern for animal rather than human health. Other residues that might be present in DPW include pesticides although those approved for use in poultry houses in the UK are mostly short-lived organophosphorus compounds, carbamates, pyrethroids, etc., and anti-stain agents for wood treatment such as chlorophenols (see paras 77, 78 and 81) 2-hydroxybiphenyl and borax which may be present in wood shavings used as poultry litter. Studies have shown that there appears to be no undue accumulation of pesticides in the liver or back fat of cattle fed broiler litter in their diet but it was felt that further work was necessary to establish whether the chlorophenols accumulated to unacceptable levels in animals fed DPW. Finally, it is possible that nitrosamines and mycotoxins may be produced in organic waste. It is unlikely however that the former would present any problems to the consumer since they would be metabolised by the animal and deactivated. As far as the latter are concerned, maximum levels for aflatoxin in feedingstuffs are prescribed in legislation (see para 13).

87. The Working Party which examined these issues concluded that while most of the residues in DPW can be discounted as unlikely to lead to problems of food contamination, there should be some further monitoring in order to confirm that there were no significant residues of some of the products, for example coccidiostats and chlorophenols, in human food.

88. The use of antibiotics in medicine and animal husbandry has led to an increase in the amount and type of resistance amongst certain bacteria. The effects that the recycling of manures might have on bacterial resistance to antibiotics is under consideration by the Joint Sub-Committee on Anti-microbial Substances. The Steering Group has therefore concerned itself more with the fate of chemical residues. A small survey has been organised to look into the levels of medicinal products in DPW. There is sufficient information on some of these compounds by virtue of their scrutiny under the Medicines Act and under the former voluntary safety scheme to eliminate the need for further study. Advice received from the Central Veterinary Laboratory has indicated that there are four substances which are widely used in poultry husbandry and which would merit further investigation. These are dinitolmide, sulphaquinoxaline, robenidine and nifursol. A study has therefore been arranged to investigate the effect on food of the ingestion of these substances by cattle.

POLYCHLORINATED BIPHENYL COMPOUNDS

89. Polychlorinated biphenyls (PCBs) are a group of chlorinated organic compounds bearing a close resemblance to organochlorine pesticides whose properties have given them a wide industrial use since the early 1930s. Because of their high stability, plasticising abilities and dielectric properties they have found their way into many commercial products such as printing inks, carbon paper, rubber tyres, paints, sealants, adhesives, insecticides, industrial heat exchangers and electrical transformers and capacitors. This wide use of PCBs has resulted in their broad dispersal into the environment and because of their high stability, once present they are particularly persistent. Since 1971 action has been taken by the manufacturers of PCBs in the UK to restrict their use solely to closed systems such as transformers and capacitors. An EEC directive has been agreed and will place on a statutory basis the voluntary arrangements which already exist in the UK. The sole manufacturer of PCBs in the UK has recently announced that manufacture will cease during 1977.

90. PCBs were first discovered in environmental samples in Sweden in about the mid-1960s since they interfered with the analysis of organochlorine pesticides. Attention became firmly focussed on them in 1971 when large numbers of chicken eggs failed to hatch in the United States. The cause was eventually traced to the chicken feed which contained fishmeal that had been contaminated by PCBs from a fault in the cooling system at the feed plant. The death in 1969 of over 12 000 sea birds, mostly guillemots, in the Irish Sea was attributed in part to high levels of PCBs found in the livers of these birds and probably mobilised during a period of particular stress. However the acute toxicity of PCBs appears not to be high and toxic effects in man have only been observed following direct contact in industry or from severe food contamination.

91. Checks on the PCB content of food in the UK have been made by the Laboratory of the Government Chemist and the MAFF and DAFS Fisheries Laboratories since 1966 when PCBs were first found in wild life. A small number of food commodities were examined for PCBs during routine analysis for pesticide residues. In general PCBs were absent from most of the food examined but some samples of milk, beef, mutton fat and cod-liver oil did contain residues. However the levels were not considered to be of toxicological significance. Total diet samples for the years 1970–71 were also examined for PCBs. The only food group that was consistently found to contain residues was the composite fish group. Other groups occasionally contained traces but in no case were concentrations greater than 0·1 mg/kg. Some 200 samples of human fat were examined for organochlorine residues in 1972 and PCBs were found in a few samples at levels of less than 1 mg/kg.

92. An extensive analysis of PCBs in fish and shellfish landed in England and Wales has been carried out by the Ministry's Fisheries Laboratories. The results are summarised in Table 9. Most fish samples and some 60 per cent of shellfish samples contained residues. From the results obtained it was estimated that the mean PCB content of muscle of demersal fish from the English Channel was 0·18 mg/kg and of liver 2·2 mg/kg wet weight. The figures are similar to levels found in some other UK coastal waters and have shown no trend over a five year period. Coastal areas with higher than average PCB levels in fish were the North Irish Sea and the Southern North Sea. From these areas liver tissue of cod and whiting often contained residues at concentrations of more than 10 mg/kg and ranged up to 20 mg/kg. However the levels in muscle tissue of such fish rarely exceeded 0·1 mg/kg. Fish with a higher lipid content in the muscle tissue such as herring, mackerel, whitebait, etc. contained levels in excess of 0·1 mg/kg. A survey of PCBs in river freshwater fish in England and Wales was carried out in early 1976. The fish analysed included pike, roach, bream and trout and levels of PCBs in muscle tissues of these species were 0·07, 0·04, 0·05 and 0·06 mg/kg respectively and in liver 1·74, 0·27, 0·62 and 0·12 mg/kg wet weight respectively. These values are considerably less than those reported for certain freshwater fish in some other countries.

Table 9 *Concentration of PCB residues in marine fish and shellfish taken from coastal waters of England and Wales (expressed as mg/kg of wet weight)*

Species	Tissue	PCB level
Whiting	Liver	0·1–17·6
	Muscle	0·01–0·2
Cod	Liver	0·01–13·1
	Muscle	<0·01–0·04
Herring	Liver	<0·01–5·0
	Muscle	<0·01–0·72
Plaice	Liver	<0·01–2·0
	Muscle	<0·01–1·5
Whitebait	Whole	1·0–2·0
Sandeels	Whole	1·0
Sprats	Whole	0·21–0·26
Shrimps	Whole	<0·01–0·4
Mussels	Whole (shelled)	0·01–0·44
Oysters	Whole (shelled)	<0·01–0·36

93. The FACC has indicated that further information was required on PCB levels in milk, infant foods and fish and has asked for some more recent data from total diet studies. In addition the Committee felt that information was needed about the migration of PCBs from food packaging into food where there was a possibility of direct contact with food since there have been reports of their presence in recycled paper. However because of the controls over the uses of PCBs their use in carbonless copy paper has ceased and this was the major source of PCBs in packaging materials made from the recycling of paper which included carbonless copy paper. In addition controls have been applied by the European paper and packaging industries to ensure that PCBs are no longer present in their products. Consequently the Steering Group felt no follow-up work on the possible migration of PCBs from packaging into foodstuffs was necessary.

OTHER SURVEYS

Nitrosamines

94. A wide ranging multi-laboratory investigation of nitrosamines sponsored by MAFF was started in 1973. A Working Party on Nitrosamines in Food was also formed to consider the significance to human health of the presence of this class of compounds in food. As part of this exercise the Laboratory of the Government Chemist has examined a number of food commodities for nitrosamines. The results of this survey will be published elsewhere.

95. A long term intensive programme of research on dose-response relationships for carcinogenic nitrosamines has been funded by MAFF at the British Industrial Biological Research Association (BIBRA). The purpose of this programme is to evaluate any possible hazards that could arise from the consumption of foodstuffs containing very low levels of nitrosamines in the diet.

Vinyl Chloride (VC)

96. Vinyl Chloride (VC) has been shown to produce angiosarcoma of the liver both in experimental animals and in industrially exposed humans. The monomer used to fabricate polyvinyl chloride (PVC) plastic may become trapped in the plastic and migrate into food if PVC is used as a packaging material in direct contact with food. The Working Party on Vinyl Chloride was established to obtain information on the food uses of PVC, the levels of VC in PVC and food, the factors affecting the VC content of the polymer and the packaged food and the likely intake of VC from foods packed in PVC. This information has now been obtained and the VC levels in PVC and food have been monitored as part of an ongoing exercise. The results of this exercise will be published elsewhere.

Nutritional Aspects of Food Composition

97. Responsibility for the organisation of surveys on the nutrient content of food has lain primarily with the Committee on Food Composition. This interdepartmental group has conducted a number of such surveys over the years, the results of which have been published from time to time in the scientific literature. An example of its activities are the studies which have been made

into the nutritional effects of newer farming practices and food processing methods. Recently, interest has been centred on the complete revision of McCance and Widdowson's standard text book 'The Composition of Foods'.

SOME CURRENT INTERESTS OF THE STEERING GROUP

Mycotoxins

98. The toxic metabolites of the mould *Aspergillus flavus* are generically known as aflatoxins and were first discovered in the early 1960s in the UK when a large number of turkeys were overcome with a liver disease. This was traced to the mould growing on groundnut meal used in the feed. Since that time, Port Health Authorities have monitored on a regular basis all groundnut samples entering the country. In 1973, 13 per cent of all groundnut imports were found to contain aflatoxin in amounts exceeding 0·05 mg/kg and were not used for direct human consumption. Further studies have revealed that a number of other fungal metabolites with toxic properties are produced by a variety of moulds capable of growing on foodstuffs. The general term mycotoxins has been given to these metabolites and the term mycotoxicosis to the toxic syndromes produced by such compounds.

99. In the United Kingdom, mould types producing mycotoxins are most likely to be found in foodstuffs imported from tropical or sub-tropical countries where environmental conditions are more favourable to mould growth, although in recent years ADAS microbiologists and veterinary research workers have found mycotoxins in UK-produced feedstuffs including cereal grains, hays and straw stored at high initial moisture content or in damp conditions which were conducive to mould growth. Animal products may also be affected by the use of feedstuffs containing the mould and mycotoxins. The mould organisms which produce mycotoxins include *Aspergillus*, *Penicillium*, *Claviceps* and *Fusarium* species. The food commodities in which there is the greatest possibility of infection by such moulds include grains, nuts and certain milk products. Apart from the work on animal feeds there has been no broad examination of food for mycotoxins. A small survey of imported cheeses and full cream dried milks by the Laboratory of the Government Chemist failed to detect the presence of aflatoxin and examination of a few samples of corn, maize and dried beans showed that traces of ochratoxin were present. The Steering Group has therefore taken some preliminary steps towards organising a comprehensive survey of the mycotoxin content of food. This will be a multi-laboratory exercise involving a wide range of selected food commodities and consideration is also being given to the examination of total diet samples.

Pesticides

100. Agricultural pesticides are essential in the production of an adequate supply of food. Since they are designed to control undesirable living organisms, the public have rightly questioned whether any residue of pesticides remaining in food might be harmful to human health. Most chemicals when consumed in large enough quantities over a period of time will cause illness but because of the relatively low toxicity of many pesticides to humans and because the residues so far detected in commonly consumed foods are also low, most

pesticides pose little risk to human health. The United Kingdom controls over the use of pesticides are exerted by the voluntary Pesticides Safety Precautions Scheme which has operated since 1954. This scheme requires a company who manufactures products which will be used on crops for human consumption to produce evidence of residue data before the product is cleared for use. In clearing for use the Government stipulate how the product should be used, on what crops, and what special precautions must be observed. The levels of pesticide residues in food are controlled through the Food and Drugs Act 1955 under its general provisions.

101. In order to ensure that this voluntary scheme is effective in limiting residues in foodstuffs, monitoring activities in the form of selective surveys were first initiated fifteen years ago. This work which continues to this day is mainly carried out by the Laboratory of the Government Chemist (DI), together with the Plant Pathology Laboratory (MAFF) and the Pest Infestation Control Laboratory (MAFF). The monitoring programme is based on surveys of individual food products and on 'total diet' samples. In the surveys on individual foods priority for analysis is given to the staple foods in the diet and to the more common minor foods. Foodstuffs which are thought to contain higher than normal residues (e.g., consignments from an area which has suffered particularly heavy pest infestation during the growing season) are given special attention. The Panel for the Collection of Residues Data is primarily responsible for carrying out the surveys and the results are published in the Report of the Laboratory of the Government Chemist.

102. The Association of Public Analysts, together with the Local Authorities Association, has carried out joint surveys of pesticide residues in foodstuffs and a number of studies have been initiated and published by pesticides manufacturers.

103. With the control of the use of the more persistent pesticides, such as some of the organochlorine compounds, there has been a shift of emphasis in the requirements for monitoring pesticide residues. The Residues Panel largely concerns itself with collecting data in connection with pesticide usage as recommended under the Pesticides Safety Precautions Scheme although certain surveillance data and some information on imported foods are also obtained. Interest in pesticides in food both nationally and internationally has become increasingly orientated towards consumer aspects. Consequently data at the 'as consumed' stage of the food chain are now much more in demand. There is also increasing interest in the reaction of pesticides in food commodities with other components of the food. The Steering Group is therefore giving consideration to the monitoring of pesticide residues in the context of the surveillance of foodstuffs at the retail level.

Antibiotics

104. A recommendation of the Swann Report[25] was that consideration (should be given to the need for a survey to determine the presence or absence of antibiotic residues, including degradation products, in animal products (other than milk) because of the widespread use of antibiotics in animal

husbandry and the possible adverse effects this might have on their application to the treatment of human disease. A pilot survey of antimicrobial substances in pig kidney and chicken liver was undertaken by MAFF in conjunction with the Laboratory of the Government Chemist. Kidneys and livers were examined because the concentrations of some antibiotics in these tissues can be five to ten times the concentrations in muscle. At the time of the survey, the technique used was under development and the results obtained were complicated by the presence of many false positive reactions. Nonetheless, the survey was useful in highlighting this methodological problem and work is underway to overcome false positive reactions in future surveys.

105. The requirements of the Swann Committee, the need to ensure consumer protection and the increasing international pressures to limit residues in food traded between countries have resulted in the Steering Group organising a detailed study of antibiotic residues in food. Part of this study will consist of a survey which will examine the incidence and nature of antibiotic residues in red meat in the first instance.

Veterinary and Related Products

106. The likelihood of residues in food arising from the use of organic waste as animal feed (para 79) and from therapeutic and feed antibiotics (para 104) has been discussed. In a broader context there is also the possibility that residues could arise from the general use of a wide range of preparations used as animal medicaments on veterinary prescription and from other substances used in compound animal feeds, such as growth promoters, metabolic stimulants and the like. There is an increasing desire, especially within the EEC, to limit the amount of such residues present in animal products which are traded internationally and some countries are prohibiting the entry of animal products containing particular residues. Little information is available at the present time on the amounts likely to be present in meat produced in the UK and in imported meat. The Steering Group is therefore looking into the requirements for the monitoring of these residues in animal products.

Special Survey Unit

107. The difficulties in organising food surveys of a special nature, such as for defined sections of the community or in specific localities of the country, have been referred to (para 29). In order to mount such studies closer collaboration is often required both at the local level and with other government departments. A Special Survey Unit has therefore been formed within the Food Science Division of MAFF which will have responsibility for organising and executing special surveys of residues in foods. It is intended that such surveys will be linked to epidemiological and environmental studies as required. The unit will also be in a position to take effective action quickly or advise on food survey requirements in cases of sudden contamination of food from 'environmental accidents' or from other causes.

STATUTORY CONTROLS ON FOOD CONTAMINANTS

1. Control over the contamination of food in England and Wales is exercised by means of the Food and Drugs Act 1955, and in Scotland by the Food and Drugs (Scotland) Act 1956 and in Northern Ireland by the Food and Drugs (Northern Ireland) Act 1958. The succeeding paragraphs describe the 1955 Act and how its powers are used, but the broad description applies equally to the Scottish and Northern Ireland Acts.

2. Section 1 of the 1955 Act makes it an offence, *inter alia*, to add any substances to food or subject food to any process or treatment so as to render it injurious to health, with the intention that it should be sold for human consumption. Section 8 makes it an offence to sell food which is unfit for human consumption. Section 2 of the Act makes it an offence to sell, to the prejudice of the purchaser, food which is not of the nature, substance or quality demanded. Section 4 gives power to Ministers to make Regulations for controlling the composition of food. Such Regulations include the Lead in Food Regulations 1961, as amended and the Arsenic in Food Regulations 1959, as amended which lay down the maximum amounts of lead and arsenic respectively which may be present in food. In addition a number of Regulations lay down compositional standards which include maximum permitted levels for certain contaminants. The Imported Food Regulations 1968 made under sections 13 and 123 of the Act prohibit the importation of food which has been rendered injurious to health by a process or treatment or by the addition of any substances or is otherwise unfit for human consumption or unsound or unwholesome.

3. Local Food and Drug Authorities have wide powers under the Act to take samples of foodstuffs and have them analysed for the purpose of enforcing the Act and Regulations; food which is unfit for human consumption may be seized and destroyed. Sea and Air Port Health Authorities have similar powers under the Imported Food Regulations 1968 in relation to imported foods.

TERMS OF REFERENCE OF THE STEERING GROUP ON FOOD SURVEILLANCE

To keep under review, and where appropriate to make arrangements for analytical surveys of, food with special reference to additives, chemical contaminants and nutrients.

In carrying out these functions the Steering Group will:

(a) determine priorities having regard to toxicological assessments, analytical capacity, manpower requirements and other relevant factors;

(b) co-ordinate their work with such existing panels as they consider suitable to undertake specific programmes of work or to take immediate action on particular problems, and appoint further panels as they consider necessary;

(c) maintain liaison with bodies who may be engaged on similar work including Food and Drugs Authorities, Port Health Authorities, the Association of Public Analysts and overseas research bodies so as to take advantage of this work and avoid duplication;

(d) prepare reports on the surveillance and where necessary, submit findings to the Food Additives and Contaminants Committee, the Pharmacology Sub-committee(1) of the Committee on Medical Aspects of Food Policy(2), the Advisory Committee on Pesticides and Other Toxic Chemicals, the Veterinary Products Committee or any appropriate bodies.

MEMBERSHIP OF THE STEERING GROUP ON FOOD SURVEILLANCE

A W Hubbard (*Chairman*)	Ministry of Agriculture, Fisheries and Food
L G K Alderman	Department of Health and Social Security
Dr D H Buss	Ministry of Agriculture, Fisheries and Food
R F Clements	Department of Health and Social Security
T J Coomes	Ministry of Agriculture, Fisheries and Food
Dr R F Curtis	Food Research Institute
B G Derry	Ministry of Agriculture, Fisheries and Food
F M B Carpanini	Department of Health and Social Security
Dr G I Forbes	Scottish Home and Health Department
A H Goodman	Department of the Environment
K G Gostick	Agricultural Development and Advisory Service, Ministry of Agriculture, Fisheries and Food
P J Graham	Department of Industry

[1] Now the Toxicity Sub-Committee.
[2] Now the Committee on Medical Aspects of Chemicals in Food and the Environment.

T R Graham	Department of the Environment
F H Jacob	Pest Infestation Control Laboratory, Ministry of Agriculture, Fisheries and Food
Dr N R Jones	Tropical Products Institute
Dr N J King	Department of the Environment
Dr M E Knowles	Ministry of Agriculture, Fisheries and Food
M K Lloyd	Central Veterinary Laboratory, Ministry of Agriculture, Fisheries and Food
R Logan	Department of Health and Social Services for Northern Ireland
Miss H J Morey	Ministry of Agriculture, Fisheries and Food
Professor J R Norris	Meat Research Institute
Mrs L J Powell	Welsh Office
A H Strickland	Plant Pathology Laboratory, Ministry of Agriculture, Fisheries and Food
Professor J R Todd	Department of Agriculture for Northern Ireland
R E Weston	Laboratory of the Government Chemist, Department of Industry
P C Wood	Fisheries Laboratory (Burnham-on-Crouch), Ministry of Agriculture, Fisheries and Food

Secretariat:

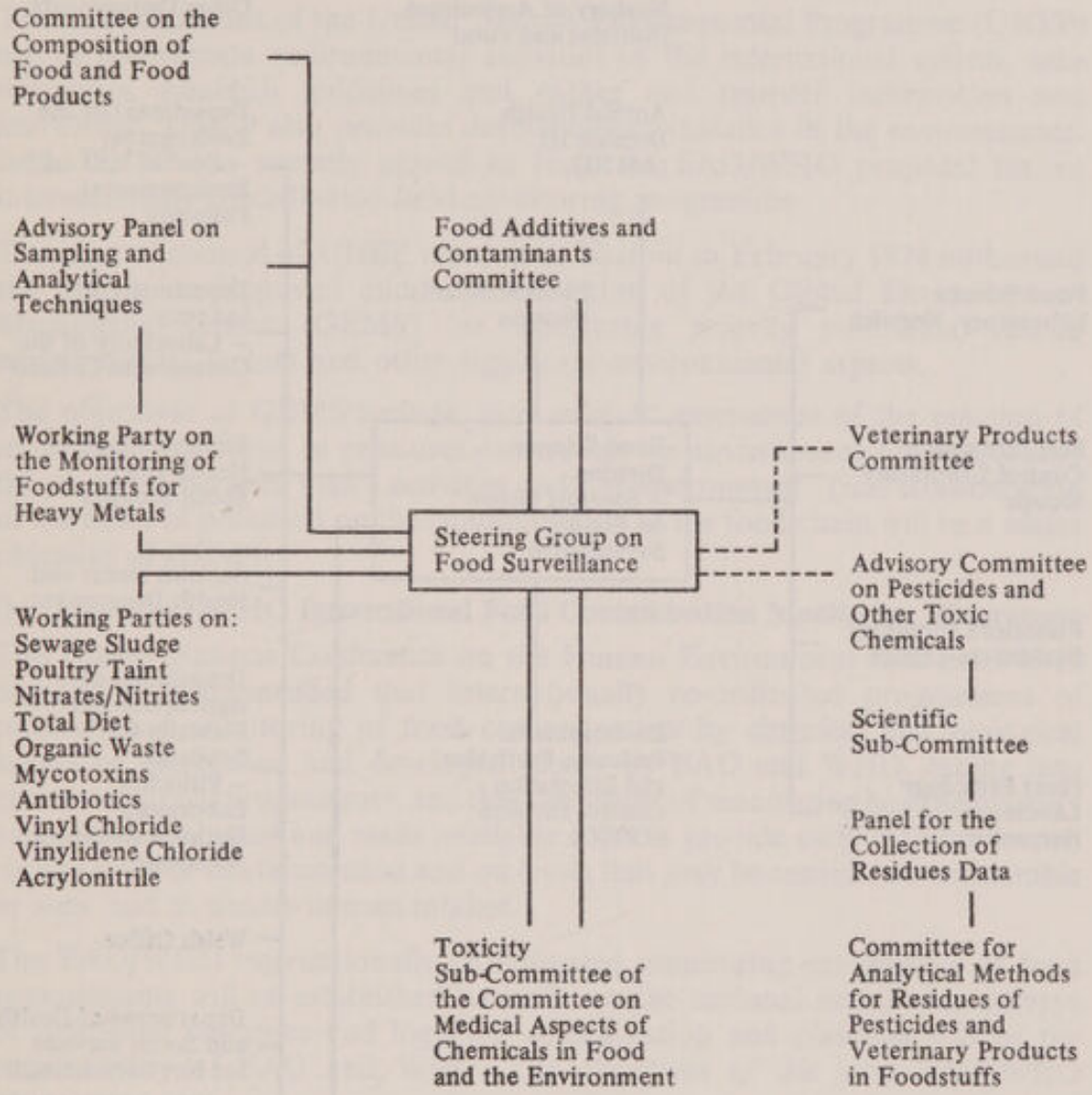
Scientific:

Dr D G Lindsay	Ministry of Agriculture, Fisheries and Food
Miss J Haxton	Ministry of Agriculture, Fisheries and Food

Administrative:

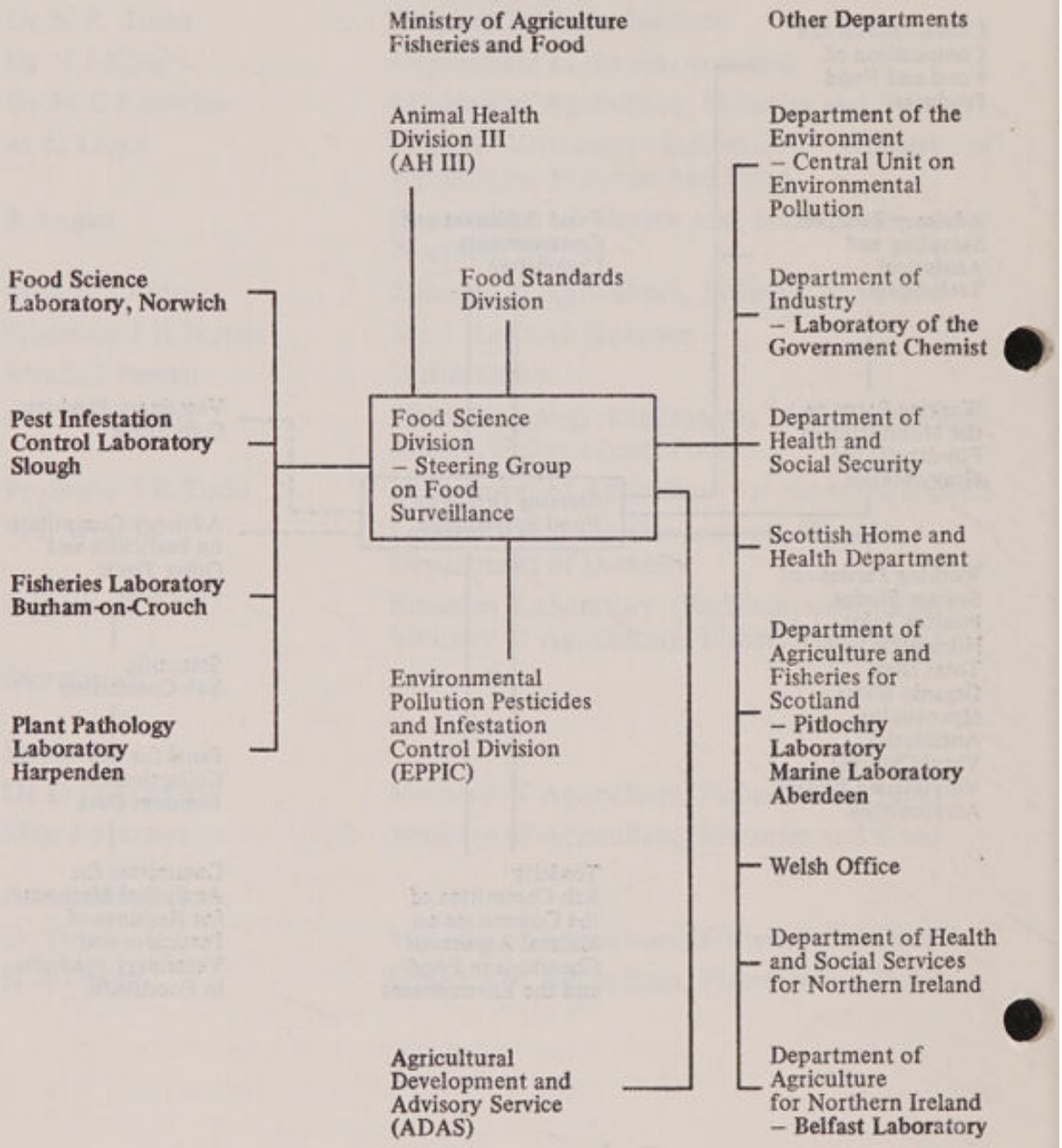
D. Tingle	Ministry of Agriculture, Fisheries and Food
R A Gregg	Ministry of Agriculture, Fisheries and Food

COMMITTEE STRUCTURE OF THE STEERING GROUP AND ITS RELATION TO OTHER COMMITTEES



APPENDIX IV

GOVERNMENT DEPARTMENTS INVOLVED IN FOOD SURVEILLANCE



Divisional Responsibilities within MAFF include:

Food Science Division—collection and interpretation of data on chemical residues in food and the provision of scientific advice on legislation.

Food Standards Division—administration of the Food and Drugs Act with particular regard to food composition and labelling.

Food Additives and Contaminants Division—administration of the Food and Drugs Act with particular regard to food additives and contaminants.

EPPIC—co-ordination within MAFF of all environmental pollution matters nationally and internationally.

Fisheries Research—monitoring of residues in marine samples.

ADAS—advice and data on agricultural residues in crops and animals.

AH III—scrutiny of licensees' data on medicinal residues in animal products.

INTERNATIONAL FOOD SURVEILLANCE

(a) United Nations Global Environmental Monitoring Scheme (GEMS)

The main functions of the United Nations Environmental Programme (UNEP) are to co-ordinate environmental activities of the international system, take initiatives, establish guidelines and gather and transfer information and knowledge. UNEP also provides development assistance in the environmental field. UNEP has recently agreed to fund the FAO/WHO proposal for an internationally co-ordinated food monitoring programme.

The general council of UNEP meeting in Nairobi in February 1974 authorised the design, development and implementation of the Global Environmental Monitoring System (GEMS) for monitoring priority pollutants, related environmental factors and other significant environmental aspects.

The objectives of GEMS include, *inter alia*, an assessment of the reaction of terrestrial ecosystems to pressures exerted on the environment and to identify the reactions between man's activities and the environment. Thus consideration of the effect of pollution on the contamination of the food chain will be a major objective of GEMS.

(b) Joint FAO/WHO International Food Contamination Monitoring Programme

The United Nations Conference on the Human Environment held in 1972 in Stockholm recommended that internationally co-ordinated programmes of research and monitoring of food contamination by chemical and biological agents be established and developed jointly by FAO and WHO, taking into account national programmes, and that the results of monitoring be expeditiously assembled, evaluated and made available so as to provide early information on rising trends of contamination and on levels that may be considered undesirable or may lead to unsafe human intakes.

The FAO/WHO internationally co-ordinated monitoring programme of food contaminants will be established basically on the national monitoring surveys of individual countries and logistics, co-ordination and planning will be the responsibility of FAO and WHO. The objectives of the joint FAO/WHO programme are:

1. To assist and advise member states of the United Nations in their efforts to develop national food contaminant monitoring systems for which they need to:
   (a) provide scientific information and data for both national and international food regulatory controls;
   (b) evaluate progress towards achieving reduced food contaminant levels by recording the attainment of defined goals;
   (c) provide a warning system to prevent or to reduce contamination of the food chain;
   (d) to collate, evaluate and interpret information of these changes in food contamination that may affect human health. This process will be based on appropriate data given by national governments in response to requests from FAO and WHO.

2. The benefits would be to:

   (a) strengthen the United Nations GEMS programme emphasising the important implication to human health particularly from food contaminants;

   (b) an improvement in the information base of the WHO environmental health criteria programme. This programme is concerned to evaluate any adverse effects on human health from environmental pollutants.

The FAO/WHO Joint Expert Committee on the Internationally Co-ordinated Food Contamination Monitoring Programme agreed in October 1974 that the initial phase of the co-ordinated international monitoring programme should cover mercury in fish and other aquatic organisms, cadmium and lead in canned foods, grains or cereal products, edible aquatic organisms, potatoes and staple crops and apples. Nuts and cereals are to be monitored for aflatoxins B1, B2, G1 and G2. Organochlorine residues in animal fats and fruit and vegetables will also be covered in the programme to which the UK has agreed to contribute.

REFERENCES

1. Ministry of Agriculture, Fisheries and Food. Press Notice No 157. 25 May 1972.
2. *Wld. Hlth. Org. Techn. Rep. Ser.* (1967), 348.
3. *Wld. Hlth. Org. Techn. Rep. Ser.* (1972), 505.
4. E. P. LANG, A. MIKALIS, H. M. BOLLINGER and J. M. DIMITROFF. (1963). *J. Ass. Off. Agric. Chemists.* **46**, 74–79.
5. J. M. HARRIES, C. M. JONES and J. O'G. TATTON. (1969). *J. Sci. Fd. Agric.*, **20**, 242–5.
6. Ministry of Agriculture, Fisheries and Food (1976). Household Food Consumption and Expenditure: (1974). Annual Report of the National Food Survey Committee. HMSO London.
7. *Wld. Hlth. Org. Techn. Rep. Ser.* (1967), 370.
8. Ministry of Agriculture, Fisheries and Food (1971). Survey of Mercury in Food. First Report of the Working Party on the Monitoring of Foodstuffs for Mercury and other Heavy Metals. HMSO London.
9. Ministry of Agriculture, Fisheries and Food (1972). Survey of Lead in Food. Second Report of the Working Party on the Monitoring of Foodstuffs for Heavy Metals. HMSO London.
10. Ministry of Agriculture, Fisheries and Food (1973). Survey of Mercury in Food. A supplementary Report. Third Report of the Working Party on the Monitoring of Foodstuffs for Heavy Metals. HMSO London.
11. Ministry of Agriculture, Fisheries and Food (1973). Survey of Cadmium in Food. Fourth Report of the Working Party on the Monitoring of Foodstuffs for Heavy Metals. HMSO London.
12. Ministry of Agriculture, Fisheries and Food (1975). Survey of Lead in Food. A supplementary Report. Fifth Report of the Working Party on the Monitoring of Foodstuffs for Heavy Metals. HMSO London.
13. Department of the Environment (1977). Lead in Drinking Water. A survey in Great Britain, 1975–1976. HMSO London.
14. Ministry of Agriculture, Fisheries and Food (1975). Food Additives and Contaminants Committee Review of the Lead in Food Regulations, 1961. HMSO London.
15. A. G. KOLBYE, K. R. MAHAFFEY, J. A. FIORMA, P. C. CORNELIUSSEN and C. F. JELINEK (1974). *Env. Health Perspectives*, 7, (12), 65–73.
16. Royal Commission on Environmental Pollution (1974). Fourth Report. Pollution Control—Progress and Problems. Cmnd. 5780. HMSO London.
17. A. L. PAGE, F. T. BINGHAM and C. NELSON (1972). *J. Env. Qual.* **1**, 3.
18. R. S. BRAMAN and C. C. FOREBACK (1973). *Science*, **182**, 1247–9.
19. J. C. MERLANGER and D. G. SMITH (1972). *Can. J. Pub. Hlth.* **63**, 53–7.
20. WHO (1970). European Standards for Drinking Water. 2nd Ed.
21. R. WALKER (1975). *J. Sci. Fd. Agric.* **26**, (11), 1735–42.

22. D. G. LAND (1975). The quality of poultry meat. Proc. 2nd Symposium on Poultry Meat Quality. Ed. B. Erdtsieck, PUDOC, Wageningen Paper No 32.
23. K. E. WEBB and J. P. FONTENOT (1975). *J. An. Sci.* **41**, (4), 1212–17.
24. T. H. JUKES (1973). *Adv. Appl. Microbiol.* **16**, 1–30.
25. Report of the Joint Committee on the use of Antibiotics in Animal Husbandry and Veterinary Medicine (1969). Cmnd 4190. HMSO London.

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