Papers and Originals

B Agriculture and the Public Health* X

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The Zoonoses

Animal health and human health are closely interrelated because biology is indivisible. As regards the diseases common to both, the zoonoses, of which something like 140 have been listed, I am concerned only with those involving farm livestock. Apart from effects on man these diseases exert a profound effect on the practice and standards of agriculture and animal husbandry.

The quality of agriculture in any country determines human nutritional standards, so our profession cannot ignore the basic biological processes setting such standards. It is a sobering thought that the principal cause of the rise in world population is due to medical technology. A Frenchman, Dumont (1969), has expressed this forcibly. "The phenomenon of underdevelopment lies essentially in the fantastic gulf between a runaway population growth and a stagnant economy. By sending our doctors and missionaries to these countries before our agronomists, we have enabled their children to survive epidemics but not to have enough food to live decent lives."

With past major public health problems mostly under control, there is now opportunity to deal more purposefully with the animal infections likely to affect man. Indeed this is necessary because it is apparent that the spread of disease from animals to man is increasing, owing to modern techniques in animal husbandry and in food processing.

Brucellosis

Brucellosis is much in the news because of the present campaign to eradicate this disease from our national herds. It is often stated that the only causal microbe in this country is *Brucella abortus*, but this is not so. Instances of *melitensis* infections, now labelled *Br. abortus* type 9, occur here, and recently I was consulted about an outbreak in a dairy herd which infected its owners. This all arose through an immigrant navvy employed on a large public works contract fouling some land to which cows had access. Such imported infections are in the future likely to be more frequent and serious than formerly owing to the rapid increase in human movements between the Continent and these islands. Another instance of how unwanted infections can be introduced is provided by the seven cases of human *Br. melitensis* infection after eating contaminated Italian cheese (Galbraith *et al.*, 1969).

While *Br. suis* can be regarded as an infection seen only in the U.S.A. there has been one outbreak of this in pigs in the U.K. Just how it arose was never discovered, and fortunately it was confined. *Br. suis* infections, mostly occurring in Chicago slaughtermen, demonstrate the invasive powers of brucellae through small skin abrasions. This frequent portal of entry of brucellae into the human body, first observed by Morales Otero (1929), has been rather disregarded, emphasis being on these infections acquired orally. Many of the recent cases of brucellosis in those handling cattle have been in people who have not even drunk unpasteurized milk.

The true incidence of human brucellosis in the U.K. is difficult to determine because the disease is not notifiable. A recent survey (to be published) was made among veterinary surgeons in Northern Ireland, a region where cattle-keeping standards are high. Out of 123 subjects examined, 100 had significant agglutination titres in their sera and 50 showed clinical evidence of infection.

The first move to do something positive about brucellosis in cattle was made exactly 60 years ago. At that time the Devon Farmers Union (1910) urged the government of the day to help in the eradication of abortion and tuberculosis; however, nothing was done. The eradication of brucellosis is an operation full of hazards because of the bizarre nature of the disease and the persistence of the causal pathogens, which, even in ordinary soil, can remain viable for as long as six months. In animals the time is much longer, probably several years, so brucellae can be excreted in milk or droppings quite unpredictably. This feature in itself raises problems when protective vaccines like S19 and 45/20 are used, because S19 contains attenuated living microbes. Since we know that brucellae are characterized by persistence, where do they go after they have been injected? The only time you can be sure where they are is in the vaccine bottle or in the syringe with which the calves are vaccinated. The vaccine can easily produce the disease in man, as is convincingly shown when someone has been accidentally injured by a syringe needle during a vaccination session.

The popular indicator for bovine brucellosis is a serum agglutination test. In the absence of overt disease it is still impossible to say what is a significant titre. The same considerations apply to human sera similarly examined; as many as 10% of human sera show a level of antibodies to *Br. abortus* suggesting active infections, yet these people have never suffered any illness. Within the past few years two new tests have been developed which distinguish between recent infections and others (Kerr *et al.*, 1968).

The significance and trustworthiness of existing serological reactions have been called in question during the national eradication campaign now in progress. Some of the findings have been quite amazing; apparently healthy herds have come up with many positives, whereas other herds with few or no reactors have suddenly had clinical abortion due to frank disease. What is really serious, however, is that the Government scheme as it stands, a voluntary one, permits farmers, who blood-test their herds voluntarily, to sell reactors without disclosing that they have ever been tested. This matter was discussed recently in the House of Lords.

Leptospirosis

Though Inado and Ido in 1915 discovered the cause of Weil's disease, in which rats are so often implicated, years were to elapse before it was realized how extensively the animal kingdom is permeated by spirochaetes, many of which are facultative pathogens. It is often said, probably with truth, that half the rats in this country are carriers of some variety of leptospirae, but, somewhat surprisingly, the incidence of human infections with *Leptospira icterohaemorrhagiae* is declining.

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Whereas not so long ago about 100 cases occurred annually, in 1967 there were only eight reported cases and in 1968 seven.

Hitherto the most widespread spirochaetal disease of domestic animals has been *L. canicola* fever, with jaundice, in dogs. This is easily transmittable to man, causing an illness, without jaundice, somewhat resembling meningitis. Dogs may be infected with *L. icterohaemorrhagiae* and this is now the commonest type of infection (J. A. Boycott, personal communication). I have seen how the incidence of "yellows" in hounds is directly related to any rat infestation of Kennels. Get rid of rats and you get rid of "yellows," likewise the infectious fluxes to which hounds are prone, particularly as puppies. *L. canicola* has now become established in pigs, and several human infections from this source have been reported. *L. pomona* is generally regarded as the common infection of pigs, but no human infection with this has been known to occur here; in other countries it causes swineherd's disease.

The fairly recent recognition of leptospirosis in cattle presents a new biological problem, emphasized by the frequent positive tests on Continental bulls proposed for importation to improve British beef production. Of 400 bovines recently tested, some 300 were infected with *L. icterohaemorrhagiae*. In turn British cattle are now being tested, but the extent to which these may be infected or act as carriers must remain unknown until more data are available.

Already it is clear that bovine leptospirosis is not merely a disease of veterinary importance. It is directly communicable from cows to man, and four instances of this have occurred. The mechanism of how these men became infected is unknown. In the herd involved no leptospirae could be identified in the urine of 20 cows examined, 15 of which showed significant leptospirosis agglutinins to the hebdomadis group, generally regarded as primarily an infection of voles. Of special interest is the fact that a number of rodents trapped on the farm which were suspected to be a reservoir of infection were all negative for leptospirosis.

The risk of spreading leptospirosis by bovine carriers is rapidly receiving world-wide recognition, and many countries importing livestock from the U.K. now require these to pass an agglutination test against *L. icterohaemorrhagiae*. Over the years I have often done agglutination tests on my own stock with completely negative results. Last year, however, to our surprise a home-bred heifer reacted 1:20 to *L. icterohaemorrhagiae*; a low titre, but there it was. To try to clarify the position Colonel Hart at Millbank kindly retested her for me against various varieties of leptospirae, some of which, so far as we know, are not found in this country. The results of the investigation (Table I) showed low but positive titres, whereas all the other bovines with which this heifer was in contact were negative. An immunological mystery is how human or animal sera can sometimes show reactions to infections which the subjects have never suffered from or been in contact with.

TABLE I.—*Leptospiral Titres in Pedigree Heifer (retest)*

Icterohaemorrhagiae (R.G.A.)	1:10	Erinacei-auritis (607)	1:10
Copenhageni (Coppard)	1:30	Erinacei-auritis (W.V.14)	Neg.
Ballum	1:10	Australis	1:30/1:100
Castellonis	1:10	Bratislava	1:100
Bulgarica	1:30/1:100	Pomona	1:10

Metazoal Infections

The metazoal parasites of animals are of importance to man by the risk of infection via the butcher's slab. Fortunately meat inspection in this country is so well done that few carcasses with obvious cysts or other faults escape notice. Recent inquiries I have made from butchers show that it is extremely rare for them to receive meat infected in any way. In most countries meat inspection is required to be done by veterinary surgeons—a great drain on a profession with limited personnel. In Britain, on the other hand, inspection is competently

done by public health inspectors, who receive special training for this work. In 1968 15½ million carcasses were inspected, which indicates what these inspectors do (Table II).

TABLE II.—*Meat Inspection 1968*

No. of carcasses inspected	15,500,000
Total rejections	49,500
Partial rejections (excluding tuberculosis and cysticercosis)	2,750,000
Tuberculosis { Pigs	110,000
Bovines	950
Cysticercosis	4,500

Fortunately, except for fluke disease and the rare case of orf and of louping ill, no common disease of sheep is transmittable to man. Owing to the increasing size of roaming flocks and the wet summers of the past few years *Fasciola hepatica* has spread alarmingly in sheep. As a result, more contamination of streams with infected snails (*Lymnaea truncatula*) has occurred and caused a sharp increase in the human incidence of fluke disease. This has always been due to the consumption of wild watercress infested with cercariae. Stringent precautions have always been taken by commercial growers of watercress to prevent their water supplies becoming contaminated by sheep, but most large cress growers, who supply 95% of the market, now get their water from artesian wells. Full chemical control of snails is usually impracticable, but, fortunately, flocks of ducks will often clear snails effectively, though this is not a method of universal application.

It is understandable that much veterinary practice is based on human medicine. Still, the therapeutic use in animals of medicinal agents devised for use in man is not entirely a one-way traffic. For instance, there would probably be no phenothiazine compounds or methylpolysiloxane in human therapeutics but for initial veterinary experiences with their potentialities. Further, guidance from veterinary surgeons has made it possible for domestic pigs to play an important part in experimental medicine and, more recently, in organ transplant techniques. A great deal more could be done in the way of finally screening potential drugs for human use in the larger domestic animals, whose size and economy reflects that of human beings more realistically than laboratory rats and mice. Of interest may be the fact that the acceptability tests on the early injectable sulphonamides were made on some of my own sheep. Initial experimental therapeutic trials of certain types of drug should also be possible, and thereby overcome some of the difficulties, both ethical as well as practical, in bridging the gap between laboratory findings and initial human application.

Control of Infections

Diseases common to man and farm livestock can be controlled. There are two main ways by which this may be done. There is preventive inoculation or vaccination to control overt infections together with reduction in the number of clinical cases by selective treatment. The other way is to raise the general hygiene of animal husbandry together with the application of what is already known about epidemiology in general.

Preventive Inoculation

From the very nature of things animals live in contaminated surroundings. Provided they have an immunity to any pathogens which may infest these surroundings, all is fairly well until the time they meet an overwhelming infection. But under field conditions how are you to eliminate gross contamination simply by ordinary physical cleaning and disinfection? Disinfection of environment can be useful only when the parasite does not pass direct from host to host, but the

better use of modern fogging techniques opens up fascinating possibilities to limit aerial spread.

Certain viral and microbic diseases of livestock can now be contained by picloxydine preparations developed from those originally introduced to assist in controlling cross-infections in hospital wards (Couston and Campbell, 1967). Interest in better control of animal infections was further stimulated by a suggestion I made at the time of the foot-and-mouth outbreak in 1967, when certain picloxydine products were examined experimentally against the causal virus. Ultimately, by a slight adjustment in composition, it was found possible to produce a viricidal solution which should be valuable in helping to control future ravages of this serious disease. Recommendation about its use have already been made by the Ministry of Agriculture. Time will show how far it may be possible to apply these findings to limit the spread of human viral disease.

Standards of Hygiene

Another way by which animal diseases affecting man can be prevented concerns the conditions under which certain foods are produced. Milk provides the most striking example. As Mr. C. D. Wilson has said, a great deal of milk is still produced under conditions which would not be tolerated in a public lavatory. Fortunately, by persuasion, sweetened with Government grants of various kinds, standards on all dairy farms are steadily improving. Throughout the campaign to improve the conditions of milk production, there has been the retarding effect of pasteurization, a marketing process often relied on to cover up production faults. It was introduced in the early years of this century by farmers some distance from London to ensure that milk was not sour by the time it ultimately arrived on metropolitan doorsteps. It also helped to lessen the incidence of human tuberculosis of bovine origin until this disease was eliminated at source. For many years I have been an opponent of overreliance on pasteurization; not because I doubt its ability to provide a short answer to problems of infection, but because pasteurization has been regarded as an end in itself rather than simply as a means to an end—namely, to gain time to raise the standards of milk production. The idea of eating, or rather drinking, sterilized dirt is never pleasing.

It is claimed that pasteurization has little effect on the composition of milk; indeed, the only proved effect cited is a slight reduction in its ascorbic acid content, which can readily be replaced in the human diet by other means. The ascorbic acid content of other articles of food, however, is falling owing to the increase in prepacking and tinning. But there is another and more serious aspect of pasteurization of milk. I would draw your attention, even 25 years after the work was done, to the experiments made by Pottenger (1946). He studied the effect of pasteurized milk in the diet of many generations of cats examined under strictly controlled conditions.

These cats steadily declined in their general health and physique, their reproductive power gradually faded, and, finally, the surviving cats on pasteurized milk died out, whereas the controls were hale and hearty some years after the experiment started. It is often said that animals used experimentally are not man, and man is a very resistant animal to unfavourable conditions; however, these experiments sound a warning. Results like these certainly make you wonder whether the regular use of dried or reconstituted milk for domestic purposes may be desirable.

There are many things going on in connexion with the modern production and preservation of foods that are altering the whole character of the nation's diet. It might well be in the public interest that this College should investigate the long-term effects that modern food processing and preserving may have on the common welfare.

Increased Productivity

One thing that can be done almost anywhere in the British Isles to meet the increasing demands for food is to increase the yield per acre of our remaining land without it is hoped causing soil impoverishment. In the past 10 years food production here has actually increased by 44%; but the law of diminishing returns is now beginning to operate. Here I might quote something written to his sons in 1655 by Sir Richard Weston of Sutton, Surrey: "You will find the Improvement by Husbandry (after you have once had experience of it) to be very pleasing to you and so exceeding profitable; that it will make you diligent: for no man of any Art or Science (except an Alchemist) ever pretended so much gain any other way."

Among the various methods to increase productivity two are of great medical importance—namely, the insecticides and the selective herbicides (commonly called "weed-killers"), and the very words indicate that these are potent chemicals. Insecticides are available to control more than 3,000 different species of insects which infest crop plants everywhere and cause untold damage. Herbicides can reduce many competitive weeds, which in this country alone cost farmers several million pounds sterling every season, while the fungal disease of corn crops is causing much more concern, too.

Unfortunately, much of the chemical research behind these new products has been rather fortuitous and has resulted in an array of active compounds, many of which are toxic to man and animals unless carefully handled.

Compounds Used in Agriculture

The classes of compounds used in agriculture fall into four groups: (1) chlorinated hydrocarbons, typified by D.D.T. (dichlorodiphenyl trichlorethane) and B.H.C. (benzene hexachloride); (2) organophosphates, typified by parathion (O, O-diethyl O-*p*-nitrophenyl phosphorothionate); (3) the carbamates typified by protham (isopropyl *N*-phenylcarbamate); and (4) the "hormone type" represented by 2:4-D (2:4 dichlorophenoxyacetic acid) and M.C.P.A. (4-chloro-2-methylphenoxyacetic acid). The first three groups are used as insecticides and the last as weedkillers which attack broad-leaved plants without damage to grass or cereals.

The toxic effects of these compounds on man and animals can be immediate or delayed, and many cases of acute and even fatal human poisoning have occurred after contact with them. In this country since the Agricultural (Poisonous Substances) Regulations were made in 1952 only one fatality has occurred and that by a product now withdrawn from sale. Organophosphates are cholinesterase inhibitors and carbamates are nucleotoxic, so poisoning by them can easily prove fatal, and the use of such compounds is controlled, or even prohibited, in some countries.

The chlorinated hydrocarbons have been in use for about 25 years and D.D.T. is the most widely distributed man-made chemical on earth. The good results from their use have been outstanding, particularly in underdeveloped countries. For most of this time these compounds have been regarded as not very toxic unless grossly misused. Because of uncertainties about the chronic toxicity of the chlorinated hydrocarbons and the possible inherent dangers to animals and plant life their use is being banned in Sweden, Denmark, and Canada. Only last week the use of D.D.T. in agriculture was also banned in New Zealand. Two months ago, however, in a report to H.M. Government, an Advisory Committee concludes that the use of D.D.T. and related compounds is not the serious health hazard that has been feared, provided that reasonable care is taken. A recent survey in the U.K. actually revealed an average human tissue level of 3 p.p.m. of D.D.T.

With existing disquiet about the ultimate effects on man of many of the various chemicals coming into agricultural use, it

is important to note as well the opinion expressed in the most recent report of the Government Chemist (Ministry of Technology, 1968): "From the standpoint of health it is reassuring to discover that so many of the items of human diet in Britain harbour only negligible amounts of these pesticide residues and that the total load, toxicologically speaking, is not excessive." In the U.S.A., however, the extensive use of pesticides has resulted in accumulations in man, particularly in body fat, which, it has been remarked, by our standards make Americans uneatable.

Despite what I have said, we must remember that many compounds used do not degrade easily under normal biological or weathering conditions, so their ultimate fate remains obscure. Indeed, the problem of the physician and the farmer is much the same; both use compounds of whose total effect they often have very little idea. The compounds commonly called weed-killers are, fortunately, remarkably non-toxic provided that they are handled and used sensibly. No one can blame farmers in this country for using compounds which have made modern farming systems possible, and many farmers can survive only by using new aids.

Chemical research is constantly finding new compounds, but it may take years to be sure that these exert no long-term ill effects. Since it is said to cost nearly £1m. to devise and launch one new product it is understandable that manufacturers are anxious to market them as quickly as possible. Drink and tobacco may claim its thousands, but unless we are continually watchful modern synthetic chemistry may claim its tens of thousands.

Animal Husbandry

As agricultural expansion progresses morbidity and mortality among domestic livestock tend to increase, despite all we know about disease control. What can be done? Well, to raise the standards of animal husbandry by trying to keep stock in physiological surroundings and free from access to pathogens to a degree not previously thought possible. Another thing we can do with animals is to increase their actual yield. By yield I do not mean just the extra milk which can be got, say, by good cow management and forced feeding, but actually increasing the efficiency and rate of food conversion of all domestic animals. I mention this matter of food conversion because increasingly large amounts of animal food are imported. The question arises, indeed, as to what extent it is desirable to import food to be eaten by animals in this country rather than to import the finished animal fed more cheaply in its country of origin. On the whole our standards of livestock husbandry here are already so good that probably we can do better by importing foodstuffs to supplement home-grown supplies.

Without greatly increasing costs much can be achieved by detailed improvements and applying biological principles to better effect. Here I might venture to cite a little personal experience. Twenty years ago the average annual yield of dairy cattle in this country was about 550 gallons (2,500 litres), which has steadily risen to the present 800 gallons (3,635 litres). This latter might be regarded as a low figure when you see at shows or read in newspapers about cows which produce up to 2,000 gallons (9,090 litres) in a single lactation: cows that do this sort of thing are genetic freaks. Many years ago I gradually changed from some other breeds to the smaller Irish Dexters, which by their special qualities offered tempting scope for development. When I first kept them this breed had an average yield of about 500 gallons (2,270 litres) per lactation, only just below the national average here. But it has been possible to raise the herd average in my own establishment to well over 700 gallons (3,180 litres) per lactation with a food conversion rate, on a weight-for-weight basis, half as much again than required by the larger cows popular at the moment. This has been done by selective breeding to improve

their udder conformation, and to breed cows of a somewhat different configuration from what was accepted practice, but which has greatly increased their overall efficiency.

Factory Farming

Continuing the matter of better food conversion rate brings me to the subject of factory farming, which is here to stay. This is a way to use land more economically and to improve food conversion rates in poultry, pigs, calves, and now lambs, so as to make them more plentiful for human food. In European countries and the U.S.A. the new techniques enable the protein requirements of increasing populations to be met adequately. Elsewhere in the world protein shortage, the real basis of hunger, steadily increases, and will increase so long as population control and modern farming methods are ignored.

In farming, when you are dealing with animals there can be kindness and animal sympathy, but sentiment and emotion must be regulated. Every farmer knows that badly treated livestock are bad doers, yet some recent events, widely reported, could make you imagine that only people in towns know anything about the care of livestock. Indeed, many really important matters actually affecting nature conservancy, about which countrymen are the most fitted to judge, have become controversial simply through the misguided efforts of urban do-gooders. It is a pity that more of the public zeal and money for animal welfare is not devoted to the care and circumstances of many of our children. Some people judge animal reactions by human reactions; animals cannot be dressed in human clothes—to try to do so is misleading. To give an example. Recently during lambing two ewes got on their backs and were later rescued. While they were on their backs foxes had eaten away their udders and part of their belly flesh. Immediately these ewes had been turned up they rushed around looking for their lambs quite oblivious of what, I imagine, must have been intense physical suffering.

It is quite evident that livestock in intensive units, as conducted at present, are more prone to disease than those reared in conventional surroundings. In fact we are seeing in animals the sort of things known to happen to human beings under crowded conditions. Two main clinical groups of diseases affect intensive husbandry. Firstly, there are the usual epizootics common in livestock and almost entirely confined to animals, such as bovine virus pneumonia and the avian leucoses. Secondly, there are the infectious fluxes, often due to microbes pathogenic to man. It is this group of diseases which is so disquieting owing to the new reservoirs of potential human microbic pathogens which not only may be established but are being established. Whether certain viral infections can behave similarly remains to be seen.

Use of Antibiotics

In these intensive units great use has been made of antibiotics and kindred drugs, not only in attempts to provide cover against infections but also as additives to feeding-stuffs. The growth rate of young stock may be enhanced by food additives such as penicillin, tetracyclines, and certain nitrofurans, and these have been increasingly used for over 15 years. Such drugs have often been also used therapeutically without adequate veterinary supervision, and some dealers have actually included a packet of drugs when delivering stock to customers. All this has filled many of us with dismay.

In 1960 a special committee was set up simply to review the possible consequences of antibiotic feeding. This committee considered that the then current practices and legislation about the use of additives were satisfactory and that the economic benefits outweighed what were regarded as theoretical hazards. Had a couple of dog-and-stick farmers been members of the committee I think its opinion might have been different. The

findings of this committee seemed to be in direct conflict with all that has been discovered in the past 30 years about drug resistance; indeed, five years before this committee reported came the first warnings about the phenomenon of transferable drug resistance. This resistance in microbes can be started by contact many generations back, and now we know it can affect all the common pathogens. Under farmyard conditions, where the number and varieties of microbes are high, the effects of transferable resistances are obvious. Dr. E. S. Anderson (1968) even suggested that transferable drug resistance may well have been assisted by attempts to provide antibiotic "cover" in herds, a practice that has been widespread.

Mercifully in 1968 the Swan Committee was appointed to review the situation again. Its recommendations last November to restrict or prohibit the free-for-all use of antibiotics in husbandry have been widely reported, and the form of the likely forthcoming legislation is well known. Despite what has already been said publicly about the economic effects of these recommendations, experience shows that good stockmanship can produce results just as good as those believed to be obtained, but often not achieved, by antibiotic food additives and "cover."

The special consideration at the moment of chloramphenicol, widely used in animals, is important. This drug can cause transferable resistance in almost any of the enterobacteria, which, in turn, could nullify its efficacy in human typhoid. Drug-resistant strains of *Salmonella typhi* have already been reported from several countries, in some of which chloramphenicol is on free sale (Agarwal, 1962; Njoku-Obi and Njoku-Obi, 1965). Recently in France there have been instances of drug resistance in *S. paratyphi B* isolated from cases of enteric fever (Chabbert, 1967).

Slurry

The new units and modern farming practices have also added to the increasing public health problem of slurry disposal—particularly if this waste contains salmonellae or other pathogens and ova. Slurry is essentially a semi-liquid water emulsion of animal droppings, mainly from cattle and pigs, together with rotten organic material such as bedding straw. Varying quantities of slurry have always existed on any farm carrying livestock, and its effective disposal in the past has never given trouble. It was scooped up and tipped on to the dung-heap, which just mopped it up before the heap was periodically spread on to the land. Also, there were no such things as concreted yards, and much slurry just soaked into the ground. But recently several things have happened which are generally regarded as farm improvements. Concrete has replaced gravel, or nothing at all, so that slurry now drains off hard surfaces and probably reaches a near-by watercourse, while more plentiful water supplies have permitted hosing down. It is somewhat paradoxical that hosing down in and around dairies or yards, a practice encouraged in the interests of public health, has produced another more serious one with contaminated waste water.

Liquid farm waste of any kind is very difficult to purify because of its high microbic and organic content; further, various infections of domestic animals and birds are spread in their excreta. An average sample of slurry contains as much as half of organic solids. The organic material in the concentrated daily slurry from just a large pig farm with 400 head is equivalent to that from a town of 10,000 inhabitants. So if farm waste is diverted into a public sewer, local authorities may have to enlarge their sewage treatment plants to cope with the additional load. Thousands of farms with a slurry problem are nowhere near any sewer into which to drain, so the obvious thing is to try to return slurry to the land. To spread quantities of watery slop on some kinds of land is always difficult and in the winter often impossible. So once again watercourses become contaminated, with the remote

consequences you can imagine. All this has created a need for the domestic treatment of slurry on site before it is permitted to drain away on to land or into streams. Any form of treatment on site is very costly, and at present the capital and running costs to any farm with a slurry problem amounts to something like £3 per 1,000 gallons (4,545 litres).

Fertility Farming and Health Foods

It must be clearly understood that the preservation of soil fertility has ever been the guiding principle of British farming. An important factor in successful growing of corn or of grass for livestock is the maintenance of soil structure which has been achieved by ploughing in cellulose of many kinds. The yields of corn or grass grown in this fashion remain surprisingly constant. To obtain higher yields more plant foods must be made available in the soil. Heavy corn crops will denude land. Though the Romans knew nothing about soil chemistry, they discovered that regular liming helped to maintain yields. With more knowledge of chemistry in this day and age it is agreed that selected extra minerals down the spout of a corn drill are even more effective provided always that soil structure is preserved.

The yields per acre of wheat in this country at 10-year intervals since 1885 are given in the Chart. The sudden

Ninety years' progress in wheat yields.

increase in yields since 1946 has been due to the wider use of modern fertilizers. In contradistinction to these national yields the yields from purely organic farming are rather pitiful. At one experimental farm the wheat yield is but 23 cwt. (1,170 kg.) per acre, and other corn crops are in keeping. There are categorical statements that in long-term human health "organic" farming has such advantages. No evidence in support of these ideas has, so far as I know, ever been adduced.

We must face up to the fact that the British public has very little interest in food values. In a recent survey only 6% of people questioned even knew what good nutrition meant. What is more disturbing is that in the same survey only 2% said they learnt anything about this from their doctors, though 26% had received advice about what foods to eat or not to eat. Just what should constitute the national diet is, in the end, a medical responsibility. If this responsibility is avoided then amateurs and faddists will accept it and attempt to guide the public. Inevitably food production must increasingly come under biological control, and we have a duty as doctors to ensure that this is done in such ways that the public health benefits to the utmost.

While we must not fall into the error that modern technology and even legislation can solve all the riddles of life, we already possess sufficient knowledge to solve many of the problems now confronting us in agriculture. The thing is to ensure that such knowledge is properly applied without loose

thinking or commercial carelessness permitting some of the situations I have described to get out of hand.

No form of biological development should be allowed to become isolated, otherwise there is a danger that medicine or agriculture may come to be regarded as collections of technical achievements. To permit this loses sight of the interrelationship of human needs and problems, something possibly in the mind of the Apostle Paul when he stressed the dependence of the parts of the body upon each other and the surroundings.

Positive health and preventive medicine in all aspects are as important today as ever. The concept was first propounded by Xenophon over 2,000 years ago in the words: "As there are persons who mend torn garments, so there are physicians to heal the sick; but your duty is far nobler and one befitting a great man—viz. to keep the people in health" (Xenophon, *Cyropaedia*, i, 6).

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Follow-up Study of Physical Growth of Children Who Had Excessive Weight Gain in First Six Months of Life

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Methods

Summary: The aim of this study was to determine whether excessive weight gain in the first six weeks, three months, or six months of life was correlated with overweight and obesity at the age of 6 to 8 years. One hundred and thirty eight infants with excessive weight gain in the first six months of life, 53 children with slow weight gain, and 33 children with an average weight gain were re-examined at the age of 6, 7, or 8 years.

The mean height and weight of children who had gained weight rapidly in infancy were significantly higher than those of children who had gained weight slowly; those of infants whose weight gain had been average fell in between. The number of obese children in the rapid-weight-gain group was significantly higher than that of the combined average and slow-weight-gain groups. The rapidity of weight gain in infancy was a better guide to the risk of overweight in later childhood than the weight of the parents.

Introduction

The treatment of obesity is difficult and unsatisfactory; it is therefore more important to prevent its development than to wait until the child is severely obese before treating him. It has been suggested that obesity in the early years is likely to be followed by obesity in later childhood and adult life, though Mossberg (1948) claimed that this was true only when there was more than one case of obesity in the family. Asher (1966) compared the subsequent weight of 21 children whose weight was above the 97th percentile in the second half of the first year with that of 24 controls; at 5 years the weight of the former was significantly greater. Asher also found that of 269 children attending an obesity clinic in Birmingham 46% had been overweight in infancy. Takeya *et al.* (1967) followed up 101 infants who were overweight in infancy and found that they were overweight three years later.

The present study was planned in order to determine whether excessive weight gain in the first six months presaged overweight in later years.

The records of all babies born alive at the Jessop Hospital, Sheffield, in 1961 were reviewed, provided that the babies weighed 2500 g. or more at birth after a gestational period of 38 weeks or more and were followed up at 6 weeks, 3 months, or 6 months of age in the baby clinic. These babies totalled 878, 474 of whom were intended for study. They were divided into three groups, on the basis of their weight gain by 6 weeks, 3 months, and 6 months, the tables of Tanner *et al.* (1966) being used. The groups were as follows:

Group R (rapid weight gain)—306 whose gain was above the 90th percentile.

Group M (average weight gain)—72 whose gain was around the 50th percentile.

Group S (slow weight gain)—96 whose weight fell below the 10th percentile.

Mothers were asked to bring their children to the Children's Hospital, Sheffield, for measurement. If they were unwilling to come, school health records were used. A total of 178 children were examined personally and data concerning a further 46 were obtained from the school health records. These 224 children fell into the following groups: R 138, M 33, S 53.

The mean birth weight of the children included in the study was virtually the same as that of the original entire group (Table I). The standing height was measured by Har-

TABLE I.—Comparison Between Mean Birth Weights of Original Groups and Followed Groups

Group	Mean Birth Weight $\pm$ S.D. (kg.)		Difference
	Original Groups	Followed Groups	
R	3.364 $\pm$ 0.464	3.385 $\pm$ 0.150	0.021
M	3.405 $\pm$ 0.495	3.347 $\pm$ 0.504	0.058
S	3.554 $\pm$ 0.509	3.630 $\pm$ 0.215	0.076

penden Portable Stadiometer. The child stood bare-footed, with slight traction upwards on the mastoid processes. The head was positioned so that the child was looking directly forward, with the Frankfort plane (external auditory meatus to the lower margin of orbit) and the binauricular plane hori-

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