

disturbance of equilibrium, which at the next filling results in fresh peptone being absorbed while the nitrates, ammonia, amido-bodies, etc., are eliminated.

The results obtained with Filter C, which was in effect a kind of septic tank, were only such as were to be expected. They show that without oxygen no satisfactory regeneration is possible. The apparent increase in the amount of "oxidisable organic matter" is due partly to the presence of reduced salts of iron (derived from the clinker) which interfered with the test, and partly to the fact that the products of the anærobic fermentation of albumen and of peptone often show a higher value for the oxygen absorbed than the mother-substance.

To sum up the main points of my thesis:—

1. A biological filter eliminates from sewage dissolved putrescible substances almost immediately.
2. This elimination does not *directly* depend on the presence of micro-organisms.
3. As the substances in question are almost all colloidal it is highly probable that the force at work effecting their elimination is absorption.
4. But absorption does not go on indefinitely. To ensure its continuance a change—"mineralisation"—must take place in the absorbed matters.
5. To initiate this change oxygen alone is not sufficient; we require in addition the active presence of micro-organisms (and their ferments).
6. On the other hand, micro-organisms alone are also insufficient, although through them no doubt a partial "mineralisation" does occur. The products of this mineralisation, however, are quite as objectionable as the mother-substances, as evil smelling, and with as great an affinity for oxygen, so that an effluent containing them can no more be considered pure than the original untreated influent.

TOOTH-BRUSH DRILL IN SCHOOL.—The regular use of the tooth-brush is practically unknown, and the parents do not appreciate the seriousness of neglecting to keep their children's mouths clean and free from decay. It is useless to preach to parents or children on this matter. The lesson must be driven home by the practical enforcement of tooth-cleaning at the school. The daily practice of this just before the commencement of the afternoon session would alone result in a great improvement in the general health.—*Annual Report of Dr. R. Ashleigh Glegg, Medical Officer of Health, Lindsey County Council.*

SOME DIFFICULTIES IN THE CONTROL OF THE MILK SUPPLY.*

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THE subject I am venturing to address you upon this afternoon is by no means a new one, nor are my remarks likely to include any very novel or original points, but, nevertheless, the matter is one of the highest importance at the present time, and of the very greatest interest to us as sanitarians. Much has been done of late years to educate the public in the ways of healthy living, and much good has resulted; but the process is a slow one, and sometimes a very thankless one, and there are still many directions in which little progress has been made. The milk supply is a striking case in point, for in spite of the great advance in our acquaintanceship with the conditions which affect this almost indispensable commodity, both in its production and in its distribution, and also in our knowledge of the means by which its purity and wholesomeness may be safeguarded, so formidable are the obstacles raised by conservatism, prejudice, ignorance and self-interest, that progress and improvement have been retarded to such an extent as often to nullify the effects of our efforts.

Many local authorities have shown themselves acutely conscious of present defects, and have been for some time actively engaged in endeavouring to remedy them. But unfortunately this activity is confined to certain local centres, principally the larger towns, while the lesser towns and rural districts for the most part continue to maintain an attitude of apathy or even obstruction. So long as this state of affairs exists, individual effort on the part of isolated authorities is of little use to the nation generally, and of not much more to themselves. Little assistance has hitherto been obtained from the Government. Laws, regulations, orders, powers to make bye-laws, and so forth certainly exist, but they are incomplete, fragmentary and indefinite. Further, no disposition has been shown by the central authority to compel local councils to make use, and carry out the terms, of the various enactments; in the parliamentary return of 1907, showing the districts in which regulations under the Dairies, Cowsheds and Milkshops Order, 1885, had been made, it appeared that 12 per cent. of

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boroughs, 18 per cent. of urban districts other than boroughs, and 33 per cent. of rural districts had none such. That is to say, in the districts in which the milk supply is principally produced there was the least attempt at supervision. Where the vested interest was greatest there the individual was considered before the community. In what proportion of agricultural districts in which regulations have been made are those regulations enforced? So long as the Local Government Board maintains its present lax policy in regard to the duties of local authorities, there is little hope that much good will accrue from the law.

Before considering our powers and their limitations, let us first review the conditions affecting the milk supply which call for the exercise of supervision and interference.

These conditions may be grouped roughly under two main heads, according to the methods by which they are discovered, viz.:—

(A) CHEMICAL, including all adulterations, deliberate or unintentional, which are revealed by the analyst; and

(B) BACTERIOLOGICAL, including all germ contaminations, which, though unintentional on the part of those responsible, are usually the result of culpable carelessness.

(A) Under the first head (Chemical) we most frequently meet with

(1) *Poverty of the Milk*.—This may be brought about by a number of causes, varying from the old crude adulteration of the milk with water, or abstraction of cream, through various degrees of scientific manipulation. These latter include dilution of genuine milk with skim milk, or worse still, with separated milk; in such cases there may be an attempt to substitute a cheaper fat for the cream, though I have not myself met with this; and in the simple watering of the milk there may even be addition of milk sugar as well, so that there is, on analysis, no apparent diminution of the proportion of solids, not fat. But the most up-to-date mode of artificially augmenting a milk yield is by feeding the cows scientifically, on such cheap belly-filling material as brewers' draff and turnips, or by mixing salt with the food to cause thirst and consequent free drinking of water. Again, if a farmer desires to fatten his beasts for the butcher he usually increases the feed considerably; this also has the effect of increasing the quantity of the milk at the expense of the quality.

The "scientific" method we find practised principally by members of the better or more well-to-do class of farmers, and the cruder

methods by the smaller dealers. As the former are much better informed than the latter, and plead "natural causes," it is extremely difficult to obtain a conviction against them, whereas the small trader receives much less indulgence. A recent morning's work, including three cases in the Newcastle police court, gave a good illustration of this. A farmer in a large way of business, whose farm is advertised widely as a "prize dairy farm," was summoned for selling milk below standard. No actual adulteration could be proved, although it was shown that the milk habitually contained considerably less butter fat than the average obtained by the City Analyst from all samples examined throughout the corresponding month of three previous years (2.7 and 2.5 per cent. as against 3.45 per cent.). An independent analyst gave evidence of having personally taken samples of mixed milk from the byres during milking-time, and having found a similar analytical result to that obtained by the City Analyst. Much evidence was also given to show that a high standard of cleanliness was maintained at the farm—this being quite beside the point—but it also appeared that the cows were fed on a very generous diet, which included a small amount of brewers' grains. Although this man's milk was so much poorer than other people's than it ought to be, and no satisfactory reason other than overfeeding for that state of affairs was forthcoming, the magistrates dismissed the case. This is a type of case which is becoming exceedingly common, the main feature being that the court is flooded with evidence on the part of large numbers of employes of the defendant, to prove that the poverty of the milk is due to natural causes, and not to tampering.

The next two cases were against small dealers who emphatically denied adulteration, but had not a swarm of workpeople to swear to this. They were each fined 10s. and costs.

But the annoying thing was that though the last two cases were duly detailed in the newspapers, there was no mention whatever made of the first, so that the prosecution absolutely went for nothing, whereas the mere publication of the facts would have had a salutary effect.

That there are genuine natural variations in the quality of the milk cannot be denied. Thus morning milk is poorer than that obtained in the evening; "foremilk" is much below average, and the "strippings" are by far the richest part of the yield. Indeed, it is a well-known fact that the head byre-man, one of whose

duties it often is to go round all the cows after the other milkers and draw off the last of the milk, does not always add these "strippings" to the rest of the milk, which thus contains less cream than it ought to. Another point about the "strippings" is that in tuberculosis they are richest in tubercle bacilli. Cold and inclement weather also affect the quality of the milk to some extent, and in the spring months, February to May, when the cows are first turned out, and about calving time, the general tendency is for the quality to be rather lower than usual. But I am quite certain that only a comparatively small proportion of the milks found to be below standard are due to genuine natural conditions.

Another important factor in the question is the breed of cows used. We all know that if we want to keep fowls we must first decide whether we require them principally for laying eggs or as table birds, because the good layers are not generally the best for roasting. So with cows: if a man wants to make his profit from milk he must not stock his byres with beef cattle; the best milking classes, such as the Alderneys, Kerrys and Dexters, are too small and skinny to be popular with the butchers. Even the Ayrshires, though excellent milkers, are rather small for the butcher. If a beast is allowed to become fat, the quality of the milk falls at once.

That the price paid for an animal bears little relation to its suitability for the dairyman was well shown in a list recently furnished to me by the manager of one of the largest dairies in the north of England. In consequence of the average analysis results of his milk being rather low, one of the farmers supplying the large dairy was advised to invest in two really good animals, in order to improve the general yield. He paid £24 for each, as against £16 for his two best milkers; the former gave milk containing 2.57 per cent. and 2.32 per cent. of butter fat, whereas the milk of the latter showed 4.61 per cent. and 4.08 per cent. respectively.

2. Next in frequency, under the first head, we have *Adulteration of Milk with Preservatives*.

Of these the various preparations of boron are the commonest, and although it is still somewhat under dispute whether the assimilation of small doses of these actually does harm to healthy adults, it is generally agreed that they are dangerous and injurious to young people and invalids.

Formalin is also used to some extent. That it acts as an irritant poison was well borne out

by the now classic outbreak of an epidemic skin disease at the Central London Sick Asylum at Hendon, in the summer and autumn of 1903. Some 66 cases were attacked, and there was great difficulty in determining the cause; then it was noticed that the milk, which was the only article of diet which all the victims had consumed, had kept remarkably well for days without souring, and this led to the discovery that the milk contained a large quantity of formalin. Cases are also on record in which formalin has acted as a renal irritant.

Salicylic acid also is said to be used, and bicarbonate of soda, the latter probably to disguise the acidity of fermentation. I have not myself happened upon instances of the use of either of these, however.

3. *Colouring materials*, mostly of a harmless nature, are also used to a slight extent. The commonest are annatto and carotin, but coal tar dyes are sometimes found, and these, according to Newsholme, should be considered an adulteration, as they are sometimes poisonous of themselves, and sometimes by contamination with metallic poisons during manufacture. What is sold as annatto occasionally contains poisonous coal tar dyes.

Artificial colouring is generally used to disguise the fraudulent abstraction of butter fat.

(B.) Under the second head (Germ Contamination) we have to deal with:

1. *Germ of specific epidemic diseases*, such as enteric fever, cholera, diphtheria, and scarlet fever; and anthrax has also been described as being transmitted by milk.

The contaminations may occur directly from workers at the dairies by "carrier" or acute cases, as in the outbreaks of enteric fever recently described by Davies in Bristol, Sir Charles Cameron in Dublin, and Harrington in Massachusetts; the outbreak of diphtheria reported by Armstrong in Sydney; and those of scarlet fever described by Garrett in Cheltenham—to name only a few of those which occurred last year.

Or the infection of milk may take place incidentally during its transmission to the middleman and customer, or during storage by the customer.

2. *Organisms associated with dirt*. These act chiefly on the intestine directly, causing such conditions as zymotic enteritis or summer diarrhoea.

For some years past in Newcastle samples of milk have been regularly examined for these

organisms, and the results have been very striking. During 1907, for instance, 37 per cent. of samples were classed by the bacteriologist as unsatisfactory; while in 1908 there was a drop to 25 per cent, which, though not a figure to boast about, at any rate shows an improvement which is extremely encouraging. Of the samples taken from dairies, farms and carts 22 per cent. were unsatisfactory. Of those from general dealers' shops 43 per cent. were unsatisfactory, and of those from cafés, tea rooms and restaurants 53 per cent. were unsatisfactory. I might mention that the standard set is not a high one—a milk being classed as satisfactory if bacillus coli is not found in a smaller volume than 0.01 cc., and bacillus enteritidis sporogenes in not less than 10 cc. of milk.

This particular organismal contamination has been shown by the very complete report of the investigation of Dr. Thos. Orr, for the various Yorkshire authorities which united for the purpose in 1906, to occur principally at the cowshed, and to be almost entirely preventable, while the propagation of the germs introduced into the milk can be largely prevented by efficient cooling. So much has been written recently on this part of the subject that it is quite unnecessary for me to particularise further.

3. *The bacillus of tuberculosis.*—This is by far the most serious of all the contaminations. Great advances have been made by the "powers that be" since January last, for by the issue of the third interim report of the Royal Commission on Human and Animal Tuberculosis, they have at last admitted what everybody else who knew anything about the question was satisfied of long ago: that it was not necessary for a cow to have tuberculosis of the udder, visible either ante or post mortem (which after all, indeed, is relatively rare) before it could give tuberculous milk.

During the past two years only some 5 per cent. of the milks sampled in Newcastle were found to be tuberculous. But already during the present year, out of 39 samples examined 9, or 23 per cent., have been found to be tuberculous.

Now, what can we do under all these various circumstances?

From the very outset we are hampered by the lack of uniformity in the action taken by the various local authorities. An active authority begins to put the screw on, others remain apathetic, and the result is that in case of prosecution the magistrates are disinclined to

support views which are not favoured by their neighbours in other districts; so, what is the use of prosecuting, especially where the culprit manages to have all mention of his case by the newspapers suppressed, and so avoid the notoriety and consequent loss which the publication of the facts of the case would inevitably cause?

Let us now rapidly consider our powers under each of the above headings.

(A.) 1. *Poverty of the Milk.*—Here action is taken under the Food and Drugs Acts. The instructions in the Acts must be very carefully followed in taking samples and so forth, as any slight divergence from the prescribed formalities may cause a good case to be lost on a pure technicality.

The charge is made under section 6 of the Food and Drugs Act, and under clauses 1 and 2 of the Sale of Milk Regulations, 1901.

The main difficulty, as indicated above, is that as under certain conditions cows do produce milk of a lower fat-standard than that fixed in the regulations, the magistrates do *not* "presume" (to quote the clause) "that the milk is not genuine," because they usually consider that "the contrary is proved," by the evidence given that the milk has not been tampered with, and this evidence is not always very conclusive.

It has been held in some courts that deliberately feeding cows on a diet calculated to increase the quantity at the expense of the quality of the milk constitutes tampering or adulteration.

The question of "warranty" is another great stumbling-block in the way of getting a conviction; the person who gives the warranty may be, through distance or other circumstances, quite un-get-at-able, and, speaking generally, a smart lawyer can always work out the necessary chain of evidence to complete the defence under section 25 of the S.F.D.A.

2 and 3. *Preservatives and Colouring Materials.*—Action on this head would also be taken under section 6 of the Sale of Food and Drugs Act, the milk not being of the nature, substance, and quality demanded. Action ought really to be taken under sections 3 and 4, but the defence provided by section 5—the necessity of proving "guilty knowledge"—makes these practically inoperative. But under subsection 1 of the same section no offence is committed whether "any matter or ingredient *not injurious to health*" has been added to the food or drug, because

it is required for the production or preparation thereof, as an article of commerce in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight," etc.

Therefore it falls to the prosecution to prove that the added ingredient *is* injurious to health, a by no means easy matter in the case of boron compounds, for example. Consequently action is rarely taken nowadays for addition of boric acid, which is by far the most frequently used preservative.

In a case recently reported a conviction was obtained on three arguments: first, that the use of boric acid *was* injurious; second, that no notice of the fact that the milk (and also cream, in another case) contained boric acid was given to the purchaser as required by section 8 of the Food and Drugs Act; and thirdly, that preservatives were only used in order that stale commodities might be sold as fresh. In this case the milk contained $2\frac{1}{2}$ gr. of boric acid to the pint.

I need hardly remind you that the recommendation of the Departmental Committee on Preservatives and Colouring Matters in Foods that the use of any such in milk be constituted as an offence under the sale of Food and Drugs Act, has, like many other recommendations of special committees and commissions, remained a dead letter.

(B.) CONTAMINATIONS.—I. *Conveyance of the infection of the specific epidemic diseases by milk.*—

Here the powers are only fairly satisfactory, and the exercise of considerable vigilance is necessary in the use of them. These powers are obtained under section 4 of the Infectious Diseases Prevention Act 1890, which is only adoptive, however, and under the Dairies, Cowsheds, and Milkshops Orders of the L.G.B. The former permits an M.O.H. to inspect dairies within his district, or, under a justice's order, without his district, when he has reason to suspect the milk from any such to be causing, or likely to cause, infectious disease in his district. The sale of the milk can then, if necessary, be stopped, but time is lost through the M.O.H. having to go to his local authority. Furthermore, the latter can only stop the sale of the milk in their own district.

Under the Cowsheds, Dairies, and Milkshops Order, section 9, to permit the contamination of milk by an infected worker is forbidden. Under section 13 a local authority may make bye-laws for, among other matters, prescribing precautions to be taken by dealers against such contamination. But the limitations of our

powers were well shown recently in the enteric outbreak in Dublin, due to a carrier case among the milkers on a certain farm, when, although Sir Charles Cameron was satisfied of the causative part played by the milk, the Corporation's legal advisers held that in the existing state of the law no legal action could be taken, and that therefore the sale of the milk could not be interfered with.

Under Part IV. of the P.H.A. (Amendment) Act, 1907, the powers in respect to infectious diseases in connection with the milk supply have been considerably amplified, dairymen being now required, if requested, to furnish lists of the source of their supplies, and to notify cases of infectious disease occurring among their servants. This Act is also only adoptive.

2. *Organisms associated with dirt.*—Comparatively few authorities have taken up this branch of observation, and, so far as I can find, no prosecutions have taken place under this head. Should it be necessary to take legal action, section 117 of the P.H. Act 1875 would appear to apply—a polluted milk being an unsound article and unfit for human food. Or if uncleanness in the cowshed or dairy could be shown action might be taken under the bye-laws.

3. *Tuberculosis.*—This is perhaps the most difficult question of all to deal with. Under the present circumstances our procedure is lengthy, somewhat uncertain, and frequently leads to nothing. The tuberculin test, which is an extremely delicate and accurate one, is the means of exposing such a vast proportion of tuberculous cattle that farmers will never submit to its application to their herds if they can help it. As we have no power to enforce its use, we can only fall back upon the extremely cumbersome (because long) process of inoculating guinea-pigs with the mixed milk of a farm. Fortunately for us in Newcastle, the big companies never mix the supplies from different farms, and also they keep a careful account of the final destination of each farm's milk, so that it is possible to find at once from what farm any customer was supplied. If the guinea-pig does not die of some other bacterial infection, *e.g.*, streptococcal, meanwhile, it is killed in a month and examined for evidence of tuberculosis. If the disease be found we are very little further on than we were before. If the farm be within our own district, the veterinary officer of the Corporation visits and

inspects the cattle. If udder disease be found in any of the animals the sale of their milk is stopped; the farmer may or may not have the animals slaughtered. If he does not, but merely sells them to some one else, how much better off are we? There is nothing to prevent their going into a district where inspection is more lax, and being used still for dairy purposes. If the tuberculous milk be from a farm outside the Corporation area, all that can be done is to communicate with the M.O.H. for that district. He *may*, or may not, contrive to persuade the farmer to get his cows examined by a veterinary surgeon, and animals with tuberculous udders eliminated from the herd; but even if he does manage so much, what becomes of the animals?

If tuberculosis were only a statutory infectious disease under section 6 of the Infectious Diseases Notification Act, then section 4 of the Prevention Act would apply both as regards inspection of the dairies and cowsheds, and stoppage of the sale of the milk. Unfortunately the recent regulations as to tuberculosis do not constitute tuberculosis one of the infectious diseases, and what Mr. John Burns' Milk Bill is going to do remains to be seen.

Such is, roughly, a sketch of the principal difficulties encountered by the medical officer of health in his endeavour to improve and safeguard the standard of the milk supply of his district. And the greatest difficulty of all is just this: that such means as are to hand for the purpose are designed, not for the nation generally and equally, but for the individual districts; as it depends absolutely upon the constitution and interests (sometimes purely personal) of the local authority to what degree the law, such as it is, is carried out, it follows that there is very great variation in procedure in different localities, which goes far to nullify any general effects which might otherwise accrue.

Again, there is no such encouragement to the trade to make improvements as is recommended by a conference under the auspices of the United States Department of Agriculture (circular 114). In this circular the strong approval of the conference is given to the system of "certifying" milk supplies as the result of regular, frequent, and careful inspection, the purveyor receiving a better price for "certified" than for uncertified milk. At present it pays a dealer to do as little as possible in the way of improvement.

As regards tuberculosis, some system of

national application and central administration is urgently required. The Danish procedure (or Bang system), already tried by some large owners in this country, appears to be a good one and not too drastic. It consists in the slaughtering of all animals showing visible signs of tuberculosis, with compensation to the owners, and the isolation of reactors to the tuberculin test from non-reactors; the latter includes the immediate separation from reactors of their calves. By this means it is claimed that the gradual elimination of tuberculosis is quite feasible. Failing some such national scheme as this it will be necessary for individual authorities to endeavour to obtain such useful milk clauses as are possessed by the Corporations of Sunderland, Liverpool, Sheffield, Manchester, Birmingham, etc.

Under a local act in Newcastle it is forbidden under penalty to sell the milk of a cow known to be tuberculous, and makes it compulsory to notify the occurrence of tuberculosis in a herd. But as "guilty knowledge" must first be proved—an impossibility—these clauses are quite useless.

Much more might be said upon this subject, and I have not attempted to do more than summarise the difficulties we commonly meet with. The suggestions for overcoming them are legion, and as I am sure that I have tried your patience severely enough already, I shall spare you any further details than I have already mentioned. Before sitting down I should like to express my indebtedness to Dr. Henry E. Armstrong for much information obtained from him on this, a favourite subject of his also, during my tenure of office in this Department, and for permission to make use of the office records.

THE SCARCITY OF MILK IN COUNTRY DISTRICTS.—

There is more difficulty in procuring milk in these country villages than many people would imagine, and if legislation is made too stringent I am afraid the supply would tend to be smaller than it is now. I find so many people only allow their neighbours to have milk as a favour, and if drastic alterations are ordered to be made, they would give up selling milk altogether and use all they have for the rearing of calves and pigs to the detriment of the babies of the village. By persuasion and education we must hope to greatly improve the dwellings of the cows and the cleanliness of the milk vessels, and thus lead to the provision of a pure supply of milk in this neighbourhood."—*Annual Report of Dr. R. Ashleigh Glegg, Medical Officer of Health, Lindsey County Council.*