showing the diplococcus found by Dr. W. Bullock in Mr. Pernet's case of acute pemphigus, was shown.

SECTION OF ETHICS.

Dr. R. W. DOYNE introduced a discussion on Clubs, Medical Aid Societies, and Contract Practice. Dr. Dickinson afterwards read a paper on the Provident Principle in Sickness Attendance, and Dr. Pearce on the Sweating of the Profession by various Friendly Societies. In the discussion that followed, Mr. Hemming, Mr. Goss, and Dr. Elliston took part, and a very strong opinion was elicited from the members present against medical aid societies, which were universally condemned. It being reported that Dr. Raye (Banbury), who held one of these appointments, was present at the request of the Section, the President invited him to address the members. He did so at some length, pointing out the conditions under which he held his appointment, showing clearly that, although it had objectionable features, it did not properly come under the category of the associations which were specially condemned. Dr. Philip Lee then gave details of the struggle at Cork between the profession and the amalgamated clubs, stating that over £600 had been subscribed to assist the men of Cork, but so strong was the feeling there, that the profession as a whole should move in this matter, that they were willing to give nearly the whole of this sum to assist medical men fighting the same battle in other parts of the United Kingdom. Dr. M. Greenwood then moved: "That the Council be requested to take steps to prevent members of the British Medical Association accepting posts in medical aid societies, and that in the opinion of the Section no practitioner who accepts office in any society of this kind be eligible for membership of the Association. That medical aid societies be defined to be 'any lay association which endeavours to obtain pecuniary profit for its members solely out of the labour of salaried medical officers.'" It was also moved by Dr. John P. Henry, and seconded by Dr. George H. Broadbent: "That the Council be requested to communicate with the universities and medical corporations, with a view to induce them to insert a clause in their diplomas forbidding, under pain of forfeiture, the taking of offices in medical aid associations, or the taking of clubs without a wage limit or at unremunerative rates, or undertaking any appointment or engagement calculated to degrade the profession." These resolutions were deferred with the others till Friday. Dr. Lattey and Dr. Henry further continued the discussion. Dr. Hugh Woods then introduced the discussion on Hospitals and Dispensaries, and was followed by Mr. F. Greaves and Mr. Nelson Hardy, the latter of whom condemned the use of unqualified practice at hospitals. A strong opinion was expressed by all the speakers against the gratuitous attendance by physicians and surgeons of the patients in the pay wards of hospitals. Dr. Campbell Black read his paper on Hospital Advertising and Medical Etiquette, and Dr. Draper took part in the discussion that followed.

THE HUXLEY MEMORIAL.

At the conclusion of the general meeting of the British Medical Association held at Exeter Hall on Thursday afternoon, the President desired the attendance of the members for the consideration of the proposed memorial to the late Professor Huxley, and introduced Professor Michael Foster, Secretary of the Royal Society, who stated that steps were being taken to raise a memorial to the late Professor Huxley on as broad a basis as possible, but that, owing to the lateness of the session, it had been thought desirable to defer active steps until after the autumn recess. No attempt had been made to determine in any way the nature of the memorial, which must depend upon the amount received, but a Provisional Committee had been formed, and he trusted that the medical profession, of which the late Professor Huxley was a member, and which he

loved, and which whenever possible he helped, would desire to join in this effort to perpetuate the memory of so great a man. Sir John Lubbock had consented to act as Treasurer to the Committee, to whom subscriptions might be paid, and Professor G. B. Homes, of the Royal College of Science, South Kensington, was one of the Secretaries, and would receive names and answer inquiries.

Dr. WARD COUSINS, the President of Council, desired to say he felt sure that the whole profession would respond warmly to the effort to produce an adequate memorial of so great and good a man.

A REPORT ON THE MILK SUPPLY OF LONDON BY A SPECIAL ANALYTICAL AND BIOLOGICAL COMMISSION.

III.

REPORT OF TWENTY-FIVE SAMPLES OF MILK, EXAMINED AS TO THEIR BACTERIAL FLORA.

By SIDNEY D. ROWLAND, B.A.

THE present research, undertaken at the request of the Editor of the BRITISH MEDICAL JOURNAL, and carried out by the kindness of Dr. Klein in his laboratory at St. Bartholomew's Hospital, does not pretend to be anything like a complete investigation into the bacteriology of the London milk supply. Such an account has yet to be written; it would involve, perhaps, years of laborious work, and would of its very nature never be a complete and definite statement, for at the outset we are confronted with this difficulty—physiologically milk is recognised as the ideal food stuff; it is the pabulum on which all mammiferous animals are nourished in their most tender and susceptible years. This is a fact that is well known to everyone. And it seems that in a similar way it is equally well fitted as the nutrient medium in which bacteria—pathogenic as well as non-pathogenic—can grow and multiply to their best advantage. Accordingly it is impossible to speak of a normal milk bacterial flora, for exposed, as it always must be, to many and various sources of infection, there will continually be the possibility of new forms finding in milk a convenient and suitable nidus, and thus, with the evolution or importation of new diseases, there will exist a corresponding chance of their being found in milk. In fact, we might as well speak of the normal population (bacterial) of gelatine, agar-agar, or any other common nutrient medium. Milk does not possess, or ought not to possess, any population at all; it just depends upon what chances of infection it is exposed to, and on the power infecting organisms have of thriving in it—a power which we have already said is possessed by a very large number of forms.

Consequently it was necessary to restrict the examination to the detection of particular organisms which might be found in any great abundance, or which by their properties might be particularly injurious in their action. Normal milk as it exists in the udder of the healthy cow is perfectly sterile, and cocci have been found in milk ducts, and any microbe that may be found in it must have been introduced from without during the period that elapses from the time of milking to that of consumption by the purchaser. A searching examination has therefore been made for the presence of micro organisms that are either distinctly harmful in themselves or indicative of contamination from impure sources. It is, of course, not to be assumed that because a particular organism was not found that therefore it was absent. In work of this nature, as indeed in all scientific work, it is impossible to prove the proverbial nega-

tive. Any evidence as to purity, therefore, that this report may furnish depends entirely on the use of approved methods and on the individual care of the workers. All that can be said is that certain micro-organisms were found, and from a consideration of these it may be possible to furnish evidence of a more or less conclusive nature as to the purity of any particular sample. More than this it cannot claim, therefore it is well to be careful in drawing any conclusion on a collateral subject towards which the work was not definitely directed.

It is also well to add a word or two on the impression that may be produced on other than medical readers. When a subject of this kind is discussed, the technically uninformed mind (struck, maybe, for the first time with the fact that bacilli exist, and having heard that certain of them possess at least a doubtful reputation) is apt to come at once to one of two conclusions—either that we are all on the verge of being poisoned, or that for purposes of their own the medical world is bringing a scare on the public. It is, of course, needless to say that either of these conclusions is, on the face of it, absurd. What we wish to call attention to is not that our milk supply is not perhaps as good as it might be, but that it is not the best possible.

In dealing with our minute and ubiquitous foes, absolute measures are alone of any value, and the smallest breach in any system of prophylaxis is sufficient to admit whole armies of the enemy. What we require, therefore, is to be in a position of absolute security, and to be ready to meet all and every emergency. To do this our safeguards must be of the most accurate description, not admitting the smallest deviation from perfection. Anything less is of so little value that it may be almost said to be useless.

SOURCES OF CONTAMINATION.

The risks to which milk is exposed in the way of microbial contamination are very numerous. Perhaps the largest number are introduced at the time of milking, which is what might be expected considering the way in which this operation is usually carried out. Sedgwick and Batchelder, who investigated the Boston milk supply in 1892, found that when the milking was done in a clean stable, and received into a sterilised bottle, the average number of micro-organisms present was 530 per cubic centimetre; but if no special precautions were taken it rose to the astonishing number of 33,500 per cubic centimetre. Whence come this extraordinary number of bacteria? It is not difficult to imagine their source if for a moment one recalls the usual conditions of the cows, in even the cleanest and most hygienically managed of our dairies. The stable or cowshed in which the milking is usually carried on is itself saturated with excremental matter, the very straw the animals stand upon is too often but an incubating ground for micro-organisms; for warmed by fermentation, and saturated with faecal matter, it offers all the conditions of warmth and nutriment material for their best growth. The restlessness of the animals and the walking of the milkman disturb at each moment myriads of these micro-organisms, some of which passing into the open pail, find in the warm milk all the conditions for life and active multiplication. That this is not an exaggerated picture will be evident when we state that fully 90 per cent. of the organisms found are the *Bacillus coli communis*, the common inhabitant of all excremental matter.

Other sources of infection are to be found in the dirty hands of the milker, unclean dairy utensils, and in the insecurity and carelessness commonly employed for the transit of the milk from the dairy to the consumer. In the case of London milk at least, this always involves a railway journey, with sojourns on crowded platforms and ill-ventilated goods-sheds and vans, so that it is not difficult to imagine that means of infection are neither infrequent nor inconsiderable. Indeed, it may even be remarked that with such a unique medium and so many roads of access it is remarkable that there are not more epidemics traced to milk than those hitherto recorded; and it is only just to say that, considering the difficulties in the way, it is remarkable that our daily supply is as good as it is.

METHODS OF INQUIRY.

In all cases the milk was bought over the counter in the

usual manner, the collector being furnished with sterilised bottles. It was brought back to the laboratory at once, and an examination made as soon as possible, it being kept during any unavoidable interim in an ice chest to avoid the possibility of incubation at a living temperature.

EXAMINATION.

A drop of milk removed by a sterilised platinum loop was introduced into nutrient gelatine. This was then liquefied, and poured out into a plate after the usual method. The plates were then incubated at 21-22° C., and examined as soon as copious growth had taken place.

PHENOL METHODS.

It was soon found that many of the plates were spoiled by the rapid liquefaction of the gelatine. It was consequently necessary to avoid this if any but liquefying organisms were to be looked for, and as many such were suspected and found, these methods were subsequently adopted.

EXAMINATION OF PLATES.

The plates as thus prepared were carefully searched under a low magnifying power. Subcultures were made from any suspicious colonies, and subsequently identified, if necessary, by further subcultures.

AVERAGE NUMBER OF BACILLI FOUND.

The average number of bacilli found in the samples examined was 500,000 per cubic centimetre. Previous researchers have put the number found in other milk supplies at somewhat higher figures, but it must be remembered that in any numerical examination the sources of error are very numerous. Among such sources the following is perhaps the most important. As already stated, bacteria find in milk all the conditions necessary for rapid multiplication. The rate at which bacteria can multiply is hardly conceivable. Kohn calculated that a single germ could produce by simple fission two of its kind in one hour, in the second these would have multiplied to four, and in three days they would form a mass that can scarcely be reckoned in numbers—or if reckoned scarcely imagined—4,772,000,000,000 (Woodhead). Hence it is readily understood that the numbers found in any given sample of milk must vary enormously, according as the sample was examined soon or late after its being drawn from the cow, and according as it had been kept at an incubation temperature (that is, at such a temperature as is most favourable to multiplication, namely, 37° C. for most forms) or not. Hence the number found may only afford evidence of its having been kept carelessly by the vendor; but still such evidence is hygienically useful. We put the number, then, at 500,000 per c.c.m., and when it is remembered that the number found by Sedgwick and Batchelder in freshly drawn milk was 30,500 per c.c.m., it will be seen that considering the vast possibilities of multiplication our milk compares very favourably with other samples in this respect. Indeed, all the evidence we have goes to show that the faults of the London milk supply lie chiefly with the careless hygienic arrangements which obtain in farms, railways, and dairies, and which allow the entrance of the various forms which we have found.

THE MOST IMPORTANT MICRO-ORGANISMS FOUND.

The Bacillus Coli Communis.—This was the form that was found in the greatest abundance, it constituting fully 90 per cent. of all the forms found. Its presence is not difficult to account for when we remember that this organism is the one which is *par excellence* diagnostic of faecal contamination, and when we recall the picture above given of the conditions attending an ordinary milking operation. Its presence in milk is thus easily accounted for, and the question arises, What does its presence signify? Now, the *Bacillus coli* if found in potable water is usually taken as diagnostic of sewage contamination, but its presence in milk cannot thus be summarily dealt with, it having such ready access directly from the soiled cow and its surroundings. Its presence, then, means for the most part that adequate care is not taken of the cows and cowhouses in the dairy from which the sample in which it was found came. It may be objected that it is practically impossible to take such care that the

colon bacillus can be absolutely excluded; undoubtedly it is, still it is an imperative duty which must be carried out if we are to have anything like a sterile milk supply. It may again be objected that a bacillus which is present normally in the intestines of the most healthy of us can do no possible harm if introduced from without. Such a contention would not for a moment hold good. It is a very different thing to possess a normal quantity of a certain constituent, and to possess a quantity that is abnormally large. It might with equal justice be argued that, because we already possess indol in our intestines, that this is a desirable article of food, or that because we possess blood corpuscles therefore it is a good thing to have our vascular system crowded with them; but we all know that too many corpuscles are just as injurious as too few; and the same applies to the colon bacillus. Besides it has been clearly shown that many of the milder forms of disease are closely dependent on the presence of abnormal quantities of the bacillus coli communis. It will be sufficient to mention, among many others, its determining action in many cases of cholera nostras (Gilbert and Girode), cholera infantum (Lesage), cholecystitis (Charrin and Roger), etc.¹ In fact its rôle in abnormal quantities is by no means a small one, and its presence in milk, especially in such milks as might possibly be used for infant feeding, cannot but be a grave source of danger. We therefore insist that the quantity of bacillus coli communis present in London is dangerously large, both in itself and for that which it represents and portends, and that means ought to be taken to reduce the same.

Liquefying Organisms.—These were similarly present in every sample examined. The extent to which they were present varied in each sample, and such an extent, we think, can be taken as a very fair criterion of the purity of any given sample. The commonest species were varieties of proteus. The significance of these forms is not hard to see. The forms now known as proteus embrace many of those formerly collectively known as bacterium termo; they are found in putrefying organic matter of all descriptions, and their distribution is very wide. Their presence in milk must mean one of two things, either direct contamination with putrefying matter (stale milk such as might occur in improperly washed dairy utensils, etc.), or needless exposure to an atmosphere containing particles of decomposing matter. Both of these possible channels of infection are such as might, and most certainly ought to be, successfully guarded against; and it is not possible to find the same excuses for the presence of liquefying forms as in the cases of the colon bacillus.

Bacillus Fluorescens.—This form was similarly present in all the samples examined, and its significance, while not so conclusive as that of the two previous forms, is yet worthy of note. Bacillus fluorescens is an aerobic form, distinguished by a particular sensitiveness to want of oxygen. It is frequently present in potable water; hence its presence may be taken as presumptive evidence of added water—but as presumptive evidence only, as its distribution is far too wide to allow of any such definite statement.

PATHOGENIC FORMS.

In two of the samples was found *oidium albicans*, the exciting cause of thrush. It is not possible to say whence this organism found entrance, as so little is known of its life-history, but its presence calls forth the same remark and teaches the same lesson as the presence of the other forms. Its pathogenic properties give to it special significance.

The conclusion of the whole matter is this: Not even the smallest of the dangers we have pointed out can be considered trivial; perfunctory precautions are futile, and we would again insist that the same weak spots in our system of defence, which in times of microbial peace admit but comparatively harmless varieties, may in times of microbial war and epidemic disease allow the entrance of forms which in their life-action may be the cause of large disease diffusion and of frequent sporadic outbreaks.

SUGGESTED REFORMS.

1. That all milking be carried on in the open air, the animals and operators standing on a material which is capable

of being thoroughly washed, such as a floor of concrete or cement. Such a floor could be easily laid down in any convenient place which can be found. The site chosen should be removed from inhabited parts as far as possible, and should be provided with a plentiful water supply. Only in this way does it seem possible to avoid the initial contamination with the colon bacillus.

2. That greater care be expended on the personal cleanliness of the cows. The only too familiar picture of the animal's hindquarters, flanks, and side being thickly plastered with mud and faeces is one that should be common no longer. It would not be difficult to carry out this change; indeed, in the better managed of our large dairy companies' farms such a condition no longer prevails, but in the smaller farms it is but too frequently met with.

3. That the hands of the milker be thoroughly washed before the operation of milking is commenced, and that after once being washed they be not again employed in handling the cow otherwise than in the necessary operation of milking. Any such handling should be succeeded by another washing in fresh water before again commencing to milk.

4. That all milk vendors' shops should be kept far cleaner than is often the case at present. That all milk retailing shops should be compelled to provide proper storage accommodation, and that the counters, etc., should be tiled.

SKIMMED MILK IN WORKHOUSE INFIRMARIES.

A CORRESPONDENT writes to us: Knowing the deep and practical interest you take in the reform of our workhouse infirmaries, I know I need offer no apology for troubling you. For many years, nothing but skimmed milk has been supplied to the inmates of our workhouse infirmary. The cream is taken off and used by the officers of the house, either as cream or after being converted into butter. As a member of the Board, I am anxious to have this state of things altered, but I am at once told that skimmed milk furnishes all the nutriment required. Further, I may say that the milk is sometimes twenty-four hours old when used in the infirmary and is at times sour, but the inmates must either consume it or have nothing. May I venture to ask, as the result of your large experience, whether you know of any other workhouse infirmary where skimmed milk only is supplied, and whether you consider this is a proper state of things to exist, and one that the medical inspector of the Local Government Board would approve of?

MILKBORE DISEASE:

AN APPEAL TO MEDICAL OFFICERS OF HEALTH.

MR. ERNEST HART is engaged on a general inquiry into milk-borne disease since 1881, in continuation of his paper of that year on the Influence of Milk in Spreading Zymotic Disease, and will be much obliged if those health officers who possess notes of outbreaks of disease traceable to the agency of milk will be good enough to furnish him with a brief statement of the facts, so far as known, in the shape of answers to the questions subjoined:

1. Date.
2. Locality.
3. Reporter.
4. Total number of cases.
5. Deaths.
6. Number of cases amongst drinkers of suspected milk.
7. Number of persons supplied by milkman.
8. Number of such families invaded.
9. Sanitary circumstances of farm or dairy from which milk was obtained.
10. Exciting cause of outbreak.
11. Circumstances implicating milk.
12. Facts showing special incidence of disease.
13. Reference to report.

THE STEWART PRIZE.

THE Stewart Prize for 1895, consisting of an illuminated address and a cheque for £50, was awarded to Brigade-Surgeon-Lieutenant-Colonel D. Douglas Cunningham, M.B., C.I.E., F.R.S., for his bacteriological work in India, especially in the investigation of the bacillus of cholera. In the absence of the recipient the prize was received on his behalf by Surgeon-General Cornish.

¹ Brouardel, *Traité de Médecine*, p. 627, vol. I.