No attempt was made to determine the extent of intestinal infection. The examination of 30 of the mothers of these children revealed no sign of urinary infection. The prevalence of the disease amongst the better classes may be inferred from the fact that at the present time 25 per cent. of youths, aged 16, applying for entry into the professional branch of one of the public ministries are rejected on this account. Former estimates placed the incidence at from 50 to 80 per cent. of boys between the ages of 10 and 18, and 25 to 30 per cent. of girls of similar ages.³ The number of women affected at the age of 40 is less than 3 per cent.⁴ These figures point to some method of infection which hardly operates during infancy, becomes active during childhood, and ceases to affect the adult women to any great extent so long as they reside in the city.

The hypothesis that Nile water, as supplied to the gardens in Cairo, is the chief source of infection⁵ does not meet the age periods during which infection is active or quiescent. Having decided that unfiltered Nile water is probably not a serious danger, we examined the mollusca present in the small collections of water in places where the children can reach them. Specimens of *Bullinus* and *Planorbis* were found in small numbers in public ponds and fountains in Cairo. They were also present in a small fountain in a private garden and in the casks sunk in the ground from which the watering cans are filled. The Arab gardeners were quite familiar with the snails, and volunteered the explanation that they came from the Nile, which may or may not be correct. A large number of zirs (the great earthenware jars used to store water for household purposes) were examined and found to be free from snails. The large marble bath in the garden of the old Ismailia Palace is now dry, but there are on the floor abundant recent shells of *Bullinus*, *Planorbis*, *Limnea*, and *Unio*. Many snails are also present in small irrigation channels in the suburbs irrespective of the source of the water.

Suitable intermediate hosts are therefore present in the city and suburbs, and the habits of the people make it certain that these collections of water will often receive the ova of the trematode. Some of the Australians merely washed their hands and arms in these ponds, and yet received a full dose of the cercariæ. The Arabs rinse their mouths and drink the fountain water, while the children of native servants are often allowed to play in the employer's garden. It is, perhaps, more than a coincidence that the only European girl known by one of us (B. S. E.) to have become infected in Egypt used to be taken regularly by her nurse to the lawn surrounding one of these fountains. The importance of these sources of infection, however, is growing less every year, as, owing to the campaign against the mosquito, the fountains are disappearing from private gardens and the canals and ponds are being filled up. The suburban irrigation channels appear to be the only serious local menace.

The Sham-el-Nessim.

As these local sources could not account for all the infections we looked further afield. The Coptic Easter Monday is kept by all Egyptians, Moslem as well as Christian, as the Sham-el-Nessim. On this festival parents make every sacrifice in order that the children may have a good time. The family leaves home early in the morning for the country, and the children are allowed to play as they please around the banks of the ubiquitous channels. At this time of the year infection is likely enough to follow an hour's paddling in the water. Besides including children of both sexes and of every social rank, this annual exposure to infection accounts for the age-incidence which we find in Cairo. At the age of 6 or 7 the children become more independent and remain in the water for a longer time than the infants. This regular exposure to the attacks of the cercariæ is the most important factor in the causation of the disease among the city population. The second but much less important factor is found in the suburban irrigation channels and other small bodies of water already noticed.

Eradication of the Disease.

Up to the present time no attempt has been made to control the spread of this disease amongst the Egyptians—its presence for more than 3000 years investing it with the apparent authority of Fate. Interest in the matter may also die out because the regulation of bathing removes all danger of infection as regards the British troops in the country.

Yet it would probably be an easy matter to eradicate the disease from the Delta and the Egyptian portion of the Nile Valley. In this connexion two important points may be emphasised: (1) that the danger spots are the small channels running through the fields, not the river or the large canals; (2) that a flock of ducks will quickly remove the snails from any small body of water and prevent these mollusca from re-establishing themselves.

We have already set out the evidence for the first of these propositions. The second is based on the following observations. All the ponds but one in the Zoological Gardens, Gizeh, Cairo, are frequented by ducks, both tame and wild. In these ponds snails can be found only after a prolonged search, and then only small specimens. The exception is a lily pond, which is kept free from ducks and is well stocked with half a dozen common species of mollusca. The lake in the Botanical Gardens, Melbourne, which has long been a sanctuary for wild ducks, is quite free from snails, and a similar alternation of snails and ducks holds good in Adelaide and Perth. The proclivity of ducks for snails is as marked on dry land as in the water. They not only keep gardens free from these pests, but they search the bushes and herbage for land forms, such as *Helix pisana*.

Thus in order to eradicate bilharziasis in Egypt each village should keep its own channels free from snails by means of a flock of ducks. The local duck, which is not a common domestic bird, may be suitable for this purpose; but in Egypt the Pekin, Muscovy, and Indian Runner ducks would doubtless thrive as well as in hot, dry parts of Australia. The green and dry berseem or clover would form part of the food of the birds, and the children could keep the flock in the required portions of the channels. The keeping of ducks would not be an innovation, but an extension of native custom in widely separated districts. The birds might be made a source of substantial profit to each village, and a bonus might be offered for the production of birds of specified quality for table use.

In the first place, a canal supplying a dozen villages might be selected for experiment and the results observed. A small expenditure is thus all that is necessary to give the scheme a trial, while the eradication of the snails would confer an inestimable benefit upon the whole native population.

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SOME CAUSES OF FAILURE IN THE VACCINE TREATMENT OF ARTHRITIS, RHEUMATISM, AND NEURITIS.

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A CERTAIN measure of success has followed the treatment by vaccines of muscular rheumatism and fibrositis. Good results have also not infrequently been claimed in poly-arthritis deformans (rheumatoid arthritis). To these two groups I would add in my own experience, primary neuritis—that is, neuritis not due to pressure or of toxic origin. A fairly high percentage of failures have, however, been reported, a fact damaging to the reputation of this valuable method of treatment.

The causes of failure may be grouped under six heads: (1) False diagnosis; (2) Errors in bacteriology; (3) Incorrect or inefficient vaccine; (4) Faulty administration of vaccine in regard to dosage and interval; (5) Peculiarities in the constitution of the patient and in his response to vaccines; (6) Mistakes in general treatment.

It is hoped that the discussion of these causes of failure in the light of experience gained from the bacteriological study and treatment of a considerable number of cases may tend to improve the results.

(1) *False Diagnosis.*

To this may be added failure to discriminate between curable and incurable conditions. Apart from such gross errors as confusing lumbago and Pott's disease, intercostal rheumatism and pleurisy, one must be on the look-out for gonorrhœal rheumatism and the pains of locomotor ataxia.

In the main, however, fibrositis and muscular rheumatism are easy to recognise, and can be readily and successfully treated by vaccines.

The diagnosis of arthritis is much more difficult. The monarticular varieties are best left alone, especially if of long standing. Failure here is the rule rather than the exception. Where multiple joints are involved the essential thing from the vaccine point of view (apart from the bacteriology) is to decide whether the condition is one of chronic rheumatoid arthritis in its generally accepted sense or of rheumatism. The earliest, almost pathognomonic, sign of the former is creaking of the occipito-atlantoid joint. Stiffness of one or more joints in the morning which wears off during the day is common to both diseases, but whereas in rheumatism the joints affected vary from day to day, in rheumatoid arthritis this is not usual. When periarticular inflammation and glossy skin appear, then, of course, no mistake is possible. Slight skin affections are more frequently associated with a rheumatoid state. X rays should always be employed before attempting the vaccine treatment of any chronic joint trouble, for there can be no complete success where bony changes have occurred. A radiogram of the hip-joint before treating sciatica will prevent many disappointments. It is very important to distinguish between rheumatic fever and acute febrile rheumatoid arthritis. The former will, as a rule, yield readily to vaccines, whereas the latter is not only extremely

two are salivary (Andrew's and Gordon's classification). These organisms can readily be distinguished from each other and from all other streptococci by their behaviour in culture on neutral red egg medium. All of them are to be found in severe cases in the urine. One, the *Streptococcus gracilis* or *zymogenes*, a gelatin liquefier, belonging to the faecal group, must be regarded with extreme respect, as a vaccine prepared from it is very toxic. This organism has been found associated with the more serious forms of rheumatism, especially those complicated by either functional or organic heart disease. Three times was it isolated from malignant endocarditis.

The single variety of staphylococcus is closely allied to the *S. epidermidis albus*. It is this organism for which I ventured to propose the name *Micrococcus deformans*⁵ on account of its frequent presence in, and probable ætiological connexion with, rheumatoid arthritis. This organism is also not uncommonly found in cases of neuritis. It is possible that rheumatoid arthritis and neuritis are manifestations of the same infection. For practical purposes at any rate, where nerve lesions are in evidence, a vaccine of this organism will be found to be effective. In rheumatic cases a stock vaccine of the streptococci should be used. In a number of cases with mixed symptoms the two vaccines can be combined with advantage. *Bacillus coli communis* is a fairly frequent contributory factor, but it must be very rare indeed as a primary cause of muscular or joint pains.

Chart showing the daily variation in weight of a woman suffering from fibrositis and undergoing treatment with mixed streptococcus and deformans vaccines. In the framed portion of the chart, note I., two days fall of weight and two more days to reach the former level; II., one day fall and one day to reach former level; III., one day fall and next day high above former level. The dose of vaccine is given in millions of each organism. The thick lines beneath the chart indicate increased pain in joints and muscles. The dotted lines indicate fluctuations such as may follow excessive doses, and the drastic reduction necessary is shown by the figures in brackets.

intractable, but will often flare up most alarmingly after a minimal dose. Full doses of salicylates should decide the point. Again, failure may result if it is not recognised that to find an uncomplicated case of either rheumatism or of rheumatoid arthritis is unusual. Both may occur together or either may be associated with a number of diseases of the alimentary and respiratory tracts. In these cases combined vaccines are necessary. It may be suggested that the bacteriological diagnosis is the main thing and that clinical diagnosis does not much matter provided the causative microbe is found. As will appear below, this attitude is frequently fatal to success.

(2) Errors in Bacteriology.

Mistakes are extremely difficult to avoid in this field, and this although the specimens for examination are irreproachable. It is so fatally easy to find a microbe either in the gums, from the nose, from the faeces, or in the urine. Serum reactions give but little assistance in determining pathogenicity. It is for these reasons that clinical diagnosis is of paramount importance, and that, given correct diagnosis, stock vaccines are usually so much more efficient in this group of diseases than autogenous. In various earlier communications^{1 2 3 4 5} I have tried to reduce the bacteriology of the "rheumatisms" to some sort of order. Further experience extending over several years has strengthened the suggestions then put forward. The following is a brief summary of the conclusions as published.

Constantly recurring are four varieties of streptococci and one of staphylococci. The streptococci included in these varieties are all capable of causing fibrositis and rheumatism both of muscles and joints. Probably the *Diplococcus rheumaticus* of Poynton and Payne is synonymous with several of them. Without exception they have their origin in the alimentary tract. Two are faecal streptococci and

Though *B. coli communis* is often the only organism that is seen microscopically, or can be isolated by ordinary methods from the urine, yet if the urine, when heavily infected, is incubated for a few hours, then heated to 60° C. for varying times, cultivation will almost always show a growth of streptococci after the *B. coli* have been killed off.

(3) Incorrect or Inefficient Vaccine.

This source of failure is partly due to faults in clinical diagnosis and partly to bacteriological errors. The only preventive is care. It is far wiser to use a well-tried stock vaccine than to prepare one from an organism of doubtful ætiological significance.

(4) Faulty Administration in Regard to Dosage and Interval.

The correct dose of a vaccine made from these organisms varies enormously in different cases. In consequence mistakes in dosage and interval are perhaps the commonest cause of failure. It is almost impossible to give any scale which will apply to more than a very few cases. The difficulty can be largely surmounted by charting the daily weight of the patient under comparable conditions of time and clothing. Symptomatic reactions read in relation to the daily weight chart will be found to provide an excellent guide. In a former communication⁶ it was shown that the fluctuations of the weight, day by day, following an injection of tuberculin could be regarded as an immunity curve and used as such for determining the proper dose and interval. This has since been confirmed by Cochrane and Sprawson.⁷ The same is true of streptococcus and deformans vaccines.

The chart shows the daily weight of a woman suffering from fibrositis and a slight degree of rheumatoid affection of the finger-joints. Stock polyvalent streptococci and

M. deformans were combined in each dose in equal numbers. The first dose (one million of each organism) was followed by a drop in weight, but since there was no definite curve and no subjective signs of a reaction the fall was regarded as accidental and the dose was doubled. Immediately the weight fell further and the pains in the joints and muscles increased (indicated by the thick line beneath the 5th, 6th, and 7th days of the treatment). The dose was clearly too large. It should be remembered that in this case without the weight chart the symptomatic reaction might easily have been put down to a change in the weather or some similar outside agency. The third dose was reduced to $1\frac{1}{2}$ million. The weight remained at its new level. On doubling this amount at the fourth injection a definite rise and fall was recorded. In the absence of a negative phase the dose was then raised to 5 million. This had to be repeated three times, for after the first time fall in weight and reaction lasted two days, after the second one day, whereas following the third there was no more than a short negative phase registered on the chart and no symptomatic reaction. The immunity curve induced by each dose of 5 million is brought out clearly by the enclosing lines. It can be noticed that the interval between the doses was entirely dependent on the weight; $7\frac{1}{2}$ million gave no reaction; 10 million seemed not to affect the weight at all. The drop was very gradual and probably due to the exercise of the increased powers of walking. Fifteen million was followed by a brief rise and fall. Several further doses were given, but it was at or about the last dose on the chart that the infection seemed to have come to an end. It will be noticed that the fluctuations in weight were considerable. On the 9th, 22nd, 26th, 32nd, and 41st days of treatment a difference of one pound was registered, and even greater excursions are often seen. It is then comparatively easy to graduate the size and arrange the spacing of the doses in accordance with the indications given by the weight chart. Failures due to faulty administration should by this means be practically eliminated.

(5) *Peculiarities in the Constitution of the Patient and in his Response to Vaccines.*

There are a certain few people who are relatively insensitive to injections of a vaccine and in whom enormous doses fail to produce response. Such cases gain no benefit from treatment by this method. On the other hand, there are some so sensitive that the smallest dose may excite an intolerable reaction. Or, during a course of treatment, this state of sensitiveness may develop. Sensitiveness is frequently found on giving vaccines to a patient who has recently been inoculated with excessive doses of some other or the same vaccine. It is also met with to a most annoying degree in people who have been subjected to intravenous inoculations of bacterial extracts in large amounts. One gains the impression that in these cases, over-stimulation has disarranged the immunity mechanism, with the result that it has become irritable. Again, a spurious kind of sensitiveness may appear when an unsuspected organism becomes active in a patient under treatment by the vaccine of another organism. Finally, in another course of treatment and for no apparent reason, sensitiveness may develop and cause considerable trouble.

There are five ways of dealing with this condition, and I do not apologise for going into the matter fully because it presents one of the greatest difficulties with which one has to contend. (a) The first thing to be done is always to revise the bacteriology of the case, and if a secondary infection is found to prepare a fresh vaccine and try that. (b) The dose may be reduced almost to vanishing point, and then gradually raised at frequent intervals. This may succeed, but it more often fails. (c) The dose of vaccine may be combined with about $\frac{1}{2}$ c.cm. of 4 per cent. eucaine lactate. The original communication on the subject³ had reference to tuberculosis, but the method is equally efficacious in the diseases now under discussion. (d) A sensitised vaccine may be employed. There is no great difficulty in preparing this for the rheumatic streptococci. Unfortunately, a *M. deformans* antiserum which is necessary for sensitisation is far from easy to produce. Doses of a sensitised vaccine can be given daily at first and then every second or third day. Increase should be rapid, up to several thousands of millions. A return can then be made to quite small doses of ordinary vaccine. (e) Treatment may be

suspended. If a good many doses of vaccine have been given before the sensitive condition appears this method is the best of all. Symptoms gradually disappear. Improvement may be maintained for weeks or months. When relapse occurs treatment may be resumed with confidence since sensitiveness will have disappeared and improvement is usually rapid.

In all cases of sensitiveness the weight chart will be found to be an almost indispensable guide. When the patient becomes sensitive an irregular curve develops, up one day and down the next, then up again, perhaps, and so on. As soon as sensitiveness is overcome the curve becomes rational and intelligible.

(6) *Mistakes in General Treatment.*

It is usual to find patients suffering from rheumatoid arthritis ordered haphazard massage, or rheumatics told to "walk it off." When vaccines are being given such directions are most dangerous on account of the auto-inoculations induced. During a course of vaccines massage and electrical treatment, baths, exercise, in fact, anything which may be the exciting cause of an auto-inoculation must be most carefully watched and controlled from day to day. Otherwise the success of the vaccines will be seriously prejudiced.

Conclusion.

In conclusion, one would draw attention to the importance of guarding against the fallacy that because the vaccine of a given organism has a pronounced effect on the patient that therefore this organism must be the causal germ of the disease. Sir Almroth Wright has recently suggested that vaccines are not nearly so specific as has hitherto been thought.⁹ His conclusions greatly strengthen the case for a more extended use of stock vaccines.

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Harrogate.

A NOTE ON THE DIURNAL VARIATION IN BODY-WEIGHT IN TUBERCULOUS PATIENTS.

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THE following observations were made on the body-weight of patients attending Stepney Green Tuberculosis Dispensary during the time that I was acting medical officer.

The Measurements of Body-weight.

The patients were weighed at each attendance between 2 and 4 in the afternoon. I made it a practice to call up 10 or 12 for re-examination next morning at 10 A.M. when they were again weighed. The weighing was done by the porter, who was very keen on his work, and after careful observation I can trust his records.

I noticed that in the majority of cases there was a fall in the morning weight as compared with the previous afternoon. It varied from $\frac{1}{4}$ lb. to as much as 4 lb.

The patients being of a poor class have no extensive wardrobe, and the difference was unlikely to be due to a change in the clothing. To eliminate this possible factor, however, the patients were instructed to wear exactly the same clothes in the morning as they wore in the afternoon. The fall in weight continued to be recorded.

Careful questioning and observation showed that changes in sleep or diet could not be the cause of this variation. The patients were unable to have any alteration in diet, and in every case reported sleep as usual.

Out of a total of 962 recorded weights I found that 146 showed no variation, 205 showed an increase, and 611 showed a decrease. The average increase was 0.77 lb. The average decrease was 1.03 lb.

The patients attending the dispensary are divided into positive cases, including pulmonary and glandular cases of