of infection the chance of becoming infected must be larger in proportion to the number of centres than when the centres are more sparsely distributed. No direct measure of this is possible, but it may be assumed that as the death-rate in a population increases in proportion to a power of the density (Farr's law) a similar law will hold in this case. If, in other words, y be the number of infecting centres at any moment, the intensive power due to the increase in y may be represented by y^n , the number n being determined from the observations.

On the theory that the power of infectivity on the part of the organism decreases with time in a geometrical progression, or, in physico-chemical language, that the substance necessary to produce infection decreases in amount according to the law of the mono-molecular reaction, the infecting power at any moment is represented by the form

$$e^{a-bt}$$

Introducing the intensive factor by analogy with the corresponding equations of physical chemistry, of which a typical example is furnished by the influence of temperature on the rate at which a chemical reaction takes place, the infectivity at any moment is evidently

$$y^n (a-bt)$$

which by the process described in my previous note gives the epidemic equation:

$$\frac{1}{y} \frac{dy}{dt} = y^n (a-bt)$$

The solution of this takes the form:

$$y = \frac{m^n}{(c-at + \frac{1}{2}bt^2)^n}$$

where $m = \frac{1}{n}$ and c is a constant.

This is Pearson's Type IV.

Comparing this form with the observations, n is found to vary in value from 0.07 to 0.25, the commonest values being in the region of 0.14.

This form does not allow for asymmetry, but as very nearly symmetrical epidemics are most commonly found, the theory, so far, is in accordance with the facts. Asymmetry may, however, be introduced if it is assumed that the increase of concentration does not act exactly as just described, but rather in the manner represented by

the expression $e^{a+y^n(a-bt)}$ which gives the epidemic form:

$$y = \frac{a^2 m}{\left(c a^2 e^{-\frac{a}{m}t} + a b t - b m - a a \right)^m}$$

This curve closely approaches the symmetric Type IV, as a becomes equal to zero.

An explanation of the epidemic form from the theory of physical chemistry is thus furnished. I do not for a moment think that the lack of susceptible persons may not in many cases tend to bring an epidemic to a more rapid close, nor that the form of the epidemic may not to a large extent be explained on the latter hypothesis, but I still adhere to my previously expressed opinion that the decline of an epidemic is much more likely due to the loss of infectivity on the part of the infecting agent.

The introduction of the idea that the power of infectivity is enhanced by concentration also explains the distribution of disease in space. When such a chart as that issued in the report of the Metropolitan Asylums Board for the year 1902 regarding the distribution of small-pox in London in the great epidemic of 1901 is examined it is found that instead of the cases being distributed according to a normal surface, as seems *a priori* probable, the distribution is again that of Type IV. The same distribution in space has been found for many other epidemics, and is now for the first time explained.

WITH the opening of the September term a fund of £200,000 from various donations will be available for use by the Washington University Medical School. This will enable the school to create full-time appointments for teaching and research work in medicine and paediatrics.

ON THE IMPORTANCE OF TECHNICAL DETAILS IN THE PREPARATION OF A TRANSPARENT BLOOD-AGAR FOR THE CULTIVATION OF THE MENINGOCOCCUS.

By DOROTHY JORDAN LLOYD,

"N" FELLOW OF NEWNHAM COLLEGE.

(Report to the Medical Research Committee from the Biochemical Laboratory, Cambridge.)

THE meningococcus needs for its metabolism (a) some digested protein, and (b) a comparatively high concentration of the vitamins or accessory growth hormones whose importance in metabolism is beginning to receive general recognition. The former may be supplied by a tryptic digest of bullock's heart; the latter may be supplied, as has long been known, by the addition of a small quantity of blood to the medium.

The tryptic heart digest is made according to the method of Douglas.¹ To use it as a medium for the meningococcus, powdered agar is added to 2 per cent. of the digest, and the mixture is steamed and filtered. After the final filtration, the reaction of the medium is adjusted, and defibrinated bullock's blood is added to 5 per cent. The medium is now cloudy. The method of clearing is important.

1. The melted tryptic blood-agar is placed in the steamer for from thirty minutes to one hour in order to coagulate proteins of the blood. These are thrown down as a spongy dark-brown clot.

2. The melted agar is cleared by centrifuging for ten minutes at a speed of 3,000 revolutions a minute. The vessels of the centrifuge should be made hot before use, to prevent the setting of the agar.

3. The clear fluid is poured off, and should be tubed and sterilized at 100° C. for three successive days according to the usual routine method.

Should the centrifuging of large quantities be difficult, the clear medium can be obtained by the use of a siphon. In this method the fluid should be transferred to an Erlenmeyer flask. It should be steamed for an hour, and then allowed to settle, and this process can be repeated a second or third time if necessary, in order to render the clot sufficiently compact to permit the use of the siphon in drawing off the clear supernatant fluid.

It is important to add the blood after the agar, and the medium must on no account be filtered after the blood has been added. This fact is the essential point of the present communication. Filtration either through a Chardin filter paper, or through paper pulp on a Buchner funnel removes the essential vitamins at the same time as it removes the undesirable sediment. This is probably an adsorption phenomenon.

Tryptic blood-agar made transparent by the above method has been found to be highly satisfactory for obtaining both primary and secondary cultures of the meningococcus. It is equally effective for both spinal fluid and throat strains. Moreover, the viability of cultures grown on it is good, three weeks being about a minimum duration if the inoculated slopes are kept in a moist incubator.

Table showing the Difference obtained according to whether a Dilute Emulsion of the Meningococcus in Ringer Solution is Sown on the Centrifuged or on the Filtered Media.

Medium.	Meningococcus Strain:			
	H. Spinal fluid used.)	P.	G.	Bl.
Tryptic heart-agar (Douglas)...	0	0	0	0
Ditto + blood cleared by centrifuging	+	+	+	+
Ditto + blood cleared by passing through Chardin filter	0	0	0	0
Ditto + blood cleared by filtering through paper pulp on Buchner funnel	0	0	0	0

This medium does not lose its properties after sterilization at 100° C. When tubed, it remains unaltered for a considerable time.

The full account of the researches on which the fore-

going statements are based will be published shortly. It is hoped to test the efficiency of the medium for other pathogenic organisms.

REFERENCE.

¹ *Lancet*, October 10th, 1914.

THE DURATION OF BILHARZIOSIS IN SOUTH AFRICA.

By F. G. CAWSTON, M.B., B.C. CANTAB.,
PIETERMARITZBURG, NATAL.

JUDGING from the number of men who were infected with bilharziosis during the South African war, and the number of these who are still receiving compensation from the army authorities, the study of the duration of the South African form of bilharziosis is of great importance. The disease, as met with in German East Africa, is as persistent as in Natal. At one time bilharziosis was very prevalent amongst the natives there, and in some parts of the country two out of every three of the male population were infected. The disease attacked the female population to a lesser degree.

The vast majority of persons in Natal who suffered from the affection some twenty or thirty years ago have by this time entirely grown out of the symptoms and, in a large number of these cases, microscopic examination of the urine shows no evidence of the past affection. On these grounds a life insurance society can be recommended to accept an otherwise suitable applicant at the usual rates, even though he has a past record of bilharziosis, provided the urine has shown no sign of blood or mucus for one year and has not contained any of the eggs for six months, so far as can be judged from occasional microscopic examination of the urine.

A number of those who contracted the disease some twenty or thirty years ago have suffered continually from its symptoms ever since, though they have not been sufficiently severe for them to undergo continuous medical treatment. Recently I met a gentleman who has suffered from this form of haematuria for the past thirty years; occasional treatment had improved his condition, but it has never cured him. Three children of his—two boys and a girl—suffer from the same symptoms. The relation of puberty to this complaint is a fanciful view of the past. It should be placed in the same category as that of urethral infection. Some patients have attributed their cure to various medicinal remedies, and have great faith in their efficacy; but it would seem that diuretics and urinary antiseptics are the only drugs on which much reliance can be placed.

It is probable that, from time to time, the worms produce an exceptionally large number of eggs, which would account for the occasional aggravation of the symptoms, and that, sooner or later, they die out in the blood stream. Even after the worms themselves are dead, there are numerous eggs still present in a badly infected case, and it is uncertain whether these eggs ever entirely disappear from the human body. The remains of dead ova have been found in the kidney substance, in the bladder walls, and in minute calcified nodules in the lungs. Such objects would presumably never quit the body.

The following instructive case, for the details of which I am indebted to Dr. James Petrie, of Zululand, subsequently proved fatal:

CASE I.

Some years ago in Natal a European boy was infected with bilharziosis, but did not suffer much inconvenience from it. Then he went to study in Sweden and, after two or three years in that country, began to suffer so much that he was compelled to undergo treatment. Finally, he was taken to hospital, where he died from the effects of the disease. He was about 20 years of age when he died. Two adult worms were found at the post-mortem examination, one was alive and the other dead.

CASE II.

On August 9th, 1915, I examined for life insurance an applicant whose case I was obliged to postpone on account of slight albuminuria. A further examination of the urine in September indicated some bladder or kidney abnormality. Early in October he was mentioned to me as one of many in this part of Natal who had suffered severely from bilharziosis; it was attributed to swimming in the Umsindusi River, and had troubled him for a long time. On March 15th, 1916, he came up again for a fresh medical examination. On this occasion he told me that he had suffered from haematuria in the past; but

that, as he had not noticed it for ten years, he considered that he was cured. Occasionally, however, he complained of pains in the back, which could only be relieved by hot baths and rest. Presumably these were attacks of renal colic, which is a fairly common sequela, even where there is no renal calculus. Examination of the cloudy urine which he passed on this occasion revealed the presence of shreds of bladder mucous membrane and a number of ova containing miracidia.

It would be of service if practitioners would submit to microscopic examination the urine of persons who are said to have been cured of this affection before placing too much reliance on the remedies that have been recommended. Even if some be effective in destroying the parasites in the blood stream and in diminishing the haematuria, the escape of the spine-pointed eggs which continues is too frequently associated with bacilluria and damage to the bladder wall to enable one to pronounce such a case as cured, even though it is most exceptional to hear of cases which have died or whose lives have been shortened by bilharziosis in South Africa.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

CLINICAL RESULTS OBTAINED WITH THE TUNGSTEN LAMP.

THE bactericidal powers of ultra-violet rays are well known, and those emitted by the quartz mercury vapour lamp have been used for the sterilization of water. Though the penetrative power of the rays is very low, their action is rapid, so that by causing them to act on a thin film of quickly flowing water even large water supplies can be dealt with. Ultra-violet rays have also been used a good deal recently in therapeutics, but the manner in which the improvement, which undoubtedly in some cases follows their employment, is brought about has not yet been fully explained. The quartz mercury vapour lamp has commonly been used for the purpose, but it has recently been pointed out that tungsten electrodes give out a very large quantity of ultra-violet rays. The physics of the matter was discussed by Dr. Sidney Russ, physicist to the Middlesex Hospital, in this JOURNAL in a paper illustrated by some instructive spectrograms (January 22nd, 1916, p. 124).

Tungsten is at the present time difficult to procure, and in the lamp I used (Simpson's) for the past five months was replaced by its ore, wolfram. I am indebted to Lieutenant-Colonel Bruce-Porter, R.A.M.C.(T.), Officer Commanding No. 3 General Hospital, Wandsworth, for permitting me to instal an apparatus in that hospital, and to Captain Humphris, R.A.M.C.(T.), in charge of the x-ray department, for much valuable assistance.

The apparatus consists of a lamp mounted on a portable stand, adjusted so that the light can be directed where desired, a switchboard with switch, ampère-meter, fuses and resistances for lowering the voltage and ampérage of the main to a suitable value—about 5 ampères at a voltage of 40 to 60. The electrodes, consisting chiefly of wolfram (tungsten of iron and magnesia) are fixed in clip-holders and are easily adjusted by a hand-screw.

The light is supplied at a distance of 10 to 15 in. either as "open arc" or "focussed arc," the former when treating large surfaces, the latter for smaller areas, or where more intense treatment is considered necessary. The first exposure should be one minute, as the reaction differs considerably in different cases, and can be afterwards increased to two or even five minutes. It varies from slight irritation to considerable erythema and desquamation, and is not usually seen until four or five hours after exposure. The treatment should not be repeated until the reaction of the previous exposure has passed off. If the reaction is sufficiently severe it can be treated with boracic powder or olive oil, and soon disappears. The light is not only very rich in ultra-violet rays, but contains also rays of shorter wave length than the light from a carbon arc. As the light is very dazzling, the patient's eyes should always be protected by a dark bandage, and the operator should wear lead blue glasses, as the light may cause conjunctivitis.

I especially desired to try the curative effects of the light on sinuses and the indolent ulcers left after "frost-bite"