

are subject to daily or weekly attacks, while conversely the smallest percentages of confirmed and the highest of arrested cases occur in those whose fits are as infrequent as once or twice a year.

8. The character of the seizures influences the prognosis to the extent that the major attacks are the most tractable; then follow combined major and minor seizures; and lastly, the minor attacks occurring alone.

9 Marriage exerts little, if any, influence upon epileptic fits. Some patients are relieved and others are made worse. In the majority of cases the disease remains unaffected.

10. Pregnancy has little influence upon the seizures; at the best there may be only a temporary respite. On the other hand the puerperium would seem to be especially favourable for the recurrence of fits; while lactation also is not without an exciting influence in their production.

11. The common incidence of epileptic fits is an irregular periodicity. There are types, however, which have been described as "increasing" or "decreasing," according as the fits increase or decrease in number in a definite period of time or in which there is a shortening or lengthening of the intervals between the fits. A case of increasing type may by treatment be converted into one of the decreasing variety.

12. Long remissions, induced either by successful treatment or from spontaneous cessation of the fits, sometimes lasting for several years are not unusual in epilepsy; they are of favourable prognostic value but are not synonymous with a cure of the disease.

13. From the collected statistics a period of remission for at least nine years has been fixed as the basis upon which a cure of epilepsy may be established. With this definition of a cure I regard 10.2 per cent. of epileptics as curable.

14. There are some cases of epilepsy which may be regarded as belonging to a curable type of the disease. These present little or no mental impairment, notwithstanding that fits may have existed for a long period. In the cases in which arrest took place cessation of the fits occurred within the first year of continuous treatment in over 50 per cent.

Bibliography.—Hippocrates: Sydenham Society's Translation, vol. ii., pp. 850 et seq. Maisonneuve: Recherches et Observations sur l'Épilepsie, Paris. Pinel: Nosographie Philosophique, Paris, 1813, vol. iii. Esquirol: Traité des Maladies Mentales, Paris, 1838, vol. ii. Valleix: Guide du Médecin Practicien, Paris, 1851. Herpin: Du Pronostic, &c., Paris, 1852. Trousseau: Clinique Médicale, Paris (mentioned by Habermaas, op. cit. infra). Russell Reynolds: Epilepsy, London, 1861. Tissot: Traité de l'Épilepsie, Lausanne, 1790. Hufeland: Manuel de Médecine, Paris, 1841. Nothnagel: Ziemssen's Encyclopædie, vol. xiv., 1878. Dana: Text-book of Nervous Diseases, New York, 1893. Habermaas: Allgemeine Zeitschrift für Psychiatrie, Band lviii., p. 243. Hughes Bennett: Epilepsy and its Treatment, 1884. Sir William Gowers: Epilepsy, second edition, 1901. Biro: Deutsche Zeitschrift für Nervenheilkunde, Band xxiii., p. 40. Wharton Sinkler: Journal of Nervous and Mental Disease, 1898, p. 601. Tooth: Out-patient Observations on Epilepsy, St Bartholomew's Hospital Reports, vol. xxxi. Binswanger: Article, Epilepsy, in Nothnagel's Specielle Pathologie und Therapie, vol. xii. Spratling: Journal of Nervous and Mental Disease, 1899, p. 297.

Queen Anne-street, W.

MALARIA AS SEEN IN THE ANDAMANS PENAL SETTLEMENT.

By ERNEST EDWIN WATERS, M.B., C.M. EDIN.,
CAPTAIN, I.M.S.; OFFICIATING SUPERINTENDING MEDICAL OFFICER,
PORT BLAIR.

MALARIA is the disease that causes by far the greatest amount of sickness in the Andamans penal settlement and which consequently causes a serious disorganisation of the labour supply and a heavy financial loss to the administration. In 1902 there were nearly 14,000 admissions from malaria and though only 57 deaths were directly attributed to this disease, yet I am convinced that many patients who died from other diseases had their constitutions undermined by previous malarial attacks. In other words, a healthy man has strong resisting powers to the bacilli of dysentery or tuberculosis, but once his vitality is lowered by malaria he falls an easy prey to these complaints. The tax of malarial fever is a very heavy one; taking 14 days as the average period for which fever cases are non-effective, malaria alone in 1902 accounted for 196,000 labour units (one man for one day) or, at four annas per day, for 49,000 rupees. This represents the labour of 2000 men for 98 days.

And all this is exclusive of the cost of quinine, hospital establishments, and medical comforts.

On investigating the causes of this disease one notices that in 1902 the least malarial month was February, with seven inches of rain, that the admissions increased slightly in March, much increased in April, further increased in May, till they reached a maximum in June. In July there was in nearly all districts a decline in the malaria more or less marked, whilst in August and September, the two wettest months of the year, the admissions for fever sharply declined. These statements also apply for the two previous unhealthy years 1900 and 1901, but more especially to the larger stations and districts. Ross Jail and the Female Jail show variations and do not conform to this. Table I. shows precisely the proportion of the monthly malarial admissions in the various areas and the rainfall from January, 1902, to March, 1903, inclusive. The rainfall shown is the average of the whole settlement. In 1902 Ross was the wettest station.

TABLE I.—Showing the Number of Admissions for Malaria into the Hospitals and the Average Rainfall from January, 1902, to March, 1903, inclusive.

Months.	Average rainfall.	Ross.	Aberdeen.	Haddo.	Female Jail.	Wimberley Ganj.	Southern District.
1902.							
January	0.12	15	24	67	21	313	218
February	7.28	12	13	41	29	232	199
March	0.53	22	41	52	20	287	312
April	1.93	33	61	85	19	472	608
May	18.59	31	147	156	34	626	793
June	21.47	35	372	312	192	738	817
July	16.49	75	310	253	196	620	484
August	33.65	39	172	129	123	460	279
September	24.83	27	129	109	89	354	211
October	9.44	37	153	77	85	278	212
November	10.95	58	158	98	84	219	186
December	5.38	67	98	51	53	225	242
1903.							
January	0.31	70	70	40	66	186	185
February	4.61	53	49	35	49	200	180
March	Nil.	67	88	54	33	310	213

The approximate strengths in the various hospitals during the period mentioned were as follows: Ross, 700; Aberdeen, 2200; Haddo, 1800; the Female Jail, 400; Wimberley Ganj, 2350; and in the Southern District, 3500.

There are two methods in which we may attempt to account for the prevalence of malaria: (1) the purely mosquito theory; and (2) the relapse or recrudescence theory.

I.—THE PURELY MOSQUITO THEORY.

This would require infection from a specific anopheles to account for every attack of malaria, and the malarial admission-rate should be coincident with a marked increase in mosquitoes or at least with more favourable conditions for their existence. Now, our malaria begins in April, the hottest and one of the driest months. It increases and reaches its maximum in June and then declines irrespectively of the rainfall. This feature is constant. If mosquitoes are solely responsible for our malaria they must be of a type which flourishes in the hot month of April and the wet ones of May and June, suddenly dying off in July and subsequent months, although these months, from conditions of temperature and moisture, would appear to be equally suitable for their development. More than this, the number of cases of malaria from which the mosquitoes may become infected is much greater in May and June and consequently the number of infected and dangerous mosquitoes should be much larger. With more infected mosquitoes the malaria rate should rise, but it undoubtedly falls. (It has been suggested to me that the mosquitoes themselves become so ill from malarial poisoning that they, too, die off. This theory is ingenious but it is hardly practicable to investigate it.) Also, it may be that in July other mosquito-eating insects and animals appear who prey upon the culicidæ and so enormously reduce their numbers.

If we can exclude mosquitoes, does malaria diminish? It does, most decidedly. For the past 15 months careful experiments have been carried out in the Female Jail, one of the most unhealthy and malarious units in the settlement. This experiment was initiated by Major Anderson, I.M.S., and has since been extended by me.

37 women selected from all classes were placed under mosquito curtains, going under them at dusk and coming out in the morning. Their occupation, health, and food in no way differed from any other section of the jail. The remainder of the jail population was divided into two classes. To one class 20 grains of quinine were given in two successive days; to the other no prophylactic issue was made. The effect was most marked. In Class A, in which the women slept under mosquito nets, there were 1007 admissions per 1000; in Class B, who received quinine, the admissions were 2421 per 1000; and in Class C, who received no quinine, they were 4177 per 1000. I believe that the figures would have been better in Class A but for an unfortunate case of chicken-pox in one of the women which necessitated a change in the inhabitants of a second net which had just been occupied. These figures go to show that under conditions prevailing in the Female Jail the exclusion of mosquitoes is an effectual and inexpensive method of reducing malaria.

II.—THE RELAPSE OR RECRUDESCENCE THEORY OF MALARIA.

This theory is somewhat heterodox nowadays but it has some grounds for consideration. To begin with, practically every native who comes to the Andamans has suffered from malaria in his youth and probably has had several attacks of fever. He has not become immune or he would not suffer from malaria or fever. The malarial parasites are supposed to be locked up in the spleen and under favourable conditions will be eventually destroyed there. But it is a matter of common knowledge that in the case of a person who has once suffered from malaria a chill, over-exposure, &c., will induce a fresh attack, even years after the original infection, and that a malarial subject should avoid circumstances where he is likely to be so exposed. Now, as I have said above, most natives have suffered from malaria and on arrival here as prisoners they are subject to new and trying conditions. The climate, water, and food are strange to them, they are worked hard, and they are constantly exposed to sun, rain, and wind. Differing from free men they cannot, if feeling only slightly unwell, leave work for a day or two, change their food, or take life a little easily. They must either work on or go sick to hospital, with the possibility of not being admitted and the risk of punishment. Our hospital figures substantiate this theory. Well-cleared, established stations like Aberdeen, Haddo, and Phoenix Bay are less malarial than out-stations like Goplakabang, but even in the healthy stations it is the men doing hard outdoor work who furnish the bulk of the malarial cases. True, it is these men who have the most inducement to come to hospital; but latterly all our cases of malaria have been examined microscopically and I have yet to find a malingering who is competent to produce pigmented crescents at will or to arrange for a suitable increase in his large mononuclear leucocytes. It appears to me that the convict may at times derive his fever from the bite of infected mosquitoes but that he may also have a relapse from a previous attack through exposure, over-work, or some cause lowering his vitality. Again, while a healthy, well-nourished man may only suffer slightly from fever after an infected bite, it is obvious that a weakly, chilled, tired man whose powers of resistance are much lowered would in all probability suffer to a much greater or more serious extent.

This question is admirably worked out by Attilio Caccini¹ of Rome. He gives specific instances (with detailed examinations of cases) where fever has re-appeared within 48 hours of exposure to damp and cold, even in patients who were taking quinine regularly at the time of exposure. He further proves "that in patients not treated with quinine, in whom the primary malarial infection has exhausted itself, the attack recurring after a long period always comes on after the intervention of one of these recognised determining causes." In these cases parasites rapidly reappear in the blood. He says, further: "The attack recurring after a long interval exactly resembles true first infection—that is, the paroxysms of fever may be more or less regular; attacks may or may not occur at long or short intervals and they

react equally against the quinine treatment. But whereas regular systematic treatment prevents attacks recurring at short intervals it does not prevent those recurring at long intervals, which come on after a space of time which may reach 12 months of apyrexia. The attack always occurs upon the intervention of any of the organically debilitating causes mentioned. Thus with patients treated with quinine and divided into categories according to the method of treatment every category shows the same percentage of attacks occurring at long intervals. In every case the attack followed upon the intervention of one of the debilitating causes above noted. Any patient guarding against debilitating accidents and observing a regular diet may remain free from attacks of fever for a long while (from six to seven months) but suffers a relapse after that time upon exposure to cold, fatigue, wounds, or illness."

Now these statements correspond with our experience here. We know that exceptionally hard work will send up the fever admissions from the men exposed to it, especially when proper precautions are not taken. On Ross Island in the period from December to March there is usually a strong cool wind blowing and it is to this that the population ascribe their fever. They say beforehand that when this wind begins they get fever, and they certainly do. I do not think that at that time there were any anopheles mosquitoes on the island—certainly one could never catch them—and even culices were very rare. The wind came directly from the north-east over some hundreds of miles of sea, so that the chances of infected mosquitoes being carried in may be dismissed.

The probability is that both these theories are true and that direct infection from the mosquito and relapses due to exposure together and unitedly account for the malaria as seen here.

THE MEANS OF DIMINISHING MALARIA.²

Any measures that will diminish the heavy malarial sick-rate are naturally of the greatest value and much attention has been paid to this question during the past year. So far as our present knowledge goes three, or possibly four, methods are supposed or are likely to be efficacious (always remembering that we are dealing with a malaria-infected population). These are: (1) the destruction of all anopheles mosquitoes; (2) the prevention of infection of, and by, anopheles mosquitoes by means of nets or combustible pastilles; (3) the dosage of the whole population with quinine to an effective extent; and (4) the keeping of the population "fit" or in such a good state of general health that relapses or recrudescences are unlikely.

1. *The destruction of all anopheles mosquitoes.*—This I have no hesitation in saying under local conditions is impossible. The large area of the settlement, the dense vegetation, the heavy rainfall and consequent swamps all make such a task impossible of fulfilment. It may be done over comparatively small areas and in the older stations, but to do it over the 100 and odd square miles within the settlement boundaries is not practicable. But even on a small scale much good may be done and I propose to describe in detail the results of the efforts made. The first attempts were made on Viper, a small island accommodating about 1000 convicts and some 250 troops and police. This island has no streams; its water-supply is from collected rain water, one or two wells, and from a daily ration brought from another station. The island is thoroughly cleared and well drained. Like all other stations the buildings are of wood and as a protection against fire there are wooden fire barrels distributed round all the houses and barracks. These fire barrels were the main sources from which the mosquitoes came and early in the year every barrel swarmed with larvæ and mosquito eggs could always be found. Generally these larvæ and eggs were of the culex variety, but occasionally anopheletes were discovered. The work of getting rid of mosquitoes was commenced in June with a few convalescents who were instructed to keep these barrels clean and to pick up cocoon shells, &c. The results were excellent so far as the number of mosquitoes were concerned. On every hand one got the same response to inquiries, from officials and convicts alike. The mosquitoes were much less numerous, nets were no longer a necessity, and life was rendered much more tolerable in consequence. At the same time experiments were made with combustible pastilles, so evil-smelling as to be calculated to drive out the mosquitoes from any building in which they were burnt. These were

¹ Journal of Tropical Medicine, May and June, 1902.

² Vide Ross's report on Malaria at Ismailia, 1903.

made of sulphur, charcoal, and saltpetre but were not satisfactory. They were expensive (the cost to burn them twice weekly throughout the settlement at the scale of 1 per 1000 cubic feet would have been about 10,000 rupees) and they were only temporarily effectual. The general opinion was that so long as they were burning neither man nor mosquito could exist within their range but that as soon as they had burnt out sufficiently to permit the inhabitants to return the mosquitoes returned also. Following the small Viper experiment and other small experiments elsewhere a more thorough trial was decided on. In November the Chief Commissioner issued orders forming mosquito brigades in every station and these commenced operations on Dec. 15th. Information and literature, including Ross's book, had previously been widely circulated and the petty officers in charge of the gangs were instructed in their duties. The men of the brigades, numbering in all nearly 200, were equipped with carts, tools, and dippers for searching purposes. Careful arrangements were made to check the exact sleeping places and occupations of all men reporting sick and the blood of every fever case was examined microscopically, often more than once.

In some respects the results of these special gangs have been excellent. Mosquitoes everywhere have enormously decreased—in fact, in many places a mosquito is quite a rarity and as such is immediately noticed. The exact prevalence in bungalows appears to depend on the interest and enthusiasm of the occupants. Many residents have assured me that they can now sleep without nets or punkahs and the convicts all tell me that mosquitoes have much diminished. Besides this the general sanitation of the settlement has much improved. Drains have been cleared, puddles filled, rubbish removed, and undergrowth cut back to a considerable distance. The improvement in the general cleanliness is most marked and in this respect alone the mosquito gangs have done much good. But when we examine the effect of these measures on the malarial admissions we do not obtain such encouraging or consistent results. The results from the principal stations and districts are as follows for the three months during which the brigades have been working (Table II.).

TABLE II.—*Ross Island.*

Period.	Approximate strength.	Admissions for fever.
December, January, and March, 1899-1900	660	43
" " " 1900-01	698	82
" " " 1901-02	735	48
" " " 1902-03	718	203

Of this season's admissions, mullahs furnished 67 and sweepers 25. 49 admissions came from No. 1 barrack and 29 from each of the others. Government House, the senior medical officer's bungalow, and the mess, which are close to one another, each had ten fever admissions, whilst two other bungalows, which are side by side, gave 13 and 12 admissions respectively. No other house had anything approaching this number. These cases are very difficult to explain on the purely mosquito theory. In the patients (boatmen) from the senior medical officer's bungalow distinct parasites were found and in two cases crescents; at that time of the year it was impossible to discover an anopheles on Ross Island. The patients generally and many of the residents, too, ascribed their fever to the onset of the north-east monsoon which, they say, chilled them and gave them fever. On the other hand, both the areas above named are thickly covered with vegetation which gives good mosquito cover.

TABLE III.—*Female Jail.*

Period.	Approximate strength.	Admissions for fever.
Three months in 1899-1900	359	140
" " " 1900-01	369	109
" " " 1901-02	406	80
" " " 1902-03	401	168

The results shown by Table III. are similarly disappointing. It is easy to explain why the Female Jail should be malarious, but it is not easy to explain why it should have

been more malarious this year than usual, when stringent sanitary precautions were exercised and when half the inhabitants were taking 20 grains of quinine twice daily.

At Ross hospital the blood of every patient coming to hospital was examined for malaria parasites, whatever his disease may have been. In all, 527 patients³ were examined and parasites were found in 136 cases. The analyses showed intracellular hyaline, 49 times; intracellular pigmented, 36; extracellular forms, 20; and crescents, 31. There were also combinations of these varieties. In many cases crescents were found in enormous numbers, as many as 180 being counted in a single slide. In other cases crescents abounded in the blood of men feeling perfectly well, having normal temperatures, and who were anxious to go out of the hospital.

TABLE IV.—*Aberdeen.*

Period.	Admissions for malaria.
December to March, 1899-1900	312
" " 1900-01	234
" " 1901-02	70
" " 1902-03	215

At Aberdeen Hospital, too (Table IV.), careful blood examinations were made, but the results are included with those of Haddo hospital.

At the Female Jail the malaria admissions for January were 66; for February, 49; and for March, 33. Microscopic examination of the blood in the 212 cases which were examined (being all the admissions) revealed parasites in 125 cases, of the following varieties: hyaline intracellular, 47; intracellular pigmented, 36; extracellular pigmented, 26; and crescents, 16.

TABLE V.—*Haddo, Chatham, and Phoenix Bay.*

Period.	Haddo fever admissions.	Chatham fever admissions.	Phoenix Bay fever admissions.
1899-1900	152	154	186
1900-01	69	54	92
1901-02	78	33	58
1902-03	49	28	49

In Haddo, Chatham, and Phoenix Bay (Table V.) the results are favourable; everywhere there were fewer cases, although in 1902 the population tended to increase steadily. Possibly the inhabitants of these stations are less exposed in the cold season to changes of temperature than most other men and consequently are more likely to benefit from anti-mosquito efforts. As in other cases, careful blood examinations were always made. 194 fever cases were examined and parasites were found in 173 cases of the following varieties: intracellular hyaline, 101; intracellular pigmented, 23; intracellular ring forms, 21; extracellular pigmented, 10; crescents, 10; segmenting forms, 6; and flagella 2. This blood examination was carried out by Dr. Sanyal who ascribes the high parasite rate to the facts that only "fever" cases are included, that there was no prophylactic issue of quinine going on, and that no quinine was given to the patients until the blood examination had been made and the diagnosis checked.

SOUTHERN DISTRICT.

It is in an unhealthy area such as this that the mosquito brigade work is of special interest. Attention was specially directed to Viper, Namunaghar, Dundas Point, and Minnie Bay (Table VI.).

TABLE VI.—*Showing Number of Cases in Southern District.*

Period.	Viper.		Namunaghar.		Dundas Point.		Minnie Bay.	
	Average for 3 years.	1902-1903						
December	35	76	101	61	49	26	5	9
January	40	53	75	41	33	35	23	12
February	52	64	59	27	43	34	43	19

³ These figures include sick from Aberdeen.

Of the 129 admissions from "Namunagar in the three months 83 came from one barrack—the temporary one—but the firewood cutters (who are always unhealthy) lived in this barrack. Altogether the blood of 592 fever cases was examined. In 289 of these malarial parasites were discovered.

TABLE VII.—*Wimberley Ganj Subdivision.*

Period.	Approximate strength.	Admissions.
1899-1900	1480	520
1900-01	1944	916
1901-02	2161	811
1902-03	2352	603

In Wimberley Ganj Subdivision, too (Table VII.), there is a decline in the admission rate as compared with previous years and that although the population of the subdivision has increased. In 1062 blood examinations made from October to February parasites were found in 892 cases, of the following varieties: extracellular hyaline, 851; extracellular, 19; and crescents, 22.

The above tables are, of course, but a summary of all the information which has been collected on this subject but which want of space prevent me from inserting. This account does not exhaust what has been done in the direction of mosquito brigades. In the villages, both ticket-of-leave and free, the system has also been inaugurated and men have been told off to attend to puddles, sanitation, and general cleanliness. The effect of this action is bound to be most marked.

I am indebted to Mr. Lewis, the subdivisional officer of Ross, for much assistance in connexion with the mosquito brigades and for the following information as to local varieties of the insect.

The commonest variety of mosquito in Port Blair is *Culex fatigans*. It is a house mosquito, breeding in any convenient collection of water and biting at all hours, but especially at night. The only other known variety of culex locally found is *Culex concolor*, a larger insect than *Culex fatigans* and possessing larvæ of cannibalistic habits. There is one other small culex found but it has not yet been identified. Of the subfamily stegomyia (Theobald) two species are found—namely, *Stegomyia fasciata* and *Stegomyia scutellaris*. Both are very common here, but they do not affect houses as much as the true culex. They breed usually in stagnant pools containing vegetable débris, such as hollows in trunks of trees. This species wanders further from its breeding-places than culex does and is often found where there is no possible breeding-place and where *Culex fatigans* disappears. Only one variety of anopheles is known here, the *Anopheles Rossi*, and that has been found only in two places. The breeding-place which this variety affected was a series of pits excavated during the building of a convict barrack. This variety was also discovered at Dundas Point. Except when these pits were in existence it was impossible to find any anopheles larvæ on Ross Island. Another mosquito of the subfamily panoplites has also been caught but only in small numbers. Of *corethra* three varieties were discovered, one of which breeds largely in the Ross drinking-water tank and is the only larva to be found there. These *corethra* appear to have no biting apparatus and therefore can hardly be said to be carriers of infection. One variety has not hitherto been described and appears to be a new one discovered by Mr. Lewis.

On the whole, mosquito brigades are of distinct benefit; for some unexplained reason they have not succeeded this season in Ross and Aberdeen, but in the other districts the results are encouraging. Undoubtedly the stations are much cleaner and the number of mosquitoes less, but the latter are far from being exterminated; they no longer flourish in the fire barrels or in the immediate vicinity of barracks, but except in very small or special areas or where there is enthusiastic European supervision these pests will remain and will continue to carry infection.

2. *The prevention of infection of, and by, anopheles mosquitoes by the use of nets or combustible pastilles.*—At first sight this appears to be the remedy offering the best prospects. We know that a net will keep off mosquitoes and we also know, from 15 months' steady observation in the Female Jail, that persons sleeping under a net have only one-fourth the risk of malaria that unprotected people have and

when attacked with fever are a shorter time in hospital. The cost, too, of mosquito netting is comparatively little. Why not, then, introduce it? The great drawback to netting is its interference with ventilation. Even under an ordinary mosquito net the difference in the freshness of the air inside and outside is quite marked and this is equally the case with a larger net containing 20 or 30 people. The women in the jail complain much of the heat under the net and it is absolutely certain that if nets are to be taken into general use as malaria guards the amount of cubic space per head must be very considerably increased, for there is practically no movement of air through the meshes of a thick net. The question is of much importance owing to the prevalence of phthisis and one is confronted by two precisely opposite problems. To check malaria in this way one must put up nets to exclude mosquitoes and consequently seriously interfere with the air-supply. On the other hand, to check phthisis we must have better ventilation, more air, and more superficial space. Which is the better? I think the balance is in favour of more space and more air combined with measures to be presently discussed.

3. *The dosage of the whole population with quinine to an effective extent.*—This procedure is strongly recommended by many authorities, more especially by the Italian observers and by Koch. The theory is that the administration of one gramme of quinine daily for two successive days and the repetition of this every week will check the occurrence of malaria by inhibiting the growth of parasites. The local opinion is against this theory, but quinine had never been given in sufficiently large doses nor had the distribution been made on sufficiently systematic lines. Naturally, over a district comprising 130 square miles of country and populated by men of very varying occupations, who cannot always be caught at meal or other parades, the issue of quinine regularly is a very difficult matter. Major Anderson's experiments showed that small doses of quinine, such as from two and a half to five grains daily, had absolutely no effect on the malaria admissions of the Female Jail but that the effects of large doses were more favourable. Longer observation has confirmed this view. The administration of 20 grains of quinine twice weekly has halved the admissions for malaria but the remedy is not a specific. During the malarial outbreak last year I directed that a further experiment should be made at Bindrabun, probably the most malarious place in the settlement, but the results were most disappointing so far as this station goes. 120 men were taken and their names recorded. To the even numbers 20 grains of quinine were given on two successive days, to the odd numbers nothing. The results were as follows (Table VIII.):—

TABLE VIII.

—	June.		July.		August.	
	Quinine.	No quinine.	Quinine.	No quinine.	Quinine.	No quinine.
Admis- sions. }	42	42	31	33	21	22

The average stay in hospital for those men taking quinine was 5.56 days and for those taking no quinine 5.60 days. After August the special experiment was discontinued.

In June last an attempt was made to check the malaria by an issue of ten grains of quinine to every convict on two successive days, repeated weekly. With the help of the executive authorities diaries were arranged and parades were organised. Compounders accompanied by petty officers were sent round the districts and carefully instructed. Each man had his route and times marked out for him, so that all concerned knew what arrangements to make. In the larger stations private servants, boatmen, and others in special employ were attended to by travelling compounders who visited the different houses and so avoided the inconvenience of such men having to attend parades or hospital. This prophylactic issue lasted from June 16th to Dec. 1st. Altogether 496,501 doses (each of ten grains) were issued and about 650 pounds of quinine expended. Over the whole period of five months more than 80 per cent. of the population were receiving this drug, but the results were nothing like what they theoretically should have been nor were they consistent. Thus, for Ross the average admissions from July to December inclusive were as follows: two years no quinine, 150; admissions with quinine, 1902, 236. For

Aberdeen the average admissions from July to November inclusive were as follows: two years no quinine, 960; admissions with quinine, 1902, 922. (There were 300 increase in strength of this station.) For Haddo the average admissions from July to November were as follows: two years no quinine, 818; admissions with quinine, 1902, 877. (There was some increase in strength of this station.) For the Southern District the average admissions from July to November were as follows: three years no quinine, 1234; admissions with quinine, 1902, 1372. (There was considerable increase in the strength in the Southern District.) For Wimberley Ganj the average admissions from July to November were as follows: two years no quinine, 1671; admissions with quinine, 1902, 1759. (There was considerable increase in strength of this station, so that the fever admission rate per 1000 of strength is lower.) For the Female Jail the total admissions for fever in 15 months were as follows: (a) receiving quinine, 362, with an average stay in hospital of 5.5 days; and (b) not receiving quinine, 695, with an average stay in hospital of 7.35 days. (The strength of each class was nearly the same.)

At first sight it would appear that the issue of quinine has done little or no good or at most that the results have been inconclusive. But 1902 was a particularly unhealthy year and it may fairly be assumed that but for the quinine the malarial admissions would have been even higher than they were. Thus in the two unhealthy districts of Southern District and Wimberley Ganj the fever admissions in the pre-quinine period of 1902 were very much higher than in previous years, whilst after quinine was given the figures assimilate very closely. In the Southern District the three years' average malarial admissions from January to June inclusive were 1983, the average from July to November being 1234. The malarial admissions during the first period in 1902 with no quinine were 2938 (an increase of 955) and during the second period in 1902 with quinine 1374 (an increase of 140). In Wimberley Ganj the two years' average malarial admissions, from January to June inclusive, were 2149, the average from July to November being 1671. The malarial admissions during the first period in 1902 with no quinine were 2668 (an increase of 519) and during the second period in 1902 with quinine 1759 (an increase of 88). Thus quinine seems to have brought the very unhealthy year back to the level of the previous ones, although the population has increased. It is possible that the prevalent type of malarial parasite is largely responsible for the inefficacy of quinine as a prophylactic. One of the commonest parasites is the one associated with malignant tertian fever and this, as is well known, is particularly resistant to quinine. This fact, with the known frequency of malignant crescents existing without fever or symptoms, has an important bearing on malarial prophylaxis.

4. *The keeping of the population "fit" or in such a good state of general health that relapses or recrudescences are unlikely.*—This suggestion has been already discussed above under the relapse theory and little more requires to be said. It is obvious that the better general health our men are in the less likely they will be to succumb to malaria or other disease. But here the great difficulty is the interference with discipline and with the work of the administration. If labour in swamps, forests, and brickfields is prohibited, if work is to stop at every shower of rain, then I do not doubt that the sickness will decrease, but it does not appear advisable to recommend any such procedure or to attempt to interfere with necessary forms of convict labour in the settlement. Apart from any such steps we may improve the cooking and food-supply, we may introduce drying rooms, or issue extra clothes and so insure that the convict shall have dry things to sleep in. Sanitation, air space, and so on can be attended to and an occasional extra ration may be issued when the labour is excessively trying or hard. With this object in view it is proposed to utilise the Aberdeen drying room for one particular section of convicts during the wet season, to make such arrangements as will insure dry clothes to them and possibly to make special arrangements about their food. The results will be of great interest and will be carefully noted.

I have detailed above the four principal methods in which we may combat malaria; it is now necessary to discuss their relative merits and practicability.

It has been pointed out that as far as actual admissions go the mosquito net undoubtedly has the best effect,

especially in the case of women living under jail conditions, not doing hard outdoor labour or exposed to rain and storm. But the ventilation difficulty is insuperable unless a very much larger amount of cubic space is provided—a larger amount than one could justly recommend. We are left, then, with mosquito brigades, prophylactic quinine, and general sanitation, and it is to these that we must look as means of checking malaria. I have endeavoured to show that the two former have already had some good effect. It is not unreasonable to hope that as experience is gained in the working of the mosquito brigades better results may be hoped for. The prophylactic issue did do good and, I think, not only by diminishing the admissions but over the whole settlement by lessening the periods of detention in hospital. This opinion is supported by the various medical officers in charge of the settlement hospitals, especially in the Female Jail. For general sanitation we must rely largely on the executive officers in immediate charge of the convicts. It is to their interest to have a low sick rate, for the fewer men they have in hospital the more easily can remunerative work be undertaken.

In conclusion, I advocate the following measures as the most suitable for checking malaria:—

1. The retention and, when necessary, expansion of the existing mosquito brigades. The expert trained part of each gang should be permanent and not available for other work. The coolies, drain-makers, &c., may, of course, be taken on and off as required, but the petty officer of the gang who knows what a mosquito larva is like and who can recognise culex eggs and knows the usual hiding and breeding places of the insects should be a fixture.

2. The general administration of quinine throughout the settlement in prophylactic doses.

3. The establishment in the outlying and unhealthy stations of branch dispensaries supplied with quinine and simple remedies. This plan was tried last year with much success both in the treatment of malaria and also of dysentery. It at times enabled us to get hold of patients earlier than we otherwise should have done and to save invaluable time in treatment. So far we are hampered by want of an adequate medical and dispensing staff, but it is hoped that more assistance will soon be available.

4. The provision of drying rooms or drying frames at every station and as a corollary the issue of extra clothing. I do not regard the drying room as a panacea for all evils, but I am sure that giving a man dry clothes to sleep in and a good, hot, well-cooked meal when he comes home from work will enable him much more successfully to fight against malaria and other climatic diseases.

5. The restriction of such unhealthy forms of labour as firewood cutting, swamp work, &c., to the narrowest limits and the granting to men so employed of a small extra food ration. I regard the proposed substitution of coal for firewood as a most valuable idea and one which cannot but have a good effect on the general health.

6. The continual stimulation of local public interest in the health of the convicts. One would like to see competition between stations as to which should have the lowest sick-rates and death-rates and whose malarial admissions should be fewest.

I should like to add a few remarks on the clinical characters of the malaria as locally observed and on the various methods of treatment in use.

Owing to the nomenclature adopted by the Royal College of Physicians of London we are obliged to define our malaria cases as "remittent fever" or "intermittent fever." This is a most unsatisfactory classification; many cases are remittent (in the sense that the temperature does not touch normal) for the first two or three days and then assume an intermittent type for a longer period. The patient in such a case may recover and be returned under either heading according to the ideas of the medical officer in charge of the case. On the other hand, the patient may die after a stay of some weeks in hospital, during the latter part of which stay the temperature may have been normal, intermittent, or even subnormal at times. Yet that case may reasonably be shown as remittent fever by one man and as intermittent fever by another. In the Port Blair returns "remittent fever" may be taken to mean a severe type of malarial fever, and all cases dying from remittent fever are considered as malarial. These "remittent" cases occur in all parts of the settlement, but especially in the less cleared areas like the Wimberley Ganj

and Viper subdivision. 148 cases with 48 deaths were thus returned in 1902. Many of the cases are rapidly fatal, the patients often being brought to hospital in a dying condition. Three or four days are a very common period for the patient to survive and delirium and coma are frequent before death. Hyperpyrexia is not common, though in one fatal case a temperature of 110° F. was noted and in another non-fatal case one of 107°. The men attacked are often old malarial subjects who have had many previous admissions for the disease; one patient had 24 previous admissions recorded, others had 15, 12, 10, and so on.

Malarial parasites are occasionally but not often found. As is well known in these pernicious cases parasites are often absent from the peripheral circulation. On post-mortem examination the outstanding features are the general congestion of the organs, especially of the brain and its membranes, the abundance of cerebro-spinal fluid, and the enlargement of the liver and spleen. The latter in 29 examinations averaged 22 ounces in weight, whilst the liver was frequently well over 70 ounces. These cases coincide very closely with those described by Pewintzky⁴ of St. Petersburg in his essay on pernicious swamp fever. The possibility of some of these cases being cerebro-spinal fever was considered, but no definite evidence of this disease was obtained either clinically or microscopically.

Some of these remittent cases yield very well to treatment, but others are most intractable. Hypodermic injections of quinine are freely given, in some cases with much benefit, only rarely with none. Large doses of quinine by the mouth and by the rectum have also been tried. Methylene blue acts well in some obstinate cases. Latterly we have been giving "mass doses" of 30 grains of quinine by the mouth or hypodermically and in most cases with good effect. Often the temperature falls at once and remains down. In no case have we noticed ill-effects from these large doses, nor is hæmoglobinuria known.

An attempt is now made to examine microscopically the blood of every patient who comes to hospital complaining of fever and in this way the blood of 4304 patients has been searched. In many cases two, three, or even more examinations were made. Parasites were found in 2338 cases, the chief varieties noted being intracellular hyaline in 776 cases; hyaline ring form (malignant tertian) in 438 cases; pigmented intracellular in 704 cases; pigmented extracellular in 273 cases; crescents in 123 cases; segmenting forms in 20 cases; and flagella in two cases. More attention was paid to the presence or absence of parasites than to the particular variety, but it is interesting to note that quartan parasites were far from rare and would often resist quinine for some days.

It has been stated⁵ that native children frequently harbour parasites without symptoms or rise of temperature. This I can partly confirm. Many children in whose blood we found parasites said that they were perfectly well, but on investigation they were found to be suffering from fever or from enlarged spleens. For example, *all* the children in the Female Jail and attending the Aberdeen school were examined. Of 158 children parasites were found in 58, and of these on examination 40 had fever or enlarged spleen, whilst 18 had no fever. The varieties of parasites were as follows: intracellular hyaline in 22 cases; intracellular pigmented in 23 cases; extracellular forms in 10 cases; and crescents in two cases. Again, at Haddo 68 healthy-looking persons (including Andamanese adults and children, and school children) were examined. Parasites were found in 11 cases, but all of these on examination were found to be suffering from slight fever.

With regard to the diagnosis of malaria by means of differential bloodcounts our results do not altogether agree with those of Rogers. Of over 63 counts and never of less than 500 leucocytes the average is: large mononuclears, 14 per cent.; lymphocytes, 25 per cent.; neutrophils, 59 per cent.; eosinophiles, 5 per cent.; and others, 2 per cent. Rogers claims 15 per cent. of large mononuclears as a diagnostic sign in malaria, but we do not always get such a high percentage. We have taken specimens in which the crescents were double the large mononuclears and yet the percentage of the latter was only 14 per cent. For instance: large mononuclears, 14 per cent.; lymphocytes, 21.8 per cent.; neutrophils, 60 per cent.; eosinophiles, 2.8 per cent.; and others, 1.4 per cent. The actual

count was 501 and the crescents found numbered 137. The red blood corpuscles numbered 4,026,000 and the white blood corpuscles 6000 per cubic millimetre. On the other hand, in a case of dysentery where the patient did not complain of fever the following count was made: large mononuclears, 16.3 per cent.; polynuclears, 46.9 per cent.; lymphocytes, 34.2 per cent.; eosinophiles, 1.0 per cent.; and others, 1.6 per cent. The total count was 509 and the crescents present were 58. Here the malarial factor of large mononuclears was present, even though the usual dysenteric increase of lymphocytes was marked. Altogether, 265 differential blood counts have been made and many results of considerable clinical interest have been elucidated.

The convicts whom I have trained for microscopical work have been of the greatest use. These men are now well conversant with the different forms of parasites and they can make and stain their own preparations and in some cases can perform differential blood counts.

Port Blair, South Andamans.

CHRONIC SUPPURATION IN THE MIDDLE EAR; THROMBOSIS OF THE LATERAL SINUS; GENERAL SEPTIC INFECTION; OPERATION; VENOUS TRANSFUSION; RECOVERY.¹

By W. M. WILLIS, F.R.C.S. ENG.,

ASSISTANT SURGEON TO THE NOTTINGHAM GENERAL HOSPITAL AND NO THE NOTTINGHAM CHILDREN'S HOSPITAL.

CHRONIC suppuration in the middle ear is an extremely common disease and in view of the serious complications which sometimes ensue in consequence of its persistence it is well deserving of consideration and adequate treatment. However the inflammation originates, its persistence is to be found in the fact that inefficient drainage exists and this arises from several causes. There is an anatomical cause, which is a bar to efficient drainage in the case of suppuration within the tympanic cavity, inasmuch as that portion known as the attic is a sort of natural reservoir the floor of which is on a higher level than that of the floor of the general cavity of the tympanum and discharge from this position will only occur by overflow. It is common for the inflammatory process to involve the mastoid and here we have isolated cells which communicate with the general tympanic cavity through the largest of them known as the antrum. But the communication of the antrum with the tympanum is reduced in disease, so that efficient drainage is easily impaired. Thus from these causes we have a collection, varying slightly in amount from time to time, but always more or less existing, of what may be termed residual pus and this is present under a certain amount of pressure or tension.

In addition to the foregoing there is a pathological reason why efficient discharge is prevented and this is to be found in the presence of granulation tissue which is present in varying quantity both within the tympanum and on the outer side of the perforation in the tympanic membrane through which the pent-up matter originally made its escape and from which it has continued to issue. Two facts have so often presented themselves to me that I believe them to be true. The first is that the disease in question is eminently curable if freed drainage is established and maintained, and the second is that by reason of the long time some of these cases are allowed to persist either they must be looked upon with apathy or indifference or inadequately treated. If the bar to efficient drainage found in the granulations before alluded to be removed by treatment directed through the meatus and the aperture in the tympanic membrane be enlarged, and subsequently the tympanum be kept surgically clean, the patients in many of these cases will quickly get quite well. Some, however, will not and more extensive measures will be required. For these, when the less severe methods have been thoroughly tried and

⁴ Journal of Tropical Medicine, July, 1902.

⁵ Report of the Malaria Commission of the Royal Society.

¹ A paper read before the Nottingham Medico-Chirurgical Society on Jan. 21st, 1903.