this disease. They increase the nausea, interfere with digestion and assimilation, and retard elimination. If the patient should have a chill, after beginning the eliminative treatment do not think you have made a mistake in not giving quinine, because I have seen a chill come on while the patient was thoroughly under the influence of the drug, but push the elimination, and my word for it, if the eliminative organs respond to the treatment, your patient will not have another chill and the urine will begin to clear up in thirty-six hours.

The most important indication in the treatment is the prevention of suppression, which is the cause of a large majority of our fatal cases. Medicinal diuretics usually do harm and do not increase the flow of urine. Normal salt solution, first recommended by Lewis, of North Carolina, is a valuable therapeutic agent in warding off anuria; it can be given by the rectum or in severe cases by hypodermoclysis

every four to six hours; it has the effect of preventing heart clots, it increases the volume of blood, raises the blood pressure, and increases the flow of urine, which is the end to be attained. The late Dr. W. C. Jackson reported marked success with the hypodermatic injection of atropia. Various other remedies have been used with more or less success.

Of course some patients will die under any treatment, particularly those whose resisting forces have been greatly reduced by malarial cachexia. Supportive measures are essential. Alcohol should not be used under any circumstances. Strychnine, sparteine, digitalis and such agents that will increase the arterial tension and support a flagging heart are the ones to be relied on.

After the acute symptoms have passed, some good reconstructive tonic will complete the cure.

A MALARIAL HOT-BED WITHIN SIGHT OF THE NATIONAL CAPITOL.*

By THOMAS W. JACKSON, M.D.,

Ft. Washington, Md.

(Concluded from August.)

In connection with the matter of protection against mosquitoes I beg to state that early in January, 1912, I sent a communication to the commanding officer, Fort Washington, setting forth the unsatisfactory condition of the screening of quarters and barracks here, urging that the screening be made complete and effective and also that ventilator openings and chimney and fireplace openings be properly screened before the beginning of the insect season. This communication was duly approved and forwarded, and was returned by the chief quartermaster, Eastern Division, requesting that certain estimates be made and that definite information as to the defects of

the present system be furnished. Thereupon the attached memorandum of defects was furnished. It is presumed that favorable action is now proceeding and that the matter of defective screening will be remedied early this spring.

Memorandum Report on Unsatisfactory Features of the Screening at Fort Washington, Maryland.

The present screens are unsatisfactory for the following reasons:

1. They are of larger mesh than 18 per linear inch.
2. They close but the lower half of the window openings.
3. They are inside screens, and must be raised to permit access to the window sashes for opening and closing windows.

Authorities agree that the mesh should be as fine as 18 to the linear inch to insure against mosquitoes entering through the meshes.

*Read at the ninth annual meeting of the American Society of Tropical Medicine, held at Atlantic City, June 3, 1912.

Half screens are probably more effective against the escape of mosquitoes and flies that have found their way indoors than they are against the entrance of these insects. Where they are used it is bound to happen, as shown by experience, that the unscreened halves of the windows will be opened frequently and will often remain open. Full length outside screens will prevent this occurrence.

Screens of the type of those recently installed at the Post Hospital, Fort Washington (metal framed) are desirable on account of their durability and the ease with which the units may be handled, installed and removed.

The present screening at Fort Washington has always been defective, and without doubt no small degree of the prevalence of malaria here is attributable thereto. Without the correction of the defects our anti-malarial efforts must fail in large degree.

Submitted January 31, 1912, Ft. Washington, Md.

Mosquitoes. At the time of my arrival at Fort Washington in November, 1911, the mosquito season was at an end and petrolizing had been discontinued for the winter. A few indoor anopheles were taken during November. During a warm period of two weeks in December mosquitoes appeared at the post and adult anopheles specimens were captured in the hospital and other buildings. They were sluggish and inactive, and showed no disposition to bite. At the same time an unsuccessful search for larvae was made in places where breeding might naturally be expected to occur, but no breeding mosquitoes were found.

It is believed that these mosquitoes were survivors of the army of 1911, which came out from their hibernating haunts and hiding places, called forth by the unseasonable warmth and not bred from the egg during the mild weather. Since the severe weather of early January which continued, somewhat modified, throughout the month with its heavy snowfall, thick ice and zero temperature, no appearance of mosquitoes has been noted by me indoors, nor have I been able to learn of any through inquiry. It is not unlikely, however, that indoor mosquitoes exist, as a few have been noted as present in living quarters at some time during the winter seasons of all recent years. To what extent infected anopheles females at this post hibernate or remain hidden indoors through the winter, to reappear and become active as breeders or vectors of malaria in the spring, is an undetermined matter and a rather indeterminate one. Personally, I fancy that surviving infected mosquitoes are much less concerned in the perpetuation of malaria here than human gamete carriers, for the discovery of whom we are now conducting an active search in this command and in the neighborhood of this post.

In considering the second of these medical questions, the duration of treatment of malaria cases, one has to give due weight to the opinions of observers engaged in anti-malarial work elsewhere, and this I have endeavored to do. Accordingly I quote here certain recently expressed views which have a certain bearing upon our problem. Our own opinion,

derived from experience, will be stated later. This question of duration of treatment also includes the question of the effect of quinine upon malaria parasites and the question of the duration of infectiousness in man.

The views of Darling and Thomson with regard to certain of these matters will be observed to be quite similar. Darling's views antedate those of Thomson, according to the dates of publication, but the observations come from different parts of the world.

In regard to the effect of quinine upon malaria parasites in man, Darling is of the opinion that the drug causes the gametes to disappear gradually from the peripheral circulation by the destruction of the young forms, the gametes being phagocyted by splenic and hepatic endothelium, and he concludes that quinine in solution, ten grains three times a day, will gradually reduce the sexual forms in man to a non-infective minimum in varying periods of from a few days to a few weeks, according to the severity of the infection. In simple tertian malarial fever gametes disappear from the peripheral blood within two or three days under quinine treatment, and even when quinine is withheld, if the patient is at rest, according to Darling.

There are never so many gametes in the peripheral blood in simple tertian malaria as in malignant tertian malaria. As a consequence in infected mosquitoes simple tertian zygotes are less numerous than malignant tertian zygotes.

Speaking of the production, life and death of crescents in malignant tertian malaria (3), Thomson expresses the belief that crescents develop from ordinary sexual spores of *Plasmodium falciparum* because of a developed immunity on the part of the human organism to these asexual spores. He believes that the place of development of crescents is some-

Abstract J. A. M. A., Sept. 19, 1911.

1. S. T. Darling, Malaria in the Panama Canal Zone, *Annals of Tropical Medicine and Parasitology*, Liverpool, July, 1910.

where in the internal organs and that they appear in the peripheral blood suddenly, after infection has lasted ten days or more, in broods, either daily or upon alternate days, according to the time of asexual sporulation, quotidian or tertian.

He believes that the life of the crescent is but a few days and that quinine has no direct destructive action upon these gametes at any time, but that it destroys the asexual source of supply.

Thomson is of the belief that quinine reduces the number of crescents to less than one per c. m. m. of blood within three weeks, if given in daily doses of 20 to 30 grains, and that when given in small doses it tends to increase crescent development by favoring the development of immunity to the asexual parasites.

He states that methylene blue in doses of 12 grains daily reduces the number of crescents and would seem to have some direct destructive action upon them.

Darling (loc. cit.) has attempted to determine the limit of infectiousness of man by differential counting of leucocytes and determining the ratio between crescents and leucocytes in peripheral blood at various times; by weighing mosquitoes in order to estimate the amount of blood retained by a mosquito and finding the approximate number of gametes ingested; determining by dissection the number of gametes phagocyted and destroyed; by dissecting mosquitoes which had fed but once on patients whose ratio of crescents to leucocytes had been estimated, after a period of captivity and subsequent vegetable feeding. He estimated the probable limit of infectiousness to be about one gamete per 500 leucocytes and believes that a person with more than one gamete per 500 leucocytes, or 12 gametes per c. m. m., is infective.

He concludes from observation that daily doses of quinine (10 grains t. i. d.) will re-

duce the sexual forms of the estivo-autumnal parasite to a non-infective minimum in from a few days to two or three weeks, depending on the severity of infection.

Thomson (4) notes a remarkable variation in leucocytes, numerically, at different times of day in malaria, and believes that he is able to correlate the changes with the changes in the stage of development of the parasite and with the number of parasites present in the blood. He believes that the greater the number of parasites, the greater will be the leucopenia. During the liberation of malarial virus in the blood, at times of sporulation, the percentage of uninuclears falls greatly, according to his observations. He also notes that with the fall of temperature occurs a rise of leucocytes, numerically, and he considers this phenomenon more delicate than temperature variations.

After the disappearance of demonstrable parasites from the blood and the subsidence of fever, Thomson believes that there remains for some time a typical diurnal variation in leucocytes which he ascribes to the persistence of small numbers of parasites liberating toxins upon sporulation and considers of diagnostic value.

Having observed the same variation in Hodgkin's disease, and in carcinoma, he offers the suggestion that these affections are possibly parasitic also.

In regard to the effect of quinine upon malaria parasites, it seems to me that the assumptions of both Darling and Thomson as to the non-effectiveness of the drug upon gamete forms of malaria parasites are not altogether acceptable. To assume that these gametes simply die or are phagocyted and that quinine has no effect upon them requires rather more proof than has yet been submitted. The views of Thomson, also, that crescents appear in groups or broods from asexual spores, live but

3. Thomson, D., *Annals of Tropical Medicine and Parasitology*, Liverpool, April, 1911.

4. *British Med. Jour.*, Dec. 16, 1911.

a few days and are not, directly, influenced by quinine, likewise requires proof.

That the crescent form of gamete is a resistant form of malaria parasite is generally conceded, but that it is uninfluenced by quinine is hardly admitted. It is quite as easy for me to believe that the crescent gamete is the resistant form as it is to believe that the ordinary asexual spore, from which it is said to be derived, is resistant or that it fails to continue its cycle by reason of developed immunity on the part of the human organism.

If this be so, the explanation of ultimate gamete disappearance, under quinine treatment, from the peripheral blood at least, needs but the assumption that the blood finally contains sufficient quinine to destroy it in spite of its resistance. The presence of a protective capsule in the case of crescents, as claimed by some observers, would partly explain this resistance.

With regard to the method of determining infectiousness of the individual by determining the ratio of gametes to leucocytes in the peripheral blood and the declaration of a non-infective minimum (Darling); and with regard to substituting a supposed typical diurnal variation of leucocytes for thermometric observations and the assumption of a persisting infection after the disappearance of demonstrable parasites (Thompson), I believe that these measures, aside from being of unproven reliability, are impracticable and unnecessary. In my opinion malaria may always be diagnosed directly by microscope and its cure may be established by the same diagnostic instrument, practical measures applicable everywhere by competent men. So firm is my conviction in this matter that I personally decline to diagnose malaria in the absence of demonstrable parasites and I shall continue this practice, if permitted to do so, in my anti-malarial work at Fort Washington.

One must make due allowance, of course, for inability to find parasites in individuals who have received quinine before coming un-

der his observation, a very common occurrence indeed. But in my experience these individuals will eventually show parasites in the peripheral blood, unless the quinine treatment has been curative. In these cases the leucocytic indications shown by differential counts are very useful. It should be understood that the term "blood search," as used here, includes the examination of several smears taken at appropriate intervals. Little diagnostic value is attached to a single negative finding.

The practice of determining the endemic malarial index of a community from the splenic index of its population and other data, as proposed by British workers, must ever be of little worth compared with a malaria census determined by accurately recording all cases of malaria and examining blood smears of practically the whole population, as we hope to do here. Moreover, there is a growing belief, here in America, that the study of malaria cannot be reduced to pure mathematics, as certain recent essayists would lead us to believe. Certainly the only reliable elements entering into a mathematical calculation of malarial prevalence are those determined by microscopic blood study and by case incidence.

This brings us to the consideration of (3) the cause of recurrence, and the determination of the number of cases which are truly recurrent.

Castellani and Chalmers (7) state that "the macrogametocytes are extremely persistent and can wait in the body for a long time until some chill or accident lowers its resistance, when they become active and develop merozoites by parthenogenesis, thus accounting for the relapses and recurrences of malaria even months and years after having left a tropical country. Hence in malaria there is a latent phase which is capable of lasting an unknown time, but upon this subject more information is urgently needed." They also give as one of the most important questions in malaria requiring further elucidation "the form in

which the malaria parasite lies dormant in the human body (with special reference to the parthenogenesis of the macrogametocytes)."

Christophers and Stephens (8) say: "Further, there is a certain amount of evidence to show that a gamete (female) in the blood can undergo a kind of retrogressive development and give rise by parthenogenesis to young parasites (i. e. schizonts). If this is so, it would explain the supposed function of old attributed to crescents (gametes) of producing relapses."

Krauss (2) reminds us that we have recurrences in malaria from (1) reinfection from without, (2) reinfection from one's own gametes, (3) from resegmentation of macrogametocytes without the aid of anophelines and reintroduction; and possibly by plastogamy (according to Craig).

In any case, he says, it is to be remembered that it is the symptomless gamete carrier who perpetuates infection and he considers a campaign against gamete carriers more valuable in the eradication of malaria than all other methods combined.

He considers it desirable to interrupt quinine therapy from **time to time and to continue** it somewhat longer than **is usual**. "We will probably always have gametes; let us see that they remain sterile."

Krauss advocates active and persistent cinchonization for at least 30 days.

Darling (5) considers the destruction and prevention of development of the sexual parasites in man as most important and believes that it may be accomplished by (1) appropriate quinine treatment of all gamete carriers; (2) by occasional quinine treatment to destroy latent malaria; (3) by periodical blood examinations for the detection of gamete carriers and latent malaria in order to carry out appropriate treatment.

this purpose.

He believes that 30 grains of quinine sulphate in solution daily is an efficient dose for the purpose.

In the light of these authoritative opinions we are justified, it seems to me, in considering resegmentation of macrogametocytes, retrogressive development, as a cause of recurrence of malaria, a true relapsing form. This is the only form of recurrence in which the mosquito does not act as a vector, including as gametocytes (for this purpose) the cyst-like bodies resulting from intra-corpuseular conjugation described by Craig.

Fortunately the treatment indications are identical in malaria, however induced or perpetuated, and I am strongly of the opinion that macrogametocytes disappear from the blood under the direct influence of sufficient quinine. In fourteen recently observed cases of estivo-autumnal infection (malignant tertian)—(November, 1911, to March, 1912)—there is every evidence to indicate that permanent disappearance of both ring forms (asexual) and crescents (sexual forms) from the peripheral blood occurred under the direct influence of quinine in dosage overwhelming to the parasites. That the same is true of the blood in the internal blood recesses of the body can, of course, be stated with less certainty.

In the above cases frequent blood searches were made in each case as a check against error.

It may be said in passing that the only leucocytic phenomena observed in a series of nearly 500 blood examinations of malaria infected individuals and those recovered from malaria within one to six months, were the phenomena agreed upon by observers generally for some years past.

Christophers and Stephens state them thus under the "Subsidiary Signs of Malaria." Leucocytic variation: Obvious increase in the large mononuclear leucocytes during the apyretic periods of malaria.

2. At Louisiana State Medical Society, June 1, 1911. (J. A. M. A., July 8, 1911.) "The Role of the Gametes in Relapsing Malaria."

7. Manual of Tropical Medicine, pp. 292, 631.

8. Practical Study of Malaria, p. 57.

Failure to observe this during the period of low temperature is presumptive evidence against malaria. The normal ratio of white cells to red (1 to 500) is often increased (leucocytosis) to 1 to 250 or less during the chill, and is decreased (leucopenia) to 1 to 750 at the close of the chill, or to 1 to 900 during apyrexia.

Where the stained method of blood study is used, as in the above mentioned cases, differential counting is readily carried out in the blood search for parasites.

Shortly after my arrival at Fort Washington (November, 1911), I undertook to examine the blood of all persons who suffered from malaria during 1911, with a view to determining the number of those still infected (gamete carriers). In view of the large percentage of cases which were recurrent in 1910 and in previous years, and in view of the fact that more than a few of the 1911 patients had malaria in 1910 or had more than one attack during 1911, it was expected that a number of gamete carriers would be found. The result of this examination was surprising, few gamete carriers other than the crescent carriers referred to elsewhere being found among 100 individuals examined. Differential counts were also made in most cases with non-suggestive results.

The great majority of these persons were free from parasites (in the peripheral blood at least), at the time of examination. Apparently the after-treatment (the truly curative treatment) was fairly effective in 1911, nearly every man treated in hospital for malaria during the latter half of 1911 being required to report at the hospital daily for quinine administration for at least a month after his return to duty. Then the so-called prophylactic use of quinine throughout the command, while ineffective for the purpose designed, may have served as a useful adjuvant treatment in uncured cases. If one may judge of past years by this year's findings, a certain percentage of the annually recurrent cases

are not true relapsing cases, but reinfections, although there is strong evidence that infections have persisted throughout the winter and year, with relapses at periods of weeks or months (sometimes unnoted), and that these infected individuals have been sufficiently numerous to furnish the malaria parasites for the mosquito broods of the following spring and summer.

The management of civilian cases of malaria occurring upon the military reservation is comparatively simple. All civilian individuals, infant or adult, members of families of employees, may be subjected to the same requirements as the military population upon pain of exclusion from the post. The cases occurring among the families of officers and enlisted men are not really difficult to deal with, except that considerable care, persistence and tact is called for to secure adequate after-treatment.

A post order covers all civilian cases specifically.

In the cases of individuals living outside of the reservation limit it is quite practicable to carry out treatment and after-treatment and to induce the patients to report periodically for blood examinations, if the individuals are members of soldiers' families; and these constitute a large part of the near-by population at Fort Washington.

In the cases of civilians who live near the post, but who have no connection with the military establishment, we are obliged to depend upon suasion. A certain small percentage of these persons are quite beyond our reach. To such as are willing to present themselves we accord treatment gratis.

An interesting though startling development in connection with my work at Fort Washington has been the discovery of a number of cases of estivo-autumnal (malignant tertian) infection among both soldiers and civilians of the post and vicinity. Although the records (see chart) show that only a few cases of this infection, occasional and scattered,

have been detected in the previous four years, my searches have disclosed the presence of 14 individuals (8 soldiers and 6 civilians), who were carrying about these dangerous parasites.

Most of these persons have been treated here for malaria during recent months, some of them in previous years, and it is undoubtedly true that some errors in diagnosis have occurred, the cases having been considered as simple or benign tertian infections. While it is impossible to say with certainty at this stage of our investigations that these 14 persons are the only ones who have recently suffered from infection with malignant parasites, it is my opinion that but few others, if any, will be discovered, and I feel reasonably sure that these 14 persons will no longer be dangerous to others, as all except one have been thoroughly treated for three months and have long since ceased to show crescents or ring forms in their peripheral circulations. The excepted cases, a civilian, removed from the vicinity and is no longer within our jurisdiction.

Of these 14 persons there were 11 adults and three children; four showed gamete forms (crescents) only; two showed ring forms only, and eight showed both ring forms and crescents and the clinical manifestation of fever, anemia, etc. In each case the hemoglobin percentage rose steadily under treatment until practically normal. The tolerance of these persons to quinine was remarkable and it was possible, as I believe it always is, to give the drug in sufficient dosage to cure.

Most of the hospital treated cases (soldiers) took 45 grains daily (15 grains in capsule t. i. d.) with comparative comfort, and one patient took 60 grains daily for some time without injury, incidentally gaining ten pounds in weight during the period. In but one case was it necessary to discontinue quinine treatment on account of deafness, and this soldier had a ruptured tympanum, received months before while at target practice from the dis-

charge of a 12-inch gun. Moreover, he took the drug in daily doses of 45 grains for a month and was apparently perfectly cured at the time that quinine was discontinued. All others completed the after-treatment of three months as out-patients. Children took quinine readily when the drug was suspended in chocolate syrup. Rarely was there any disturbance from it requiring the discontinuance, temporarily, of the drug. During a part of the period of out-patient treatment quinine tablets of excellent quality had to be substituted for the capsules, but there was apparently no diminished effect of the drug.

The following family and neighborhood relationships were noted among the infected number: One husband (soldier) and wife; one father (civilian) and son; one mother (soldier's wife) and infant; two brothers-in-law (soldiers). All of the civilians were neighbors. One married soldier was infected with malignant tertian parasites (a crescent carrier), while his wife suffered from a benign (simple) tertian infection with typical clinical expressions. Of the 14 cases three were married men, two were women, three were children and six were unmarried men.

But one case of foreign origin was noted: A Spanish-born recruit, formerly a sailor, who had suffered from "fever" in Mexico and South America during recent years and within six months of enlistment. This case was discovered within three weeks after his arrival here from the recruit depot.

Blood specimens, two or more slides at a time, from all of these persons were subjected to frequent examination during this period of treatment, the intervals between examinations never exceeding one week. These blood examinations, together with those previously referred to, approximated a total of 500 within three months, something of a tax upon a single observer engaged in other work, but nevertheless a necessary and important work which must be kept up in connection with any effective anti-malarial campaign.

The most refractory case in the matter of the disappearance of crescents was that of the Spaniard referred to. This case became clinically negative very promptly, but it was not until upwards of 600 grains of quinine had been taken that the last crescent disappeared from his peripheral blood stream.

The matter of disposing of these gamete carriers is one deserving some consideration. Personally I am of the opinion that all of these individuals may be cured by a proper course of treatment and it seems to me, therefore, that the first indication is to subject them to such curative treatment under proper surveillance. Having accomplished a cure, there is really no necessity for further action. However, in view of opinions, which prevail in certain quarters, to the effect that gametes may persist for months or years in the internal blood recesses of the body in spite of treatment, it is perhaps proper to recommend the transfer of these patients to localities where anophelines are not found and where, therefore, these persons cannot possibly menace others. As a precautionary measure such recommendations have been made.

To make sure that none of these individuals incur relapses or develop into latent cases, they should be subjected to frequent blood examinations for a year or more, wherever they may be.

With Craig (6), I understand a latent malarial infection to be one in which demonstrable malaria parasites are present in the blood of an individual who presents, at the time, no active clinical symptoms of malarial disease. An infection may be latent during the quiet periods between attacks of fever, chills or other clinical expressions, quite as well as before the initial clinical expression. Indeed, the majority of latent cases encountered will be of this type and not infrequently a latent case becomes an active one with clinical manifestations of fever and chills, or both, during the

time it is being studied. This has occurred in a number of instances in my personal experience.

Summary.

In conclusion I offer the following summary of the situation and prospects of success at Fort Washington.

The measures proposed for the abatement of the malaria nuisance and menace at Fort Washington by the Board of Officers convened by the War Department order in 1911 included the following:

1. The purchase of mosquito-breeding swamp land adjacent to the reservation. Apparently there is little chance of an early accomplishment in this direction, the obstacle being lack of funds. Under present conditions money is apparently valued more highly than the health of 600 or more people whom it is intended to safeguard by this expenditure.

To quote from the proceedings of this board, "A strip of land shown in the accompanying map *must* be purchased that the necessary outlet for the drainage system may be installed and properly maintained." The amount of land required is 27 acres and the estimated cost is \$5,000.

2. Thinning out trees and shrubbery and the creation of a denuded zone of land 125 yards wide, between the forest and the officers' quarters, barracks and hospital, to serve as a barrier to the flight of mosquitoes which find shelter among the trees and shrubbery. This work has been prosecuted to a very creditable degree by the post commander, who has accomplished with post labor a most gratifying amount of clearing. He is constantly prosecuting this work. Of the physical measures proposed, this is the most promising as well as the most immediately important one.

3. The conduction of storm water from parade, roads, batteries and buildings to the river, an engineering project, is being prosecuted as rapidly as funds and labor will permit, and with good prospects of ultimate accomplishment.

6. C. F. Craig: A Study of Latent and Recurrent Malarial Infections.

4. The systematic and methodical daily killing of all indoor mosquitoes. This measure, a most important one indeed, has been strongly urged and will be carried out during the coming season in all barracks.

Unfortunately, its effectiveness depends upon the carrying out of the next measure, 5, which there is some reason to fear will not be completed this year.

5. Effective screening (as elsewhere detailed) and its maintenance. The commanding officer and the special sanitary officer have done all that it is possible for them to do to secure adequate and effective screening throughout the post and it is hoped that the pleas and representations made will be effective. But fears have been expressed that the estimates submitted will not be allowed.

In this case the whole project for appreciably lowering malarial incidence at Fort Washington during 1912 will be seriously endangered and the responsibility for failure cannot rest with the Medical Department. There is no more important link in the chain of defense than this measure, especially for the immediate future, and until the more formidable and difficult undertakings of clearing and drainage are completed.*

6. The establishment of a mosquito patrol to locate and oil all mosquito-breeding pools; to clear and dig small ditches and to fill shallow pools. This measure will be carried out thoroughly during the coming year. The special sanitary officer has made a suggestion, which he believes to be a practical one, to the effect that this work be performed, under strict medical supervision, by the five different companies of coast artillery stationed at Fort Washington, one or two ravines being assigned to each company.

* No remedial action has been taken (August, 1912). A recommendation to screen open fireplaces or chimneys was disapproved (by non-medical authority) upon the grounds that it was unnatural for mosquitoes to enter by fireplaces, etc. The entire project for protection for 1912 has been nullified by inaction wholly outside of the medical domain.

In this way it is believed that the actual work could be done and maintained with far better results than by a squad of three men, as proposed and heretofore practiced. As the companies themselves will receive the largest benefit from this work, there can be no reasonable objection and the individual labor will be minimized. It is believed that company commanders would interest themselves and that a desirable rivalry could be encouraged with great benefit to the entire project.

7. The creation of a malaria census and continuous and persistent after-treatment of malaria cases for four months. These measures have already been instituted and are in operation, as indicated in the foregoing pages.

8. The voluntary use of prophylactic doses of quinine. My views and the present policy in this matter have already been recited. As an alternative measure I have proposed the following plan, which is now being carried out. All persons known to have suffered with malaria infections in 1911 will receive a month's treatment, beginning in April, 1912 (now accomplished), along the lines of the after-treatment accorded hospital cases. They will report at the hospital daily and receive and take 18 grains of quinine. By this measure we hope to cure all individuals who may be carrying gametes and who may have escaped detection accidentally in the wholesale blood examinations which have been carried out.

9. A recommendation that the forestry work be done by contract day labor, an allotment of funds therefor being made; and a recommendation for the sale of timber cut. This measure, unfortunately, has not received the necessary approval and we are still depending on post labor. There are no receipts from the sale of the valuable timber which has already been cut, nor prospects of receipts from that which remains to be cut. This is a formidable handicap to the commanding officer in his efforts at deforestation and clearing.

Finally, it is my opinion that the successful

prosecution of this fight against malaria at Fort Washington depends upon certain conditions.

It is believed that the outlined program will be successful in materially reducing malarial incidence here, provided the present co-operation between the Medical Department and the commanding officer can be maintained, and provided that the present status of the special sanitary officer with regard to his control of all malarial cases, his authority to recommend and to oversee the carrying out of anti-malarial measures be continued.

It is likewise essential, in my opinion, that the special sanitary officer be both a competent sanitarian and an experienced observer of malaria, both clinically and microscopically.

DISCUSSION.

Dr. D. Rias, Philadelphia. My experience has been that it is very difficult to get patients to take the quinine faithfully. Many advocate small doses of quinine, some advocating giving it before and others during the chills. My experience has been it is most efficacious to give the quinine, say, one hour after the temperature begins to fall. We know that at that time the parasite is very young, metabolism is very active, and the parasite is apt to take at that time more quinine than he will later—say after six or twelve hours. Doses of about 1-2 gramme or 7 1-2 grains always diluted with hydrochloric acid.

In regard to the recurrence of malaria, unquestionably these are attributable to bad management—that is to giving quinine at the wrong time.

Dr. William Kraus, Memphis, Tenn. There is one observation I wish to bring out at this time in connection with this paper, in the hope that someone else may have had the same experience. It may have been accidental, but I would like to know if anyone else has had a like experience.

About a year ago I had a patient referred for the administration of salvarsan. On the day he arrived he had a chill and I could not give it to him then. The physician administering decided he would not quinine him but would await the result of the salvarsan. The result was partial disintegration of rings—estivo-autumnal form, and no subsequent paroxysm of this same fever. On the day following, however, the malaria became more active, but coincident with that there was the disappearance of chills and since that time the patient has not had any further recurrence up to the end of my observation of the case. It is possible this remedy may have a differential effect for the very thing we have not been able to do with quinine, and might be borne in mind.

Dr. John M. Swan, Rochester.—I would like to say one word about Rochester. My opinion is, and I used to teach my students, that it was necessary

for them to administer quinine to their patients after their clinical recovery for at least two years. My reason for teaching that was that I accepted the theory that the recurrences or relapses were due to parthenogenesis. There always seemed to me to be a parallel between this disease and another which I think is due to an animal parasite, namely, syphilis. We know well that after the clinical manifestations of syphilis are gotten rid of, it is necessary to continue treatment for a long period to prevent tertiary symptoms.

I believe the administration of quinine will probably prevent relapses.

Referring to diagnosis of carriers by microscope, I would like to recall to your mind a case I reported in 1910. A patient who reported perfectly well; normal temperature, normal picture in regard to red cells, differential leucocyte count, etc. In March when there were no mosquitoes in the place had a typical attack with the organisms in the blood. It is possible for some one with the parasites in the blood to present a perfectly normal blood picture until he relapses.

Dr. Joseph H. White, President. I did not intend to say anything, but I feel impelled to do so. I feel from my own experience and that of others with whom I have been intimately associated that proper prophylaxis with malaria demands not only destruction of the mosquitoes, and the destruction of gamete carriers, but also the use of quinine as a prophylaxis.

Just one instance with regard to a unique case. Some four years ago I was called up at midnight by a gentleman and asked if I would not go to a certain town where he thought he had found a case of yellow fever. I went, very much afraid of finding yellow fever, looked the patient over carefully. I cannot say he had malaria. I looked at this man's blood for about an hour, taking two or three specimens and got nothing. Went back and looked at him again after being away two hours in the laboratory. Found him with a rising temperature, took another specimen and found organisms.

Dr. Jackson (closes discussion).—I am glad my reference to quinine prophylaxis served to bring these gentlemen to their feet. I was referring to the prophylactic use of quinine at this particular place where it had been used for two or three years ineffectually. Not under my direction, for I was not there, but I have no doubt just as judiciously as I would have used it. I do not by any means condemn quinine prophylaxis utterly, but believe that it should not be substituted for mosquito work. As to the results at Camp Stotsenberg, cited by Dr. Craig, I simply call attention to the fact that last year the malaria rate there was again the highest in the army. I believe that where a certain procedure can be carried out effectively by the same people, year after year, results may be expected, but that anti-mosquito work is far more effective. The principal objection I have to its widespread, indiscriminate use is that it undoubtedly vitiates blood diagnosis. You cannot get away from that. Under those conditions you may frequently be badly put about for diagnosis when the quinine taken has been sufficient to drive the parasite from the peripheral circulation.

So far as the treatment is concerned, I do not think that any of us are in a position to lay down dogmatically the length of time over which medicine

shall be given but I think we often make the period too short. I have little fear of the drug quinine. I think we can use it without fear of injury over a long period of time. I think usually our treatment

period is too brief. It is not resumed and our blood searches are not kept up and that is the reason why we have recurrences year after year. I think the only guide we have is the repeated examination of the blood.

MALARIA AS IT CONCERNS THE GENERAL PRACTITIONER.

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There is no object to be gained in a paper of this kind by delving into the classical literature of malaria. The discovery of its relation to the anopheles mosquito, with its explanation and control, forms one of the brightest pages of medical history. The Panama canal is more a triumph of medical investigation, heroism and self-sacrifice than it is of engineering. Engineers could have been found fifty years ago capable of overcoming the mechanical difficulties of building such a canal, but the pest-laden swamps of Panama formed a barrier that was not to be conquered by engineering skill alone.

It was only after the most absolute proof that physicians could be persuaded that malaria was due to mosquito inoculation, and even after this was proven without a doubt, a great many refused to concede that this was the only method of infection and still looked upon fogs and bad air with suspicion.

The seeming inconsistency of infection by the mosquito is best demonstrated by the cases of malaria we encounter where there is no history of mosquito bite and where the patients have lived in a locality supposedly free from the malarial mosquito for years, or for a lifetime, with no malarial exacerbations that they have known of until suddenly, after an injury, or an attack of indigestion or some acute disease, they will develop malaria so that the plasmodia can be seen in the peripheral circulation. Here there has very likely been no possibility of a recent mosquito bite, as the patient may be in a cold country where the snow has been on the ground for months, and as we know the life cycle of each plas-

modium and its approximate period of incubation, it is impossible that these patients should have a new infection from this source.

I think that as the microscope becomes less of an ornament and more of an assistant in doctors' offices that the geographical location of malaria will change until it will be much easier to remember the points where one need not look for malaria, than it will be to remember the malarial districts, and the immunity of the inhabitants of such localities will be confined to those who have never left their immediate neighborhood.

No first-class physician professes to practice medicine these days without a thorough urinalysis in most of his cases, but one is surprised by the number of physicians who overlook the examination of the blood for malaria. A blood examination for malaria is much easier, quicker and cleaner to make than a urinalysis, and while the examination of the majority of urines does not tell one anything except that the patient's urine is normal, the majority of blood examinations do give one some valuable pointers.

If I had to guess at either the condition of the kidneys or the blood, I would much prefer to guess about the kidneys, as the other symptoms connected with their pathological condition are more reliable.

I examine the blood of every patient for malaria and it may be surprising when I say that I find more parasites of malaria in the people from the so-called non-malarial states than I do in those from the extreme south. This is easily accounted for by the fact that the people down south are constantly thinking