INSECT CONTROL WORK
AT
CAMP A. A. HUMPHREYS, VA.
DURING 1918

THESIS FOR DEGREE OF M. HORT.

EDMUND HARRISON GIBSON

1919

Mosquitoes - Extermination
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TABLE OF CONTENTS.

PART I

THE ANTI-MALARIAL AND MOSQUITO ERADICATION WORK

INTRODUCTION.

Lands along the Potomac River have long been recognized as forming an important malarial section. Particularly is this true of the low lands bordering the marshes and small tributaries of the river. Because of the location of the camp, situated as it is between two bays which were known to be mosquito breeding grounds, it was wisely deemed necessary early in the year to devote particular attention and energy to the control of malaria bearing mosquitos. The campaign of prevention against malaria was planned during the latter part of March, carried on throughout the year. Briefly the result has been that there developed within this camp but five cases of malaria. Without such control measures as were carried on it is reasonable to assume that between two and three hundred cases would not have been abnormal. In measuring the importance of anti-malarial work and the reducing of the total number of cases to a minimum it must be held in mind that even one case acts as a reservoir of infection for hundreds of others when malaria bearing mosquitos are present in any numbers.

The campaign of 1918 is merely the foundation of another year's work which should have as its aim the entire eradication of malaria infections at Camp A.A., Humphreys and vicinity. Following is a detailed report of how the work of mosquito eradication was carried on.

PURPOSE OF THE WORK.

The eradication of malaria bearing mosquitos at Camp A.A. Humphreys and vicinity, and as far as possible the elimination of all pestiferous or annoying mosquitos.

ORGANIZATION.

The supervision of anti-malarial work was given to Edmund H. Gibson, Sanitary Corps, March 27, 1918. On April 6th, a detachment of fifty colored troops, unfit for foreign service, was put under Capt. Gibson's command. On May 12th, the detachment was increased to one hundred and fifty troops. From this number a detail averaging one hundred troops were daily engaged in drainage and oiling work.

MOSQUITO SURVEY.

During the latter part of March and early April a thorough survey was made of the entire camp area which included the mapping of swamp and marsh areas, stagnant pools, flowing streams, and all other likely mosquito breeding places such as old trenches, stump holes, and ruts. This map was also used to spot breeding places when such were found during the season. Observation and direction stations were also spotted on the map and corresponded to signs placed in the field. Later in the season when mosquito control work outside of the camp area was undertaken in co-operation with the U. S. Public Health Service a larger map which included all territory for a radius of three miles around camp was used. A

copy of the map accompanies this manuscript (Chart #1). It shows the area covered as being divided into five sections, A-Camp Area, B-Accotink area, lying north of area A, C-Mt. Vernon area, lying east of areas A and B, D-Gum Springs area, about one and a half miles east of Area C, and E-Rifle Range area, lying one mile west of areas A and B. Two other areas comprising the waters of Dogue Creek and Pohick and Accotink Creeks were also under observation during the season.

METHODS OF CONTROL.

Measures used in the control or elimination of mosquito breeding may be grouped into two classes, 1. Drainage, 2. Oiling. As a general principle oiling should not be resorted to if conditions can be handled efficiently by drainage. However, under certain conditions a combination of the two is best and again it is sometimes possible only to use oil. In adhering to this principle innumerable breeding places have been eliminated and millions of mosquito larvae killed without the use of oil. Drainage methods consisted of cleaning stream beds and banks to allow a regular and free flow of water and to eliminate side pools, constructing temporary and permanent ditches, filling stump holes, trenches, ruts, etc. The temporary ditches were made to suit the individual conditions. Permanent ditches were always constructed with clean straight or sloping sides with bottom graded, and always from a foot and a half to three feet wide at bottom. Chart #2 shows the drainage work accomplished. The oil used was the

standard grade mosquito oil purchased by the Quartermaster from the Standard Oil Co., Fifty barrels or twenty five hundred gallons of this oil was used during the season's work. This represented a cost of $225.00, the oil costing nine cents per gallon. It was applied by spraying from three gallon knapsack compressed air pumps, such as are used in spraying young fruit trees. The treatment the various breeding grounds received is taken up in the following paragraphs.

CO-OPERATION WITH THE U.S. PUBLIC HEALTH SERVICE.

During the early part of June Col. H. K. Carter of the Public Health Service made a mosquito inspection trip in and around the camp, and later in the month was accompanied on a similar trip by Lt. Col. J. H. White. The result of these inspections was the sending of a drainage engineer, Lieut. H. W. Snidow, and a mosquito inspector, Mr. H. Hayes, both of the Public Health Service to work in co-operation with Capt. Gibson in mosquito control work. The supervision of all such control work within and without the camp limits was given to Capt. Gibson. Close co-operation was in effect from July 9th, to date. The general plan of co-operation was that the Public Health Service would over-see and supervise the work outside of the cantonment area and the Sanitary Corps would supply the necessary labor and in return would have the services of the Public Health Service men within the camp limits when desirable. This general scheme worked out to excellent advantage. The necessity of this co-operation is made plain by the facts that, 1st,

malarial mosquitos may fly or migrate a mile or more from their breeding places, and 2nd, soldiers going out of the camp into the surrounding territory are subject to the bites of malarial mosquitos if present and people outside the cantonment may become malarial reservoirs when in the camp if they are subjected to malarial conditions outside. The actual work accomplished will be discussed on a following page.

MOSQUITO BREEDING DATES AND SPECIES CONCERNED.

The first mosquito larvae found was on April 10th, in puddles and wagon ruts along a road running through the woods in Sec. 2, of area A. The larvae represented a Culex species. April 19th, the dogwood was out in bloom for the first day, after this date Culex spp. larvae could be found in abundance in water barrels placed at buildings for fire prevention purposes. May 20th, adult Culex mosquitos were found present in small numbers in low wooded areas. The first Anopholes punctipennis larvae found was on May 21st, in small pools in an old road running through a wooded and shaded ravine in Section 3 of area A. The finding of any breeding after June 1st was a rarety due to the vigilance in keeping all standing water oiled. Breeding places were never allowed to become producing grounds. The first Anopholes quadrimaculatus larvae found in camp area was on August 15th. The twenty nine observation stations were visited regularly and at various times during the day for the purpose of capturing adult mosquitos and for noting breeding conditions. The collection of adults throughout the season was

very slim due to the efficiency of control measures in not allowing adults to be produced. During the last two weeks of August and the first two of September, Anopholes quadrimaculatus adults were frequently caught in tents in the vicinity of station #9 of area A. On July 26 one adult Mansonia perturbans was captured in a tent near the same station and on Aug. 11th one adult Culex restuans. These were identified by Dr. Ludlow of the Army Medical Museum.

CONTROL WORK IN AREA A-CAMP A.A. HUMPHREYS.

The entire camp area was divided into six sections (see map) each one of which was put under the supervision of a corporal or acting corporal and to whom was given an oiling squad of four men. The squad was comprised of two men with knapsack sprayers, one man with a pick, and one man with a shovel. To the corporal, was given the responsibility of keeping his section oiled and ditches and streams open and flowing. An acting sergeant was placed in charge of all six oiling squads. Each corporal reported to Capt. Gibson whenever he or any of his men found breeding places. Every such report was checked up by Capt. Gibson. By this method, it became an extreme rarety to find any pools, ruts, stump holes, marshy places, or streams which went without an application of oil for more than three days at any one time during the entire season. Seventy-five men were used throughout the season as a ditching detail. The duty of this detail was to clear and clean out and temporarily ditch every stream. They also did considerable drainage

work in swamp areas. From this number were taken the necessary men to carry on the ditching work in the various other areas. About 300 yards of permanent ditching was constructed within the camp limits, draining about three acres. The work in area A is now considered in detail by sections.

Section 1. Included the north east portion of the camp. Up to mid-summer over three quarters of it was densely wooded. Four streams of considerable importance from a mosquito breeding standpoint are included in this section. These were the last in area A to be cleaned and ditched because of the remoteness from the centre of the camp. They were, however, all cleaned twice during the season and were regularly oiled every seven days. After July 15th, there were no producing grounds in this section.

Section II. Contained the most important stream in camp, that running through the amphitheatre area where thousands of soldiers gathered every evening. This stream with innumerable side pools was kept oiled the entire season and was very carefully policed twice weekly. The mouth of the stream with surrounding swampy land will need much attention next year.

Section III. Included the southeast quarter of the cantonment. Old trenches of considerable length were filled to prevent breeding. The same treatment was given the two streams in this section as others of area A received. This proved to be a large but not difficult section to care for.

Section IV. Contained all that portion of the camp lying west of section three and proved to be the most difficult to handle. A marsh between the barracks at Belvoir and the Potomac River was a

breeding place for mosquitos most of the year. Because of the tide which flowed up into this swamp and its mucky bottom it was impossible to do efficient draining and oiling. It is recommended that this marsh be completely filled in with dirt and gravel during the winter. Much effort was expended on keeping streams of this section cleaned during the entire season.

Section V and VI . Each contained two streams with small marshy places. Policing and regular oiling readily controlled mosquitos in this section. Next year attention must be given to the shore line of Section VI.

CONTROL WORK IN AREA B-ACCOTINK.

All territory lying directly north of area A, for a distance of about two miles is included in area B. It contains nearly four square miles. Two branches of Accotink Creek run through this section. The village of Accotink is surrounded by malarial-mosquito breeding grounds. Interviews with doctors familiar with this section indicate that malaria has always been more or less prevalent. About 4400 yards of stream was kept flowing, clean, and free from side pools, and 100 yards of ditching was constructed in a meadow adjacent to the village draining a swampy area of about one acre. Areas ditched were oiled at intervals of seven days from June 15th, to Sept. 15th. Observations at station #18 throughout the season indicated an abundance of Anopheles punctipennis and Culex spp. breeding in the vicinity. Anopheles quadrimaculatus

adults were captured in small numbers during the first two weeks in September. None were captured at stations #19 and #21. Much drainage work should be done in area B, next year. The importance of the work is obvious because of its close proximity to the cantonment.

CONTROL WORK IN AREA C-MT. VERNON.

The only work carried on in this area was the keeping of 1760 yards of stream flowing, banks clean and free from stagnant pools. The same conditions existed here as were found in section I and II of area A. A detail of 10 men worked on one of the tributaries of Dogue Creek at three various times during the season, June 3-5, August 7-9, and September 3-4. Oil was applied to the side pools June 5, August 9, and September 4. There is much to be done in this area next year in the way of ditching and systematic oiling. At least three drip cans should be placed in Dogue Creek. The importance of giving consideration to this area is because of its close proximity to camp. The electric car line from Mt. Vernon will eventually run through this area and the cars will afford excellent passage for mosquitos into camp if they are allowed to breed here.

CONTROL WORK IN AREA D-GUM SPRINGS.

This area comprises the low lands lying adjacent to Little Hunting Creek for the distance of about one and a half miles, Near the center of the area was established a road camp for the civilian employees of Cranford Paving Co., The importance of mosquito work in this area, was, besides keeping the men at the road camp free

from malaria, the fact that the men came into Camp Humphreys to work and might prove malaria reservoirs for the soldiers. About 2200 yards of Little Hunting Creek was kept clean and flowing throughout the season and 30 yards of permanent ditch was constructed which drained a swampy area of about one half an acre. This area was oiled every ten days from July 1st to September 15th. A portion of the ditching work was done in co-operation with the Public Health Service. Observations at station #25 at various times during August and early September showed the presence of Culex spp. and Anopheles punctipennis in small numbers. The work should be continued next year if the civilian camp remains where it is.

CONTROL WORK IN AREA E-RIFLE RANGE.

The work in this section was under the immediate direction of Lt. H. W. Snidow of the Public Health Service, to whom entire credit is due for efficient drainage of twenty acres of swamp land. As before said this work was under the general supervision of Capt. Gibson but the plans for drainage and the execution of the same were made and carried on by Lt. Snidow. The area was divided into five sections the drainage of which are here dealt with separately. Area E was gone over by an oiling squad once every seven days.

Section 1. Area between camp and Pohick Creek immediately adjacent on West side. Character of the land was low flat and swampy with springs outcropping from foot of a bluff surrounding. Clear of brush five hundred feet of main ditch 3' x 2' was constructed which

required thirty men working two days.

Section 2. Area opposite camp on north side of road. Character- Small stream with several tributaries all much overgrown with brush and vines, thickly wooded swamp approximately two and one half acres. 6500 feet of stream course was cleared and reclaimed. 600 feet of right of way cleared for ditch. 400 feet of main ditch was constructed and 680 feet of lateral ditching. It required twenty-five men working twelve and one half days.

Section 3. Extensive marsh area south of camp and along Pohick Creek. Character- very low and marshy covered by high tide and for the most part very thickly wooded. A pond situated at the upper end fed by small stream but with no definite outlet other than gradual seepage through the marsh formed an ideal mosquito breeding ground. There were also two back-water ponds at lower end opening into Pohick Creek. In this section there was 600 feet of stream cleared, 3150 feet of right of way, ten feet wide cleared of brush; 3930 feet of main dicthing constructed, and 950 feet of lateral dicthing. A dam with tide-gate was constructed across the lower end of marsh. The dam was made 100 feet long, 8 feet wide, and 3 feet deep, and required a fill of 2400 cubic feet. The concrete structure for the tide-gate comprised two and one half cubic yards. Materials that went into the tide-gate was obtained upon an emergency purchase by the camp Quartermaster. The iron gate was made in co-operation with the School of Construction. The tide-gate was constructed in mid-stream necessitating draining a section 12' x 12' by driving piles, pumping with a power driven diaphram pump, and building up

a rock foundation from four feet below low tide level. The concrete structure was built on top of the rock foundation allowing for bottom of 3' x 2 1/2' flume six inches below low tide level. The gate itself was made of 10 gauge black iron plate, re-enforced with angle irons around edges. The frame work was made of heart pine with rubber pump packing gasket. T he time required on the ditches in this section was 23 days averaging 30 men. The time on the dam and tide-gate required ten days averaging 15 men. The construction of the tide-gate is illustrated by Charts #3a, 3b, 3c.

Section 4. Marshy area with long ditch through field to Pohick Creek south east of camp and near section 3. 900 feet of main ditching 3' x 1 1/2' was constructed requiring 30 men for 2 days.

Section 5. Low swampy area at lower end of target range A 300. Character - wooded swamp from which trees had been cut and stumps blasted leaving holes filled with water and very broken surface. Here 400 feet of main ditch 4 x 3 and 200 feet of lateral ditch 2' x 2' was constructed. It required 25 men working three days. The control work at the rifle range was completed Sept. 28 and next year will need nothing but policing work and regular oilings.

Dogue Creek Area. By aid of a motor boat supplied by the Public Health Service regular inspections of the waters of Dogue Creek and Bay was made possible. Inspection trips were made at least twice weekly from July 15 until Sept. 15. By the dipping process it was determined that the first Anopheles quadrinaculatus breeding took place during the first week in A ugust. It increased but little by August 15. By the last week of August the breeding was

abundant and during the first week of September it was very profuse. This breeding seemed to be limited to the floatage off shore in from 2 to 3 feet of water, sometimes deeper, and in places protected from the high winds and wave action. The floatage was that of eel grass. Cow collards and Arrow-leaf areas produced practically no Anopheles breeding. The floatage off the west shore of Dogue Bay was the principal source of breeding that produced the adults of A. quadrimaculatus that were somewhat abundant in camp during the first ten days of September. Each east wind blew into camp many adults from this source. No treatment was given this area except the cleaning of the shore line in places. The needed remedy is the destruction of the growth of weeds (eel grass principally) in Dogue Creek Bay. This can be accomplished by an aquaous weed cutting saw that has been ordered by the Public Health Service.

Accotink and Pohick Bay Areas. This area presents the same conditions and aspects as the Dogue Creek and Bay area, but because of its more remotness from camp and less frequency of winds from that direction during the breeding season, it is not as important as the Dogue Bay area but should always be held as a dangerous breeding ground. There was not as much floatage in the waters of Pohick and Accotink Bays as in Dogue Bay. The same inspections were given both areas and in general the same conditions applied.

RESULTS OBTAINED BY THE SEASON'S WORK.

As before stated the aim of the entire work was the control or

eradication of malaria bearing mosquitos and the reduction of the number of cases of malaria to the minimum. During the entire season to date, 19 cases of malaria, all of the tertian type, have been reported. But five of these were contracted by the soldier since his arrival in camp, (See Chart #4). This fact was obtained by data of the cases received from the registrar of the Base Hospital and by personal interview with the soldiers. Pestiferous or annoying mosquitos were controlled to such an extent that the camp was practically free from the pests during the entire season. Mosquitos bars were only needed by those organizations sleeping in tents at Belvoir, where mosquitos were blown in from across the river, and at the Rifle Range where malarial mosquitos were very abundant previous to the inauguration of the control measures there. It is well to remark that not a single case of malaria developed at the Rifle Range. This is directly due to the efficient work of Lt. Snidow of the Public Health Service.

APPRECIATION.

Throughout the entire season much help, advise, and encouragement has been received from Lt. Col. I. W. Brewer, the Camp Surgeon, who has a keen appreciation of insect control work.

PLANS FOR 1919.

It is planned to continue the work of ditching and oiling as carried on the past season in all the various areas. As the camp increases in size and its activities become multiplied it is anticip-

ated that the areas B, C, and E will have to be enlarged, hence more territory to be inspected and an extension of control measures made necessary. Particular attention should be paid to the destruction of weed growth in the waters of Dogue Bay, Pohick and Accatink Bays, and Gunston Bay. So long as weed growth is allowed to exist there will be mosquito breeding. The destruction of the weeds should commence as soon as the growth starts in the spring. It can be accomplished by dragging with the weed cutting saw, heretofore spoken of. It is suggested that this saw could be manipulated by two pontoons, one at either end of the 200 foot length saw. Co-operation of the pontoon school is requested. Continuation of the co-operation of the Public Health Service is absolutely essential.

RECOMMENDATIONS RELATING TO THE ORGANIZATION OF THE DETACHMENT SANITARY CORPS.

During the past season there have been but two officers with the detachment. This is not sufficient, and another second Lieutenant is requested. The duties of Captain E. H. Gibson, and 2nd Lieutenant R. A. Jackson have been so numerous that the men have not been properly supervised in the field. It is suggested that the proper organization should include one officer to plan, supervise, and check up the work; one officer to stay with the men in the field; and one officer to run the company, carrying with it the duties of supply, personnel, etc. It is also recommended that eight white sergeants be assigned to the detachment as it is necessary to work the colored men in numerous details of varying numbers and by the experiences of the past season it has been found that colored non-commissioned officers

have proved inefficient. These sergeants should be trained as mosquito inspectors and would be able to carry on considerable of the professional duties connected with mosquito work that the uneducated colored men are unable to do.

PART II.

FLY PREVENTION WORK.

Early in March 1918, camp authorities recognized the apparent probability of extensive fly breeding within the camp limits, and realized the importance of the problem in its relation to general camp sanitation and health. Hence it was ordered that praticular attention be given to the prevention of fly breeding. The general supervision of this work was placed under Captain E. H. Gibson of the Sanitary Corps, who acted under the recommendation and direction of the Camp Surgeon.

A survey of the possible fly breeding grounds of the camp was made during March. As the camp enlarged, the increased territory taken in was surveyed. By keeping this survey up to date, it was always possible to point out the important breeding places. A summary of this survey work is contained on Chart #5, which shows graphically the various principal sources of breeding. On this chart the intensity of color indicates the intensity of breeding.

The stables of the civilian contractors and employees presented the greatest difficulty in the prevention of fly breeding during the entire season, because of the fact that recommendations made to those in charge could not be enforced. This condition

was in great contrast to that which existed with the army stables where recommendations made were enforced to the letter. All army stables were required by a camp order to apply a borax solution at the rate of 1 lb. of borax to 12 gallons of water, to the stable floors twice daily, after each cleaning. This solution acted as a repellant to the flies and killed eggs that it came in contact with. It was applied by 3 gallon sprinkling cans, using 2 can fulls to the application. This method reduced the menace markedly and held the breeding around the stables to a minimum. Even so the stables formed the principal breeding places in camp, especially during the spring and early summer months. The ground around mess halls, temporary latrines, garbage dumps, etc., produced some flies, but these grounds were only temporary breeding grounds and when inspected and ordered cleaned up, their menace was eradicated.

Large out-door fly traps were designed by Capt. Gibson and constructed by a contract carpenter. The camp Quartermaster purchased a large supply of these and distributed them to the various organizations in camp for use in stables and mess halls. These traps were also factors in reducing the fly menace, catching large numbers from May 15 to the beginning of cold weather. Chart #6 shows the total number of flies caught daily by 100 such traps. These figures may be taken as a general indication of the prevalence of flies during the season, the curve showing that at June 30, and fly season was at its height, after which it gradually de-

creased until the end of the season. Bait used in the fly traps was principally fresh meat, decayed fruit and vegetables, and sweets such as molasses and syrups. The general recommendation was to use what was the most practical and easily available of the above, the main thing being to keep the bait fresh, replenishing at least once daily.

Chart #6 also contains curves showing the prevalence of the various important species of flies during the season. From these it is worthy to note that as the general sanitation of the camp improved, the percentage of house flies and blow flies to the total number of flies caught decreased.

Other factors which helped materially to decrease the fly menace were the excellent screening of all camp buildings and the common use of fly paper. However, most of the doors of the mess halls and other buildings were hung improperly, opening inwards rather than outwards. This fault was remedied in many instances before the season became far advanced and another year could be entirely removed.

RESULT OF ADVISORY AND SUPERVISORY WORK.

During what was a bad fly season outside of camp, the fly menace was reduced to a minimum within the camp limits, by the vigilance of the Camp Surgeon, Lt. Col. I. W. Brewer,

and his assistants in planning and carrying out all measures tending towards the prevention of fly breeding. No epidemics of dysentary or other intestinal troubles occurred that might have been traced to the prevalence of flies, and in general, the camp was kept comparatively free from fly nuisances.

BURNING EXPERIMENT.

At the suggestion of Lt. Col. Brewer, experiments were conducted to work out the efficiency of burning maggots and eggs by a burning apparatus which shot forth a flame of fire. For this purpose, three Buckeye Thawing Outfits, Type A, were purchased by the Quartermaster from the MacLeod Co. of Cincinnati.

It is a five gallon kerosene tank fitted with an air compressing pump, and a meter to indicate the air pressure obtained. From this tank leads a long rubber hose to which is attached the vaporizing coil and hood. Waste is placed around the coil and set on fire. As the coil is heated, the kerosene by means of the air pressure is sent into the coil and out a small hole at the base of the hood. As the kerosene comes out it is vaporized by the heat and flames from the waste and issues forth from the mouth of the hood in a strong intense white heat flame. The flame can be regulated by a valve on the tank which controls the air escape. The flame can be made to shoot forth for a distance of between 3 and 4 feet. Two men are required to operate and carry the apparatus.

It was found that this flame was sufficient to kill all fly eggs and maggots in the top two inches of a manure pile, that is the heat that penetrated for two inches was sufficient to kill

eggs and maggots that were found at such depths. This was checked up in numerous instances at various manure piles and its efficiency proved, which showed that if the surface of a manure pile was burned over by this apparatus at the close of each day, all eggs that were laid in the pile during the day would be destroyed and the probability would be that the pile would cease to be a menace so far as fly breeding is concerned. This same general scheme might be applied to the ground around mess halls, out door latrines, and any place where flies would lay their eggs, and which would be accessible to the flame. However, the fire menace must always be considered and great caution exercised in bringing the flame in contact with objects that might catch fire. The cost of applying this flame to the manure pile that would accumulate from 36 horses a day and to the dirt floor of the stable, would not exceed 10 cents, thus making the cost of preventing a stable, housing 36 horses, becoming a fly breeding place, approximately ten cents daily.

Packet 1:
14 pieces:

Chord 1
2.
3a
3b
3c
4
5
6

Packet 1
2
3
4
5
6