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REPORT ON THE 1944 ANOPHELINE
MOSQUITO SURVEY IN CANADA

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Division of Entomology Processed Publication No. 17
December 30, 1944.

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Survey in Canada

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Introduction

In March, 1944, information on the occurrence and distribution in Canada of Anopheles mosquitoes was requested from Mr. H. G. Crawford, the Dominion Entomologist, by the Directorate of the Director General of Medical Services (Army). Five species of anophelines had been recorded in various parts of the Dominion, but their distribution and prevalence was not well defined by the comparatively few and scattered records then available. What was especially desired was more accurate information on the occurrence and abundance of these species, and of any other anophelines that might be present, in the vicinity of service and D.P. & N.H. hospitals and P.O.W. camps. The Division of Entomology undertook to co-operate in this project, and the matter was further discussed and arrangements for the survey agreed upon at a conference attended by representatives of the medical services of the three branches of the armed forces, the Pensions and National Health Department, and the Division of Entomology.

Organization of the Survey

It was decided to confine the survey to the vicinity of the larger and more important institutions at the inception of the work, and to expand it later to include the smaller hospitals if developments warranted such action. Twenty-eight hospitals and casualty re-training centres in the various provinces and two P.O.W. camps situated in Quebec and Alberta were selected by the medical services for inclusion in the study in 1944. The Dominion Entomologist invited a number of entomologists and associated workers to collaborate in the work.

The final list consisted of eleven officers of the Division of Entomology, three of the Division of Plant Protection, and six in the provincial services. These officers were invited to cooperate in the surveys of the institutions and their environs in the districts nearest to their local headquarters. The actual number of civilian personnel was considerably larger than this would indicate, as in many cases the officers concerned enlisted the assistance of their associates and other competent persons. A list of the institutions, together with the names and addresses of the collaborators in charge of the survey in the various districts, is attached to this report as an appendix.

At the request of the committee of service representatives, a grant of \$2,000 was obtained from the National Research Council by the Directorate of the D.G.M.S., Ottawa, through the Associate Committee on Army Medical Research, for the construction of mosquito light traps and to meet other incidental expenses. Major R.H. Ozburn, of the Directorate of Operational Research, arranged for the construction of 30 or more of these traps by Army Ordnance. These were distributed through the Central Medical Stores (Army) in early July to the various service hospitals included in the survey. Arrangements were made by the D.G.M.S. for NCO's or other personnel to instal and operate these traps from July 15 to September 15, with instructions that the collections of mosquitoes and other insects were to be mailed daily to the Directorate of Operational Research in Ottawa, where the specimens would be sorted over and the mosquitoes subsequently submitted to the Division of Entomology for identification.

At the request of the Chairman of the Associate Committee on Medical Research, a memorandum on the installation and operation of the traps and the preparation and use of the killing bottles attached to them was prepared early in July for distribution with the traps. Major Osburn visited the various institutions to inspect the location and operation of the traps and also called upon the civilian collaborators in the different provinces to discuss their part in the survey.

A 13-page booklet entitled "Anopheles Mosquito Survey in Canada", containing information of value to the collaborators and others interested in the survey was prepared. This booklet was illustrated by a dozen line drawings by L. B. Jamson, Artist of the Division of Entomology, and by two half-tone photographs depicting typical breeding places. Fifteen hundred copies of the booklet were multilithed and distributed in July after the manuscript had been approved by the committee.

In addition to the illustrated booklet, instructions were sent by letter to the collaborators, together with two copies of topographical survey maps covering each of the areas which they were asked to survey. The collaborators were requested to return one copy of each of the maps to Ottawa with the location of the institutions marked thereon for reference purposes. They were asked to endeavour to collect adult mosquitoes as well as larvae for shipment to Ottawa, make observations and prepare a comprehensive report covering each area.

To facilitate the work of the collaborators the D.C.M.S. in mid-July made arrangements for them to have access to the various hospital grounds to inspect the light traps and make collections in

the grounds from time to time. On July 24 instructions were also sent out by the Adjutant General to officers commanding Military Districts where the survey was being made, giving the local officers authority to permit the civilian collaborators to inspect the grounds of the hospitals and other institutions and adjacent military areas over a two to three mile radius from each of the institutions concerned.

Acknowledgments

Sincere thanks are due to all those who assisted in the survey, but it should be borne in mind that the amount of time and effort the various collaborators were able to devote to the project was restricted in many cases by shortage of staff and the demands of their own research problems. Especially effective work was done by several of the collaborators, but it is regretted that no mosquito specimens were received from British Columbia. A large part of the work of identifying collected material both from the light traps and the field surveys was done by A. R. Brooks, dipterist in the Systematic Unit of the Division of Entomology, assisted by Miss M. MacKay of the Division. The names of others who assisted in the survey will be found in Appendix A and also in the reports covering the various hospital areas.

Summary of Results

The 1944 season was generally an unusually dry one across the Dominion, a condition which undoubtedly would affect the prevalence of anopheline and other species of mosquitoes. However, nearly 25,000 mosquito specimens were collected and

examined in connection with the survey, including 19,248 from the light traps and about 5,500 from the field surveys. The light trap specimens, of course, were all adult mosquitoes, but larval forms predominated in the material from the field surveys. Less than one per cent (0.85 per cent) of the light trap captures were anophelines, as compared with about 35 per cent of the field collections. The explanation of this wide difference in percentages of anophelines is that the light traps attracted many specimens of whatever species happened to be abundant in the vicinity, whereas the field collaborators searched primarily for anopheline forms and collected culicines only incidentally and in small numbers, regardless of the extent of the infestation.

Collection by the light trap method is a form of sampling of the mosquito fauna both as to species present and their relative abundance in the vicinity of the trap location. An important limitation in the accuracy of this method is that different species do not respond equally to the attraction of light. For instance, observations indicate that Anopheles walkeri Theo., is much more attracted to light than is A. quadrimaculatus Say. The former was taken in nine localities by the light traps, but in only three in the field surveys, including one specimen taken at a lighted window. On the other hand, quadrimaculatus was collected by the collaborators at five of the selected survey points in Ontario, compared with three by the light traps. Thus, the numbers of these species taken in the traps was not an accurate indication of their local abundance.

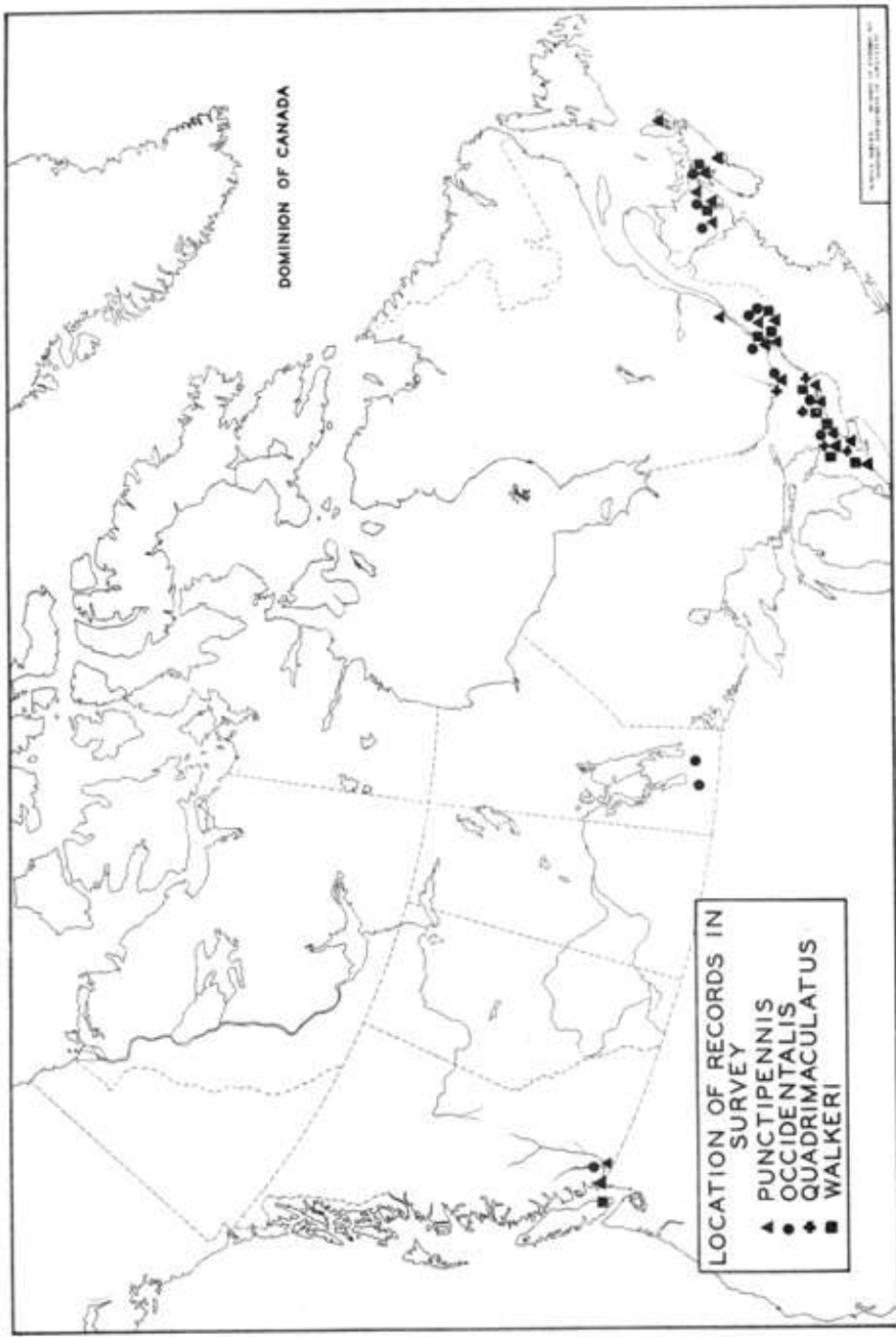
Anopheline larvae were found in many kinds of permanent and semi-permanent water bodies during the survey, such as in the marginal waters or sluggish backwaters of rivers and streams, especially where aquatic and other vegetation was plentiful; also in

cat-tail grown areas of ponds and lakes; in small unshaded grassy pools; in lily pools and ponds; in hoof-prints near cattle drinking places; in pools in drying streams, and in ill-kept drainage ditches. Adult forms were collected under culverts, in houses, root cellars and similar places. In several localities many adults were reared from the larvae.

Twenty-six species of mosquitoes (anopheline and culicine) were collected in the field surveys as compared with nineteen in the light traps. The total number of species taken from both sources was twenty-seven, including four anopheline and twenty-three culicine forms. All the species taken in the light traps were also found at one point or another in the field surveys with one exception, a western species called Theobaldia alaskaensis Ludl. The locality records from these collections are summarized in the table on page 8 and depicted graphically in the accompanying map on page 9.

In order to provide a complete picture of the known distribution of Anopheles in Canada, records from all sources are presented in the table on page 10 and accompanying map on page 11. The sources referred to include the 1944 survey, the files of the Canadian Insect Pest Survey, the data on specimens in the National Collection of insects, and published and unpublished notes.

An examination of the following tables and maps shows that Anopheles occidentalis D.&K. is the most widely distributed anopheline mosquito in Canada, and the only one known to occur in Saskatchewan and Alberta. The 1944 survey revealed its presence for the first time in Nova Scotia and New Brunswick.

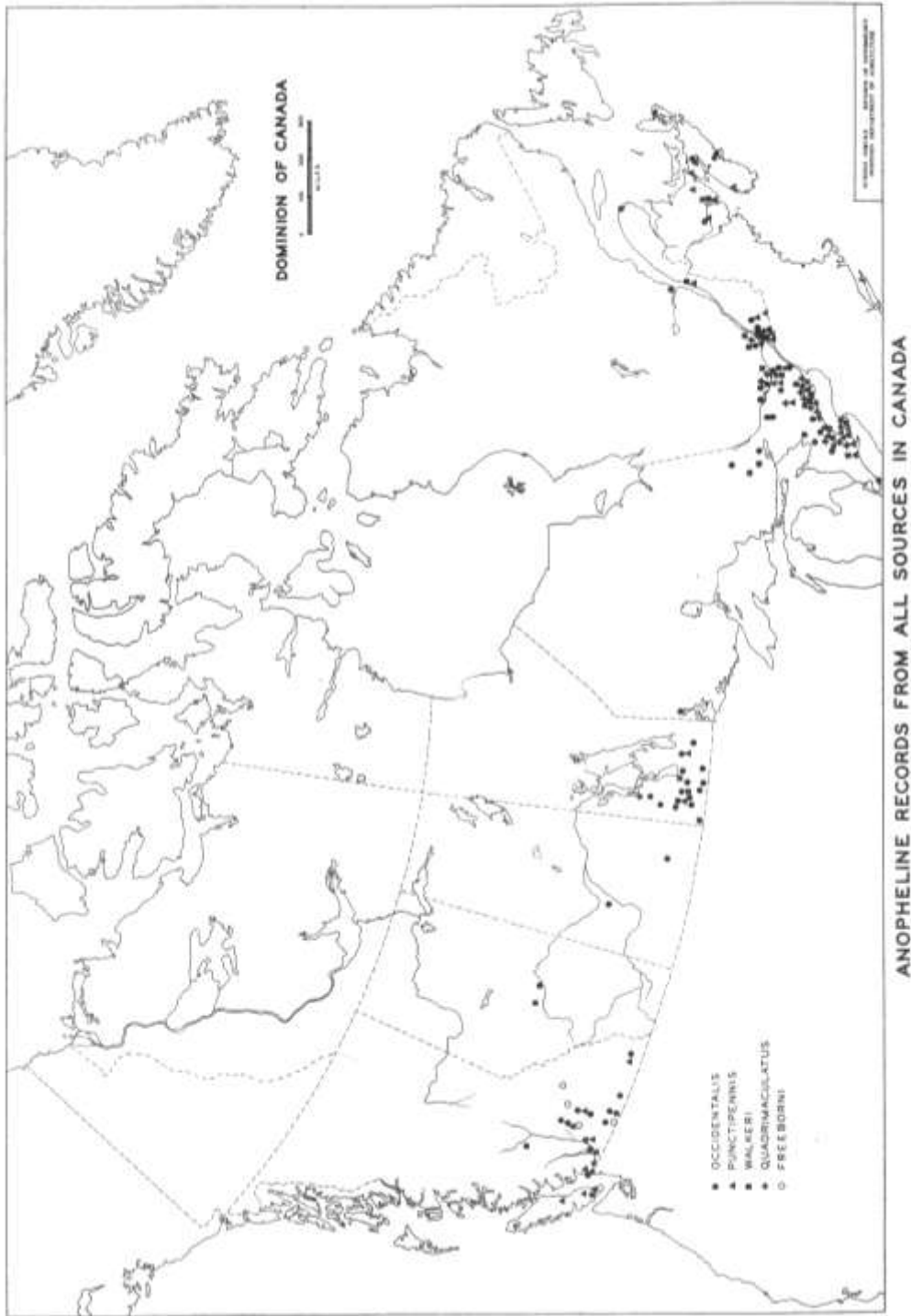


SUMMARY OF DISTRIBUTION RECORDS OF ANOPHELES IN CANADA*					
Province**	undulipennis	quadrimaculatus	walkerii	occidentalis	freeborni
NOVA SCOTIA	Ancheret, Berwick, Dartmouth, Debert, Grand Pré, Sydney, Waverley		Debert	Debert, Waverley	
NEW BRUNSWICK	Fredericton, Moncton, Sussex		Sussex	Fredericton, Sussex	
QUEBEC	Aylmer, Clarenceville, Grande Ligne, Hemmingford, Huntingdon, Kingsmere, Montreal, Norway Bay, Pointe Claire, Ste. Alexandre, Ste. Anne de Bellevue, Ste. Hyacinthe	Hemmingford***, Montreal***, Norway Bay	Grande Ligne, Hemmingford, Huntingdon, Montreal, Norway Bay, Ste. Thomas de Joliette	Bryson, Gaspé, Gatineau Point, Grande Ligne, Hemmingford, Kettle Island, Montreal, Norway Bay, Ste. Alexandre, Ste. Anne de Bellevue, Ste. Hyacinthe, Yvander River	
ONTARIO	Amesbury, Belleville, Brampton, Brighton, Guelph, Ingersoll, Jordan, Kingston, Madoc, Ottawa, St. Thomas, Simcoe, Spencerville, Stittsville, Stony Creek, Trenton, Toronto, Winona	Amesbury, Barriefield, Belleville, Brampton, Brighton, Cayuga, Colborne, Cobourg, Gananoque, Jordan, Kingston, Madoc, Ottawa, Rockcliffe, St. Catharines, Simcoe, Trenton	Algonquin Pk., Brampton, Carleton Place, Fox Lake, Jordan, Kingston, Haberley, Point Pelee, Ottawa, St. Thomas, Smiths Falls, Spencerville, Sudbury, Toronto, Trenton	Algonquin Pk., Dissecting, Camp Borden, Cobourg, Guelph, Kenora, Little Current, River, Lyn, Nagsamit River, Crillia, Ottawa, Toronto, Trenton, Welcome, Lake Westree	
MANITOSA	Brandon, Winnipeg		Awen, Westbourne	Awen, Brandon, Dauphin, Glen Bouris, Manitoba, Millarney, Lyleton, Morden, Nisset, Onah, Portage la Prairie, Riding Mt. Nat. Pk., Souris, Steinbach, Wawanesa, Winnipeg, Winnipegosis	
SASKATCHEWAN				Indian Head, Pike Lake	
ALBERTA				Edmonton, Wabamun	
BRITISH COLUMBIA	Agassiz, Davis Lake, Duncan, Chilliwack, Harrison Hot Springs, Matsic, Hope, Ladner, McConnell Creek, Mission, Nanaimo, New Westminster, Royal Oak, Ruskin, Vancouver, Wellington, Yarrow		Esquimalt	Agassiz, Blackpool, Chilcoot, Chilliwack, Cranbrook, Cultus Lake, Douglas Lake, Fairview, Harrison Hot Springs, Matsic, Kamloops, Kelowna, Keremeos, Mission, Nicola, Bloomer Is., Oliver, Osoyoos, Penticton, Summerland	Nicola Lake, Oliver, Revelstoke, Vernon
YUKON TERRITORY				Noctallingus, Mayo River Valley	

* Includes records from all sources as at Dec. 31, 1944.

** We have no records of anophelines from Prince Edward Island.

*** Authenticity doubtful. Specimens and collection data lacking.



The species A. punctipennis Say is somewhat less widely distributed than occidentalis, but is equally if not more common than the latter in many parts of its range.

A matter of special interest is the discovery that A. quadrimaculatus Say, which is probably the most important malaria carrier in the United States east of the Rockies and is officially designated by the American Association of Economic Entomologists as "the common malaria mosquito", apparently occurs widely in Ontario from the Ottawa Valley region southward to Lake Erie, and in the southern fringe of Quebec.

The species A. walkeri Theo., recorded only from Quebec, Ontario, and Manitoba previous to the survey, is now known to be present also in Nova Scotia, New Brunswick, and on Vancouver Island, where one female specimen was taken in the light trap at Esquimalt. This species had not hitherto been reported in Western North America. No specimens of the western anopheline species A. freeborni Aitken were collected during the survey, but it had previously been recorded in four localities in British Columbia.

Although the information obtained from the 1944 survey and other sources shows that anopheline mosquitoes of certain species are widespread in Canada, it is apparent that infestations of these insects are generally light, and over the greater part of the Dominion they are never abundant in the manner that the dominant culicine species are abundant. In many localities the presence of anophelines was only revealed by diligent search, and in others they appeared to be rare or absent.

Of the five species of Anopheles found in Canada, only two are considered to be important vectors of malaria in the United

States, namely, quadrifasciatus Say, which appears to be confined to southern Ontario and the extreme south of Quebec, and freeborni Aitken, which has been recorded from only four places in British Columbia. With regard to quadrifasciatus, Dr. L. L. Williams, Medical Director of Malaria Control in War Areas, U.S. Public Health Service, indicated in an article* in the Proceedings of the 30th Annual Meeting of the New Jersey Mosquito

that the danger of malaria transmission in northern areas would not likely be serious, and stated that "experience has shown that malaria disappears even in the South when quads become so scarce that they must be diligently searched for".

IN THE COLLECTIONS TAKEN DURING THE SURVEY, THE FOLLOWING SPECIES both from the traps and the field inspections were the northern house mosquito, Culex pipiens L., and the rainpool mosquito, Aedes vexans Mgn. The northern house mosquito has not been recorded in the Prairie Provinces. It has the distinction of being the only mosquito that can readily develop in water heavily polluted with sewage. Enormous numbers were found breeding in polluted water bodies at Debert, N.S., Grande Ligne, P.Q., and, in former years, at Montreal. A species that was commonly found associated with anopheline larvae in the breeding places was C. apicalis Adams, a mosquito that appears to be harmless to man and beast.

Two new culicine records for Canada produced by the survey concern the species Culex salinarius Coq., which was taken near Dartmouth, N.S., and Uranotaenia sapphirina O.S., which appeared in field collections from Montreal, Kingston

* "Density of Anopheles quadrifasciatus as related to prevalence of malaria".

and Toronto, and in trap collections from Ottawa, Kingston, Toronto, Hamilton and St. Thomas. The former is reported to bite readily, but the latter apparently is not a pest of man.

In studying the culicine records it should be borne in mind that the survey was made comparatively late in the season, at a time when many early culicine mosquitoes had largely or wholly disappeared. Actually, more than sixty species of mosquitoes have been recorded in Canada. Whereas mosquitoes of the genera Anopheles, Culex, and Culiseta overwinter in comparatively small numbers as hibernating females and multiply slowly through one or more generations to reach their maximum numbers late in the following season, the common Aedes which generally have only one generation each year, overwinter in the egg stage and hatch in spring in countless millions in the cold waters of transient pools and floodwaters. The species of Aedes are the most prolific and troublesome of Canadian mosquitoes and they are often a severe pest from late May to July. By carrying out the survey in late summer and early autumn many culicine species which were ^{only} of incidental interest were excluded from the collections.

More detailed reports from the various districts included in the survey are presented in the following pages.

Regional Reports of the Survey

The Maritime Provinces

Three species of Anopheles (punctipennis, occidentalis and walkeri) have been found in Nova Scotia and New Brunswick. Their numbers are generally sparse in Nova Scotia and sparse to moderate in New Brunswick. There are apparently no records of anophelines occurring in Prince Edward Island, perhaps because no careful survey has been made in that province.

Halifax-Dartmouth, N.S.

Survey work in the Halifax-Dartmouth district was carried out by D. C. Ferguson, a local amateur entomologist, under the direction of R. G. Webber, of the Dominion Plant Inspection Office, Halifax, the collaborator in that region. The following are pertinent extracts from Mr. Ferguson's report:

"After extensive searching in the Halifax and Dartmouth areas during August and September, 1944, it has been found that anopheline mosquitoes, if at all occurring in these localities, are in numbers hardly great enough to make their presence known. A small number of larvae (Anopheles punctipennis Say) were collected on the Dartmouth side of the harbour near the Eastern Passage aerodrome, but only in one very restricted locality. None were found in Halifax or in the outskirts of the city. The nearest spot from which specimens were secured was at Bedford, about nine miles from Halifax.

"The writer is inclined to attribute this scarcity to a lack of suitable breeding places. Observations carried

out would seem to indicate that Anopheles larvae are partial to permanent pools of fairly clean water with an abundance of decaying vegetation, especially old leaves and stems of coarse grasses, blue flag (Iris), cat-tail (Typha latifolia) and pickerel weed (Pontederia) around the edges; often with a flourishing growth of algae. None could be found in sphagnum bogs or in bodies of water where sphagnum was present. Sphagnum is prevalent in practically all moist places in the vicinity of Halifax and Dartmouth, and many coarse grasses, the Typha, Iris, etc., are usually scarce or even absent.

"A very thorough search for Anopheles larvae was carried out in the Halifax area including all possible breeding places in city parks, gardens, and in waste areas in the north end of the city, and in a wide area across the North-west Arm; i.e., Armdale, Fairview, Spryfield, Fleming Park, etc. As has been stated, no anophelines were found in these localities. Culicine mosquitoes in all stages of development abounded in many types of breeding places. Amazing numbers of the little pitcher plant mosquito (Wyeomyia smithii Coq.) breed in the leaves of Sarracenia, which abounds in most of the bogs.

"The survey was not carried on as thoroughly on the Dartmouth side of the harbour but, nevertheless, two collecting trips in early September enabled the covering of quite a wide area. This included two roads running between Dartmouth and Eastern Passage, as well as the Dartmouth-Waverley highway. Many breeding places along these routes were searched and culicine larvae were found, along with adults in many places. As already mentioned,

anopheline larvae were found only in a very restricted breeding area between Dartmouth and Eastern Passage.

"The writer also did some mosquito collecting in other parts of the province when opportunity presented itself. As a result, it was found that Anopheles mosquitoes were breeding in the lily ponds of Grand Fré Park, near Wolfville, Kings Co., and at Waverley, Halifax Co.; in considerable numbers in the latter locality*. A small amount of collecting was done in Hants Co., Pictou Co., and other parts of Halifax Co. but in these localities no unusual discoveries were made."

Mr. Ferguson's findings were confirmed by my observations during a brief stay in the Halifax-Dartmouth area in early September. There are numerous fresh water bodies in the area, mostly with soft, treacherous, muck bottoms from which marsh gases exude as one wades gingerly along the margins. Sphagnum moss and the insect-catching pitcher plant (Sarracenia purpurea), sundew (Drosera rotundifolia) and bladderworts (Utricularia spp.) grow plentifully in these boggy places, and predacious aquatic insect life is common. The nature of these water bodies apparently inhibits the development of anopheline mosquitoes for none could be found in them, and culicine forms with the exception of the innocuous pitcher plant mosquito, Wyeomyia smithii Coq., and moderate numbers of the harmless Culex apicalis Adams, were scarce or absent.

* Reared specimens showed punctipennis Say at Wolfville, and punctipennis and occidentalis D. & K. at Waverley.

As stated by Mr. Ferguson, anopheline larvae were found only in one place, namely: in small quiet pools in a stream that flows into the north end of Morris Lake. Careful search on two occasions produced less than a dozen larvae of Anopheles punctipennis Say.

Culicine species found in the Halifax-Dartmouth district, in addition to those already mentioned, included moderate numbers of Aedes vexans Mgn., A. cinereus Mgn., A. canadensis Theo., Culex pipiens L., C. salinarius Coq., and Culiseta morsitans Theo. The finding of C. salinarius is of interest in that it appears to constitute the first record of the species in Canada. The larvae were quite numerous in a small, shallow, rather dirty-looking stream which parallels the Eastern Passage Road, near Dartmouth. Adults of both sexes were collected resting in a nearby culvert. The species is widely distributed in the Eastern United States and is reported to bite readily during the evening.

Deep Brook, N.S.

The area surrounding the R.C.N. Hospital at H.M.C.S. Cornwallis, Deep Brook, N.S., was carefully surveyed by A. D. Fickett, of the Dominion Entomological Laboratory, Annapolis Royal, on three occasions in August and September. Mr. Fickett reports that mosquitoes are scarce in this general area owing to the steep and rocky terrain and the paucity of stagnant water bodies suitable for mosquito breeding. The only species found was the harmless Culex pipiens Adams, a few larvae of which were taken in a pond with a muddy bottom, situated in a small sphagnum bog about two miles from the hospital, when I visited the area with Mr. Fickett on September 3.

The sparsity of mosquitoes in the area was verified by the light trap which collected only small numbers of Culex pipiens L. and Aedes vexans Mgn.

Debert, N.S.

The Debert Military Camp, situated about fifteen miles from Truro, N.S., was visited by M. E. Neary, Acting Provincial Entomologist, on July 26 and 27, and again by Mr. Neary and myself on September 12. The main water bodies in the area are the stream and lake called the Galloping Brook, and the Chigonis River into which it flows. Otherwise, apart from several small brush-covered swampy places, the area was generally dry. An examination of these wet places produced no anopheline larvae, although it is apparent that anophelines do occur in small numbers in this locality, as three adult specimens representing the three species Anopheles punctipennis Say, A. occidentalis D. & K., and A. walkeri Theo. were picked up during the season by the light trap.

During the July visit Mr. Neary found larvae and adults of Culex pipiens L., and C. apicalis Adams, and adults of Aedes sollicitans Wlk., and A. vexans Mgn., about the camp. The latter two species comprised the bulk of the mosquitoes collected in the light trap. Specimens were taken attempting to bite during the visit on September 12. The species sollicitans is a strongly migratory mosquito that breeds in salt marshes; vexans is also a migratory species from transient fresh water pools. A few larvae of vexans and of the woodland species Aedes canadensis Theo., were also found on

September 12 in a roadside ditch containing some cat-tails. However, the only important mosquito breeding place found in the camp area was the Galloping Brook Lake, where sewage pollution had provided optimum conditions for the development of the northern house mosquito, Culex pipiens L. The waters of the lake, especially near the sewage disposal outlet, were heavily infested with larvae and pupae of this nocturnal species.

Sydney, N.S.

While in Nova Scotia I visited Sydney, N.S., September 14-16, to inspect the area surrounding the R.C.N. Hospital, at the Point Edward Naval Base. A pass to enter the Base was obtained from A/Lieut. Cdr. J.V. Payn, Staff Officer, Shore Patrol, and contact made with Surg. Lt. W. G. Burrows, under whose supervision the light trap was in operation close to some bushes a short distance from the Sick Bay.

During my visit, strong winds and frequent rains made a thorough survey difficult in the short time available. However, it is believed from the observations made that anopheline mosquitoes are unlikely to be numerous in the area, as the land is high and apparently well drained and, moreover, is separated from swampy places to the east, west and north by the waters of Sydney Harbour.

An inspection of water bodies in the vicinity of the Base and within its precincts revealed few mosquito larvae, specimens of which proved to belong to the species Culex pipiens L., Aedes vexans Mgn., and A. canadensis Theo. Of particular interest was the finding of larvae of Anopheles punctipennis Say in a shallow stream (Crawley Creek) within perhaps half a mile of the R.C.N. Hospital.

The stream was inspected for a distance of about 300 yards south of Rudderham Road, at which point it passes under a culvert on its way to empty into the South Arm of Sydney Harbour. It is a fairly clean stream with a moderate flow. The larvae were found in various stages of development among submerged grasses and patches of algae along the stream margins. The infestation was a light one, a fact that was borne out by the absence of resting adults in nearby culverts, and the failure of the light trap to collect specimens.

Fredericton, N.B.

Observations carried out in the Fredericton district by R. P. Gorham and his assistants revealed the presence of small to moderate numbers of anopheline larvae in shallow pools and along the margins of streams. About 50 reared adults and 120 larvae were received for identification. All the adults were Anopheles punctipennis Say, but some of the larvae were occidentalis D. & K. Both these species were also taken in the light trap. The collections were made from a log pool in the backwaters of the Nashwaaksis River, among wild rice along the margins of this river, and in a sedge-grown pool near its mouth. Many larvae were found in an ornamental lily pool, and a few were observed in grassy pools in a brickyard, a small oat-tail marsh in an old clay pit, and in stagnant places in Baker Brook, Garden Creek, and Regiment Creek. I went over the area with Mr. Gorham on August 31, and concluded that it was doubtful whether the general infestation was such as to warrant control measures. Other species taken in

the field survey were Culex pipiens L. and Aedes vexans Mgn. They were not abundant doubtless because of the dry season.

Sussex, N.B.

In the Sussex area, R. P. Gorham was assisted in the survey by F. S. Kierstead and W. F. Merritt, of the staff of the local high school, whose services were paid for out of a \$300 grant obtained for this purpose from the National Research Council through the Associate Committee on Army Medical Research. More than 600 anopheline larvae were taken in samplings from the various breeding places, but none were reared, and comparatively few adults were collected. Two species were found to be common in the district, namely, Anopheles punctipennis Say and A. occidentalis D. & K., the former probably predominating. A third species, A. walkeri Theo., was found numerous only at Mud Lake. One of the principal sources of anopheline larvae was the sluggish and weedy Trout Creek and pools along its margins. This creek flows from east of Sussex along the east and north of the town to the point where it joins the Kennebecasis River. The military camp and Casualty Retraining Centre are situated close to its banks. Larvae were also found in the still or sluggish waters of Salmon Creek, Ward Creek, Smith Creek and McGregor Creek, and in cat-tail ponds, shallow pools in gravel pits, a disused reservoir with a marginal growth of cat-tails and alders, roadside ditches, an ornamental lily pond, and cattle hoof-prints in marshy meadows.

I visited Sussex on September 1, and inspected the anopheline breeding places with Mr. Gorham. Larvae had been reported numerous during August, but on the occasion of my visit we

were able to find only light infestations. A search under culverts at Sussex Corner and at Jeffries' Mill Pond produced about a dozen adults of both sexes of punctipennis and occidentalis in approximately equal numbers. At Mud Lake, a muddy-bottomed lake with swampy, cat-tail-grown margins, connected with McGregor Creek, and situated in woodland two miles or more from the military hospital, females of the species Anopheles walkeri Theo., attacked us vigorously, although the hour was noon. The attacks lasted only while we waded among the cat-tails, and ceased immediately we moved away from the lake margin. This species had not been recorded in New Brunswick prior to the survey. Although walkeri appears to be more attracted to light than other Canadian anophelines, specimens were not taken in the light trap in the camp.

Larvae of culicine mosquitoes collected during the survey included Culex pipiens L., C. territans Wlk., C. apicalis Adams, Aedes cantator Coq., and A. vexans Mgn. Of these, the light trap, which surprisingly collected only 28 mosquitoes during the season, took only pipiens.

Moncton, N.B.

R. P. Gorham reported that few anopheline larvae were found in water bodies in the Moncton area. The samples submitted contained 83 larvae collected in August, of which those examined were all Anopheles punctipennis Say. The infestation was extremely light and chiefly confined to submerged grasses in the sluggish and rather dirty Jonathan Creek, which empties into the Petitecodiac River south of Moncton.

An occasional larva was also taken in one or two small ponds in the area. The scarcity of anophelines was borne out by the collections from the light trap, which contained 1,630 specimens, all culicines. Culicine larvae taken included small numbers of Aedes cantator Coq. (a brackish water species), A. vexans Mgn., Culex pipiens L. and C. apicalis Adams. Two other species were represented in the light trap collections by a few specimens of Aedes stimulans Wlk., and A. sollicitans Wlk.

Quebec

Anopheline infestations in areas examined in Quebec province were generally light, and were made up of punctipennis, occidentalis, and walkeri. The species quadrimaculatus was not taken during the survey, but in previous years was collected at Norway Bay, in the Ottawa Valley, and doubtfully reported from Hemmingford and Montreal.

Quebec City, P.Q.

A survey of the Quebec City area was carried out by Dr. Georges Gauthier, Provincial Entomologist, and Father Ovila Fournier, Professor of Entomology, of the University of Montreal. Owing to the very dry season, mosquitoes were scarcer than usual. No anophelines were found and the few mosquitoes observed belonged to two species of culicines, namely, Culex pipiens L. and Aedes vexans Mgn. Two specimens of Anopheles punctipennis Say were taken in the light trap set up in the grounds of the Army Hospital near the Citadel. The results of the field survey, however, indicate that this species is scarce in the district.

Montreal, P.Q.

The survey in the Montreal district concerned No. 4 R.C.A.F. Convalescent Hospital, which is divided into two sections, one, the Timmin's Division, being located in a residential district at Westmount, and the other, the Saraguay Division, on an estate on the Rivière des Prairies, north of the highway between Cartierville and Ste. Genevieve. The survey was under the direction of H.A.U. Monroe who obtained the assistance of members of the Montreal Branch of the Entomological Society of Ontario and certain others in carrying out the project, including Rev. Father O. Fournier and Prof. E. R. Bellemare, University of Montreal, Miss A. Fortin, Miss M. Labelle, L.A.C. K. W. Miller, R.A.F., N. Cameron, G. L. Giasson and A. C. Sheppard. Observations were also made at Ste. Anne de Bellevue, near Montreal, under the direction of Prof. F. O. Morrison, Macdonald College.

Mr. Monroe reported that the only water bodies of any significance within a two-mile radius of the Timmin's Division were two small ponds, sections of the Lachine Canal, and a portion of the St. Pierre River flowing through a swamp near the C.N.R. yards. Two species of culicine larvae, Culex pipiens L., and C. apicalis were taken, but no anophelines.

The grounds of the Saraguay Division of the hospital are bounded on the north side by the Rivière des Prairies, and within the two-mile radius are two streams, one flowing into the river on the south shore near the hospital, and the other on the north shore near Abord à Flouffe. In the mouths of these streams there is a plentiful growth of aquatic

vegetation. Anopheline larvae were found to be rather numerous there and also a short distance up the south stream and along the banks of the Rivière des Prairies. About 65 specimens of anopheline larvae were submitted, consisting of the two species Anopheles punctipennis Say and A. occidentalis D. & K. A few adults collected or reared in the same general area were punctipennis. These two species and A. walkeri Theo. were represented in the light trap collections taken at the hospital. Most of the mosquitoes taken in this trap were Culex pipiens L. Among the anopheline larvae were a few specimens of Culex apicalis Adams and one larva of Uranotaenia sapphirina C.S.

Grande Ligne and Ste. Hyacinthe, P.Q.

The survey of the area about the P.O.W. Camp at Grande Ligne and the R.C.N. Hospital at Ste. Hyacinthe was carried out by J. B. Maltais, of the Dominion Entomological Laboratory at St. Jean, and his assistant, L. Auclair. He reported that: "Mosquito breeding places are neither numerous nor large in the whole district which is almost entirely taken up with mixed farming. Mosquito larvae and adults are to be found in small pools in farm line ditches, and streams flowing into the Richelieu and Yamaska Rivers." Conditions were very dry and surface water scant throughout the season. However, small numbers of anopheline larvae were found in the water bodies mentioned by Mr. Maltais, and a few adults of Anopheles punctipennis Say and A. occidentalis D. & K. were collected on the inside walls of culverts in the two areas. A third species, A. walkeri Theo., was collected in the light trap at Grande Ligne. It is apparent, however, that anopheline mosquitoes were not numerous in this district in 1944.

The dominant species was the northern house mosquito, Culex pipiens L. In a sluggish stream probably less than a mile from the P.O.W. Camp at Grande Ligne large numbers of larvae and pupae of pipiens were observed on September 26. This species favours water containing sewage, the presence of which was also indicated by an infestation of the syrphus fly larvae known as rat-tailed maggots. Mr. Maltais believed that the water from the sewage sedimentation tanks at the camp was emptied into this stream and no doubt was the source of pollution. In this connection it is significant that of a total of 3,637 mosquito specimens taken in the light trap at Grande Ligne, 98 per cent were this species.

Huntingdon, P.Q.

No field survey was carried out in the vicinity of the Casualty Retraining Centre at Huntingdon, P.Q., and only 25 mosquitoes were collected in the light trap set up there. Of these, four were Anopheles (punctipennis Say and walkeri Theo.). Doubtless some breeding of anophelines occurs under suitable conditions in the Chateauguay River and its tributaries. The following description of local conditions was received from C. E. Petch, of the Dominion Entomological Laboratory, Hemmingford, P.Q.:

"The area on three sides of the Casualty Retraining Centre, Huntingdon, Que., is farm land. This land was exceedingly dry for several miles last year and even in normal times has few ditches, swale holes or other places which would be readily turned into breeding places. On the

fourth side and within a few hundred yards is the English* River. This river is over 100 feet wide but moves quite slowly except in the spring. There is a medium amount of vegetation along the shore which would make good breeding grounds for some species of mosquitoes."

Ontario

Four species of Anopheles were found in Ontario. Of these, quadrimaculatus was the most numerous in some areas, punctipennis in others; small numbers of occidentalis and walkeri were also taken. The common malaria mosquito (quadrimaculatus) was found in the vicinity of all the hospitals included in the survey except those at Toronto and St. Thomas.

Ottawa District

J. F. Sharp and A. R. Brooks, of the Division of Entomology, surveyed the Ottawa area within a two-mile radius of the R.C.A.F. Hospital at Rockcliffe, and of the Rideau Military Hospital near Hurdman's Bridge. Conditions generally in the district were dry and the Ottawa and Rideau Rivers at an unusually low level because of sub-normal precipitation during the summer.

Several hundred anopheline larvae were collected, and Mr. Sharp reports that "the majority ... were taken along the margins of the Rideau River. Others were found in stagnant or slow-moving streams. They were usually found resting on the top of masses of algae". From a portion of the larvae 86 adults were reared, representing three species. Of importance is the fact that 35 per cent of them were Anopheles quadrimaculatus Say, probably the most important malaria carrier in the United States east of the

* Presumably a synonym for the Chateauguay.

Rockies. All of these were reared from larvae collected along both sides of the Rideau River at points between Billing's Bridge and the Rideau Street Bridge at Eastview. The light trap at the Rideau Military Hospital picked up four specimens of this species, in addition to five of punctipennis Say and two of occidentalis D. & K. The latter species was represented by 3.5% of the specimens reared from larvae taken in McKay's Lake at Rockcliffe and along the north shore of the Ottawa River, near Gatineau Point. Anopheles punctipennis Say predominated among the reared anophelines (61.5 per cent). Of these, 75 per cent were from Green Creek (about two miles east of the military hospital) and three small nameless streams, one flowing into the Rideau River at Billing's Bridge, and the other two into the Ottawa River, north of Kettle Island; 20 per cent were from the margins of the Rideau and 5 per cent from the north shore of the Ottawa.

Another species, Anopheles walkeri Theo., not represented in the field survey or light trap collections, has been taken in moderate numbers in the vicinity of McKay Lake in past years.

Kingston and Trenton, Ont.

The areas surrounding the Military Hospital at Kingston and the R.C.A.F. Hospital at Trenton were surveyed by G. Wishart and H. G. James, of the Dominion Parasite Laboratory at Belleville. They reported, in part, as follows:

"During the greater part of the season weekly trips were made to the areas under observation. As a preliminary

step enlarged maps were made from those supplied for the survey. For reference these were covered with a square grid. The areas were carefully traversed and all probable mosquito breeding places were located and marked on the maps. On the weekly visits the waters in these areas were examined and samples of mosquito larvae taken wherever found. Search was made for adults under culverts, bridges, verandas and outbuildings. In addition, ordinary nail kegs with one end removed were placed in several locations where adult mosquitoes were likely to be present and searching for resting places. These kegs were also visited weekly. Samples of larvae were preserved in 70 per cent alcohol and adults were pinned and labelled. All specimens were sent to Dr. Twinn for identification."

Commenting on the collections of adults, the statement was made that: "It would not be wise to assume that the numbers of mosquitoes taken in hiding and in the kegs provided a reliable quantitative index of the anopheline population at any particular point. Many factors are involved. There is some evidence to show that all species of Anopheles are not attracted to the same type of hiding places to a similar degree. For example, quite a number of adults of Anopheles quadrimaculatus Say were taken under the veranda of the Military Hospital at Kingston, but no A. walkeri Theo., while in the light trap which was only a few yards away many more A. walkeri were taken than A. quadrimaculatus. As indicated by the light trap catch A. walkeri was present in numbers, but was not taken under the veranda where A. quadrimaculatus adults were found in considerable numbers. A similar situation occurred at Trenton where in the light trap A. walkeri, A. punctipennis and

A. occidentalis were taken but no A. quadrimaculatus, while in the hiding places examined, A. quadrimaculatus was the dominant species."

The following summarizes their findings for the two areas:

Kingston Area

An important anopheline breeding place is the large marsh area surrounding the Little Cataraqui Creek, west of Kingston and covering some hundreds of acres: "This area stretches from the lake shore at the mouth of the creek northward across the Bath Road, the York Road and the Canadian National tracks near the village of Cataraqui. It varies in width from a few hundred yards to a third of a mile. The stream passes through it in approximately the centre and would, in most places, be navigable for a row boat. The stream itself is sluggish but not to the point of being stagnant....

"The area between the open water of the stream and the firm ground at the edge of the marsh is filled with a more or less dense growth of cat-tails (Typha latifolia L.). Some short aquatic grasses are present at intervals throughout and at some points duckweed (Lemnaceae). The population of breeding anophelines in this swamp was not found to be dense, but larvae were found wherever the search was persistently made. It would appear probable that the whole area is a potential, if not an actual, breeding place for anophelines, with A. quadrimaculatus the dominant species. This area has added importance since it is the nearest breeding area of any extent to the Military Hospital and, if the population of A. quadrimaculatus

is such as to warrant control measures, would have to be considered first in any such programme." Collections of Anopheles adults from this area included 92 quadrinaculatus and one walker.

Two other areas, where A. quadrinaculatus adults and anopheline larvae were taken, are situated east of the Cataract River: One a small area on Navy Bay bounded on the west by the grounds of the Royal Military College, and the other a marsh a few acres in extent, at Barriefield. The species A. walker Theo., was also collected in the latter area.

Near the Erick Factory, east of the airport, is a cat-tail marsh not more than a few acres in extent where several adults of walker were taken. This marsh is in process of being filled by dumping municipal garbage and may be eliminated within a year's time. About a mile and a half to the north of this, and about three miles from the Military Hospital and from Barriefield Camp is a breeding place comprised of a small stream and neighbouring pools in the vicinity of which adults of A. punctipennis Say were collected (14 specimens).

No anopheline larvae were found in a large cat-tail marsh bordering the Cataract River near the Kingston Station (C.N.R.). "The southern extremity of this marsh is subject to considerable chemical contamination from industrial plants.... Further observations deep in the marsh would be desirable before it could be eliminated as a possible breeding place for anophelines".

Regarding the immediate vicinity of the Army Hospital, Messrs. Wishart and James stated that: "In the beginning of the survey the area near the Military Hospital was covered without finding any mosquitoes breeding. A short distance west, in the village

of Portsmouth there is a small stream with some marsh. This was carefully examined without any larvae being located. Later, when it appeared that many A. quadrimaculatus adults were present right at the hospital, the area was gone over again very thoroughly. Several old quarries are present containing water, but no signs of mosquito breeding were noted. It can be concluded, therefore, that the relatively large numbers of A. quadrimaculatus taken at the hospital (29 adults) must have come from area A (the marsh area bordering the Little Cataract Creek), the nearest point of which is one and one-half miles to the west."

In addition to the anophelines, larvae were taken in the Kingston area of Culex pipiens L., C. territans Wlk., C. apicalis Adams, and Uranotaenia sapphirina O.S. The light trap collection of culicine adults consisted chiefly of C. pipiens L., and a few specimens of Aedes vexans Wgn., Mansonia perturbans Wlk., and U. sapphirina O.S.

Trenton Area

Messrs. Wishart and James collected 27 anopheline adults (chiefly from under culverts) and 122 larvae in their samplings in this area. The infestation apparently was not heavy. Of the adults, 26 were quadrimaculatus and one occidentalis. Their report, in part, follows:

"The mosquito survey at Trenton, Ont., was conducted within a radius of two miles from the Military Hospital at No. 6 Repair Depot, R.C.A.F. On the map this area includes the shore of the Bay of Quinte from Bayside to the Trent River and extends

to the northwest as far as Glen Miller. Since work on this part of the project was begun in late August, it was thought advisable first to limit the survey to the airport and its immediate surroundings before exploring the outlying parts.

"The results, stated briefly, show that breeding places within the air-station were limited to the drainage ditches along its boundaries. One ditch contained seasonal pools, in another the water was polluted, while a third carried a continuous flow of water and contained anopheline larvae at several points along its course. South, along the water front, however, pollution appeared to be an important factor in reducing mosquito breeding.

"Outside of the air-station it was evident that anophelines were infesting the marsh land beyond it on both sides, as well as a number of small streams which are well within the two mile radius set for the investigation. Anopheles quadrimaculatus was the dominant species among the adults that were collected in the Trenton area. Anopheles occidentalis was also recorded, while Anopheles punctipennis was taken in the larval stage.

"The latter part of the summer was dry. Moreover, the drop in level of Lake Ontario was greater than normal. As a result there was a greater than normal reduction in the area of mosquito breeding places. In a season when normal water levels are maintained there would undoubtedly be a greater mosquito population. At some points where pollution occurred along the shore line and where no breeding was found, had it been possible to penetrate deep into the marsh, breeding mosquitoes might have been located."

Toronto, Ont.

W. A. Fowler, District Inspector, in charge of the Dominion Plant Inspection Office in Toronto, who was selected as collaborator in the Toronto area, appointed J. E. Armand, of his staff, to take care of the survey within a two-mile radius of the Chorley Park Military Hospital, and of the R.C.A.F. No. 3 Convalescent Hospital.

Mr. Armand has submitted a detailed report of his observations accompanied by a map and a series of photographs of anopheline breeding and resting places. The following are extracts from his report followed by a summary of the results of his activities and of the identity of the species. Mr. Armand stated (in part):

"With only limited opportunities to consider areas occupied by dwellings and industries, attention was confined to the probable breeding areas in the Don Valley system and adjacent open land which embrace these hospital sites. The Don River lies to the east of Central Toronto, emptying into Lake Ontario at Toronto Bay. It is confined to a channel between the Bay and Riverdale Park near Danforth Avenue. Going upstream the main trunk comes close to Chorley Park, swings eastward, then northward, skirting the town of Leaside, then northwestward passing by Divadale and through Sunnybrook Park, crossing Yonge Street above North Toronto. The survey ends east of Yonge. The Little Don, an arm east of Don Mills Road, lies northeast then north, and was omitted, being too distant.

"In the Don Valley system there are deposits of clay suitable for brick making. In former years several plants did operate, and one remains at present. This clay is largely responsible for the title 'The Muddy Old Don', emphasizing the murkiness of the water. Most of this water originates from springs well north of the disposal plants of Toronto and Todmorden. Now the river is only a vestige of its former self, mainly, it seems, because of erosion heightened by the disrepair of dams. The stream is now usually shallow and the water level is seldom high enough to cover the stream bed between its banks except in times of flood. One direct result with respect to mosquitoes is that little pools in the river bed lie beside the course of the stream, and tiny bays and bulges in the course contain still water suitable to harbour larvae. Coupled with this, boulder-strewn areas in the river bed give rise to grassy spots. In most of these quiet spots, pond scum forms in masses and mosquito larvae thus find much shelter. They may also dwell in clear water between the rocks. Fallen trees and debris trapped during spring floods cause pockets of water which shelter the larvae. Through the years, the river's course having altered, depressions remain in the former course where water now lies and mosquitoes breed. There are many springs along the valley sides so that seepage as well as rainfall keep these and other depressions supplied with water. During the time of the survey, little artificial drainage was maintained and hence there are a number of swamps and ponds where larvae including Anopheles were found. The walls of the valley and its borders of woods provide almost continuous wind shelter, a highway for their flight between points. Apart from

culverts and other artificial resting places, these wooded strips perhaps furnish adequate places of rest for Anopheles spp. and avenues of approach to dwellings.

"In unshaded situations Anopheles larvae usually seemed to seek concealment among pond scum and grasses or between boulders, while less effort at concealment seemed apparent in pools well shaded from above. In any situation they seem elusive once the water is disturbed and must be captured by persistently scooping with a dish into the material in which they are hiding. While most pools containing Anopheles held reasonably fresh water supplied from springs, seepage or other sources, a few pools seemed almost, if not actually, stagnant. Apart from pools they were present in water along the edges of the stream where the flow was slowed by shallowness, or by the presence of grass, weeds, pond scum, rocks, etc."

During the course of the survey (August and early September), Mr. Armand submitted 92 collections for determination, including seven of anopheline adults (18 specimens), and twenty-six of anopheline larvae (over 200 specimens). Most of the remaining 59 collections consisted of culicine larvae and adults.

Of the Anopheles adults, fifteen (83 per cent) were punctipennis Say; two (11 per cent) occidentalis D. & K., and one (6 per cent) walkeri Theo. Three of the six collections of punctipennis were taken under culverts; another was from a bathing pavilion, and the remaining two from a 45 gal. drum and from a pool, respectively. The occidentalis adults were also taken in the bathing pavilion. The walkeri specimen was captured

at Leaside at a lighted window in late evening. It is noteworthy that no specimens of quadrifasciatus Say were taken in the survey or by the light trap. Actually, the trap captured, in addition to culicine mosquitoes, only two specimens of punctipennis.

The twenty-six collections of anopheline larvae were taken in stagnant or sluggish water in or near the Don River and its tributary streams, frequently in association with species of the genus Culex. A proportion of the larvae were examined and proved to be all punctipennis.

It is apparent that anophelines, although rather generally distributed in the area, were nowhere present in large numbers.

Ten species of culicines were represented in the collections. Among these, Culex pipiens L., C. territans Wlk., C. apicalis Adams and Aedes vexans Mgn., predominated. Three collections contained larvae of Uranotaenia sapphirina O.S. associated with apicalis and anopheline larvae. The remaining species included small numbers of adults of Aedes stimulans Wlk., A. canadensis Theo., and A. triseriatus Say, and one adult each of A. trivittatus Coq., and Culiseta morsitans Theo.

Brampton, Ont.

Prof. R. W. Thompson, Provincial Entomologist for Ontario, was invited to take care of the survey in the vicinity of the Army Casualty Retraining Centre at Brampton, and of the No. 2 R.C.A.F. Convalescent Hospital at Ancaster. The following summarizes his findings.

Adult mosquitoes submitted by Dr. Thompson from Brampton consisted of numerous Culex pipiens L., and one specimen each of Anopheles punctipennis Say and A. quadrimaculatus Say. Prof. Thompson reported that at the Casualty Retraining Centre "there is relatively little in the line of bodies of open water in close proximity to the hospital grounds. The bush shown on the west of the hospital was carefully swept by Mr. Goble and myself with no particularly exciting recoveries. Later, however, we recovered a sizable number of mosquitoes from what is now a no longer active latrine on the camp site previously used as an infantry training centre." Regarding these he states: "The containers marked from Brampton, August 24th, contained two to three hundred mosquito adults when shipped to Major Ozburn, but none of these were anophelines since I helped to collect them from the disused latrine where they were resting.

"The 46 C. pipiens adults and 1 adult each of A. punctipennis and A. quadrimaculatus were collected by H. E. Scott on September 12th from the R.C.A.S.C. storage barn about 300 yards N.E. of the Casualty Retraining Centre Hospital at Brampton. I am informed by Mr. Goble, who was present, that these were taken from a disused, glassed-in telephone booth inside this barn. The barn is almost adjoining the Detention Barracks at Brampton. It is also not more than 100 yards from the latrine from which the August 24th collection of mosquitoes was made. Other specimens in this shipment were recovered on September 12th and 13th from a small creek which runs almost parallel with the eastern boundary of the C.R.C. All of these specimens were taken within one mile of the C.R.C."

Ancaster, Ont.

Regarding No. 2 R.C.A.F. Convalescent Hospital, Prof. Thompson in correspondence reported that:

"The Ancaster hospital on the Dalley Estate seems to be a quite desirable location at the present time (August 28), since continuous sweeping along the borders of a small stream which constitutes the outlet of an artificial lake in the estate grounds failed to show a single specimen of mosquito of any genus. The artificial lake has probably a sufficient population of small carp and some goldfish, which may explain our inability to find any wrigglers around the borders of this small lake.

"A careful search was made of all buildings of any kind in the immediate neighbourhood of the hospital, which is situated probably a quarter of a mile from the village of Ancaster. If you know the topography of this region at all you will realize that the likelihood of natural collections of water is relatively small. This is in no way suggested as a complete inspection of the territory, and further attempts at collecting will be made.

"On September 5 the same location was visited again by H. W. Goble, and nine mosquito specimens were recovered by him from a conained wood storage and privy 50 yards north-east of the artificial lake referred to in paragraph 1. Of these a cursory examination indicated four anophelines with the remainder probably C. pipiens. No recoveries were made from a stone-constructed tea house which immediately adjoins the artificial lake. These specimens represent the total scouting captures from the Ancaster location."

The anophelines consisted of three specimens of Anopheles quadrimaculatus Say and one of A. punctipennis Say.
St. Thomas, Ont.

No report was received regarding the survey in the region of the R.C.A.F. Hospital at St. Thomas, Ont. However, a number of mosquito specimens were submitted by the collaborator, Dr. G. M. Stirrett. These included six specimens of Anopheles punctipennis Say, of which three emerged on August 25 from reared larvae collected a short time before by D. A. Arnett, of the Dominion Entomological Laboratory, Chatham, Ont.; the remainder were collected by A. A. Wood, of the same laboratory, on September 18. The location of the collections was indicated on the topographical survey map as a small stream about a quarter of a mile from the hospital, which flows into Kettle Creek. Twenty-nine specimens of the culicine, Mansonia perturbans Wlk., were also taken by Mr. Wood in the area. The light trap at this hospital picked up two anophelines which were damaged but appeared to be A. walkeri Theo. The majority of the eighty mosquitoes collected by the trap were Culex pipiens L.

Manitoba

Only one anopheline species, namely, occidentalis, was taken in the two areas examined. This is the most prevalent anopheline found in Manitoba. Its numbers were comparatively few to moderate.

Portage la Prairie, Man.

Dr. R. D. Bird, of the Dominion Entomological Laboratory, Brandon, made the survey in the environs of the Army Casualty Re-training Centre at Portage la Prairie, Manitoba. He inspected the area thoroughly on July 25 and 26 and September 14 and 15, but other duties prevented him from making additional inspections between these dates. The following description of the area is from his report:

"The Re-training Centre is situated on the east side of the town of Portage la Prairie on the shore of Crescent Lake, an old oxbow of the Assiniboine River. The surrounding country, being the bed of glacial Lake Agassiz, is very flat. The Assiniboine River which flows in an easterly direction a mile south of the Centre has no valley and is held in place by dykes. The bed of the river is aggregating and in many places is higher than the surrounding country. At times of spring floods the river sometimes overflows the dykes and floods large areas. There are a number of permanent bodies of water and many temporary ones. In addition to Crescent Lake two other old oxbows are found a short distance east of the Centre. The land adjacent to the river and oxbows is heavily wooded. Farther back it is rich farm land."

Dr. Bird found anopheline and culicine larvae developing in several water bodies in the locality. Specimens of the former proved to be Anopheles occidentalis D. & K. They were most numerous in two places, namely, a pond on the west side of the Retraining Centre grounds, and the west arm of Crescent Lake. The pond, which was gradually being filled with refuse, contained pondweeds,

cat-tails, sedges, duckweed, and algae. The west arm of the lake "was very shallow and broken up into ponds on the bed of the old oxbow which was heavily pastured". Larvae were abundant there and also in the stagnant water of a ditch along which water is pumped into the lake. A few anopheline larvae were found among sedges along the north shore of the lake; in a tree-shaded pond in the deer paddock in Island Park, and in a slough about half a mile south of Crescent Lake on the west side of the road to the river. On re-inspecting the area in mid-September, Dr. Bird could find no anopheline larvae and concluded that it was apparently too late in the season.

The presence of adults of Anopheles occidentalis D. & K. in the Portage la Prairie area during late summer is shown by the light trap collection of seven specimens (2.5 per cent of the total catch of 275 mosquitoes) and the finding by J. McLintock of 27 specimens on the ceilings of turkey shelters and in an old root house not far from the Retraining Centre.

The common culicine forms found in the area during the survey were Culiseta inornata Will., C. morsitans Theo., Culex tarsalis Coq., and Aedes vexans Mgn.; the light trap also picked up Aedes spencerii Theo., A. campestris D. & K., and Culex apicalis Adams.

Winnipeg, Man.

J. McLintock, Entomologist, on the staff of the Manitoba Department of Health and Public Welfare, collaborated in the survey in connection with the R.C.A.F. (Deer Lodge) Hospital at Winnipeg. Under date of December 11, he reported:

"Our data on larval collections is very meagre. Mr. Norris-Elye (Field Manager for the Winnipeg Anti-Mosquito Campaign), who undertook to make these collections, could only find time for four or five visits to the Deer Lodge district during the summer. On these visits anopheline larvae were found in only two locations viz. Sturgeon Creek about $1\frac{1}{4}$ miles west of the hospital, and in a roadside ditch about $1\frac{1}{2}$ miles south of the hospital on the other side of the Assiniboine River. The species from both habitats was maculipennis (= occidentalis). Both the ditch and creek run through park land My own observations, made during the past seven years indicate that this species favours artificial lily ponds. Since Deer Lodge hospital is situated in a residential district there are most likely lily ponds within the area, but it would require almost a house to house canvass to find them. The same would apply to resting and hibernating adults. In the past I have, on several occasions, taken resting maculipennis off the sides of a concrete culvert through which Sturgeon Creek crosses Portage Avenue.

"The roadside ditch collection contained only one anopheline, and they were apparently never very abundant at any time during the summer in the (Sturgeon) creek. The largest collection taken from the latter habitat on August 28 yielded about 12 specimens from about 30-40 dips; these were all 1st and 2nd stage larvae and didn't all rear through. As a rule all stages can be found together in this creek from the middle of June till the end of August, but a few days prior to August 28 a very heavy rainfall flushed out the creek which still hadn't regained its normal

summer level on the 28th. In this collection, too, there were a few 2nd stage Culex tarsalis larvae taken from cattle hoof-prints at the edge of the creek."

In addition, Mr. McLintock reported that, of 903 mosquito specimens taken in a light trap operated from July 8 to September 30, 1944, at the Winnipeg Children's Hospital (about six miles from the Deer Lodge Hospital), 10 specimens, or 1.1 per cent, were Anopheles occidentalis D. & K. A dozen culicine species were also taken, among which Aedes vexans Mgn. predominated. The light trap at the Deer Lodge Hospital collected 4,090 specimens, of which 5, or 0.12 per cent, were occidentalis and the remainder were mostly Aedes spencerii and A. vexans Mgn., plus small numbers of A. campestris D. & K., Culex territans Wlk., C. tarsalis Coq., and Culiseta inornata Will.

Alberta

No anophelines were found in the inspections made at Medicine Hat and Edmonton. The only species recorded in Alberta is occidentalis and that only from two localities.

Medicine Hat, Alta.

Dr. J. G. Rempel, Assistant Professor of Biology, Regina College, University of Saskatchewan, was asked to survey the Prisoner of War Camp area at Medicine Hat. He visited there on July 12 and presented the following report:

"The camp is located about half a mile east-south-east of the city, on high level ground overlooking the city to the northwest and a coulee to the north through which flows Ross Creek. The camp operates a large farm north-east of

the city, enclosed on the south, the west and the north by the Saskatchewan River and on the east by steep cliffs some 300 ft. in height.... The high ground at the prisoners' camp and around the city in general consists of dark clay that supports a sparse flora.... This country is generally dry and it is extremely doubtful whether mosquitoes, especially Anopheles, breed here at any time. The coulee through which flows Ross Creek is quite heavily wooded with low bush. The creek itself is now in the main dry, only small isolated pockets of water remaining. The bed of the creek is clayey and very stony.

"Intensive search by daytime and in the evening did not disclose a single mosquito on the high ground surrounding the city and in the city itself. Two hours collecting -9.00 p.m. to 11.00 p.m. - July 12, by light and by sweeping over vegetation near Ross Creek directly north of the prison camp resulted in the collection of 56 specimens of mosquitoes, distributed as follows:

21 Aedes spencerii Theo.
13 A. dorsalis Mgn.
9 A. campestris D. & K.
8 A. vexans Mgn.
3 Culex tarsalis Coq.
2 Culiceta inornata Will.

Anopheles was not encountered. Although every possible water hole was examined, no mosquito larvae were found either in Ross or in Sevenpersons Creek. According to residents of the city, the mosquitoes have been notably absent this year. This no doubt is due to the extreme dryness of the weather."

The light trap, too, failed to collect any anophelines, but captured specimens of all but two (dorsalis and tarsalis) of the above culicine species.

Edmonton, Alta.

The environs of the R.C.A.F. (at Airport) Hospital were inspected by Dr. E. H. Strickland, Professor of Entomology, University of Alberta. He found two rather large sloughs, both of which were completely covered with duckweed and contained only culicine larvae. A small pond in an excavation about 200 yards from the light trap was heavily infested with the larvae of a species of Mochlonyx (Corethra), which are related to biting mosquitoes, but are themselves harmless, and predacious in the larval stage on other small aquatic life. Prof. Strickland concluded his brief report with the following statement:

"I have been all around the Camp area, and do not think that there are any other collections of water within two miles of the hospital. The duckweedy sloughs are very shallow, and it is impossible to do much work in them, they are 'mucky' to the surface. No adults could be found in sheds, back-houses, etc., near any collections of water".

Professor Strickland's observations were confirmed by the absence of anophelines and the paucity of culicines in the season's catch by the light trap. The latter collected three common species, namely, Aedes spencerii Theo., A. vexans Wgn., and Culiseta inornata Will.

British Columbia

No satisfactory anopheline field surveys were carried out in British Columbia during 1944, and comparatively small numbers of mosquitoes were captured in the light traps.

Apparently, Anopheles are not uncommon in the vicinity of the Harrison's Hot Springs Hotel, where, according to a report by R. Glendenning, of the Dominion Entomological Laboratory at Agassiz, there is an area of about two square miles of swamp and slough. However, too few specimens were taken to form a definite opinion in the absence of field collection data. Of 47 specimens taken in the light trap, 28, or 60 per cent, were occidentalis D. & K., and 4, or approximately 8 per cent, were punctipennis Say.

At the R.C.A.F. No. 5 Convalescent Hospital, Vancouver, only one out of 690 specimens from the light trap was an anopheline, namely, Anopheles punctipennis. The bulk of the remainder were Culex pipiens L. and C. apicalis Adams, with a few Aedes vexans Mgn., and Culiseta alaskaensis Ludl. J. D. Gregson, of the Dominion Entomological Laboratory, Kamloops, visited the hospital on July 19 and October 11. He reported that: "The only possible breeding areas here (about the grounds) were two fish pools. These appeared to be free of larval activity. Below the home is a large golf course, and beyond this the brackish margins of the Fraser River. Time did not permit an examination of this more distant territory, though it is unlikely that there would be any extensive breeding of mosquitoes in this farming area".

Regarding the mosquito situation at the R.C.A.F. Hospital at Patricia Bay, the R.C.N. Hospital at Esquimalt, and the Army Hospital at Victoria, Mr. W. Downes, of the Dominion Entomological Laboratory, Victoria, reported:

"The weather in the summer here is so dry that it is practically impossible to find any mosquito breeding places. The district in which the military hospitals are situated is on a peninsula,

which consists almost entirely of agricultural land with very few patches of bush. In this district, from May to September, practically no rain falls. Actually the average over a fifteen-year period is less than three inches (2.83") and during the past two or three summers the rainfall has been very much lighter than that. There are no creeks or stagnant pools and the few lakes that there are contain fish and are not mosquito breeding places. I spent two or three days looking around to see if there were any breeding pools where mosquito larvae could be found but everything was dried up to dust and there was no possibility of obtaining mosquito larvae. There are, of course, rock pools in gardens but most of these contain gold fish."

Only 410 mosquito specimens were taken by the light traps at the three hospitals on Vancouver Island, thus confirming Mr. Downes' report of mosquito scarcity. One, from the Esquimalt trap, was Anopheles walkeri Theo., which was surprising as this species hitherto has been recorded only from Manitoba eastward. All the other specimens were culicines, with Culex pipiens L. and C. territans Wlk., predominating, and the remainder consisting of a few Aedes vexans Mgn., and one or two Culiseta alaskaensis Lrdl.

APPENDIX

A List of Institutions and the Names and Addresses
of Collaborators in the Anopheline Survey

<u>Location of Hospital Casualty Re-training Centre, or P.O.W. Camp</u>	<u>Name of Co-operator</u>	<u>Address</u>
Halifax, N.S. - RCN and Army Hospital	R.G. Webber	Plant Inspection Office, Room 417, Dom. Public Bldg., Halifax, N.S.
Dartmouth, N.S. - RCAF (on Station) Hospital		
Deep Brook, N.S. RCN Hospital	A.D. Pickett	Dom. Entomological Laboratory, Annapolis Royal, N.S.
Debert, N.S. - Army (in Camp) Hospital	M.E. Neary	Asst. Entomologist, Provincial Dept. of Agriculture, Experimental Station, Kentville, N.S.
Sussex, N.B. - Casualty Re-training Centre	R.P. Gorham	Dom. Entomological Laboratory, Fredericton, N.B.
Moncton, N.B. - RCAF (#31 Personnel Depot) Hospital		
Fredericton, N.B. - Army Hospital		
Quebec, P.Q. - Army Hospital	Dr. Georges Gauthier	Provincial Ento- mologist, Dept. of Agriculture, Quebec, P.Q.
Huntingdon, P.Q. - Casualty Re-training Centre	C.E. Petch	Dom. Entomological Laboratory, Hemmingford, P.Q.
Grande Ligne, P.Q. - P.O.W. Camp St. Hyacinthe, P.Q. RCN Hospital	J.B. Maltais	Dom. Entomological Laboratory, St. Jean, P.Q.
Montreal, P.Q. - RCAF (#4 Convalescent Hospital)	H.A.U. Monro	Plant Inspection Office, 785 Mill St., Montreal, P.Q.
Two divisions: the Saraguay Division and the Timmins Division		

<u>Location of Hospital Casualty Re-training Centre, or P.O.W. Camp</u>	<u>Name of Co-operator</u>	<u>Address</u>
Ottawa, Ont. - Rideau Military Hospital Rockcliffe RCAF Hospital	Dr. C.R. Twinn	Division of Entomology, Room 675, Confederation Bldg., Ottawa, Ont.
Kingston, Ont. - Army Hospital	G. Wishart	Dominion Parasite Laboratory, 228 Dundas St., Belleville, Ont.
Trenton, Ont. - RCAF (on Station) Hospital		
Toronto, Ont. - Chorley Park and RCAF Hospital (#3 Convalescent)	W.A. Fowler	Plant Inspection Office, 21 Lombard St., Toronto, Ont.
Brampton, Ont. - Casualty Re-training Centre	Prof. R.W. Thompson	Provincial Entomologist, Ontario Agri- cultural College, Guelph, Ont.
Hamilton, Ont. - RCAF (#2 Convalescent Hospital)		
St. Thomas, Ont. - RCAF (on Station) Hospital	Dr. G.M. Stirrett	Dom. Entomol- ogical Labora- tory, 416 Queen St., Chatham, Ont.
Winnipeg, Man. - RCAF (Door Lodge) Hospital	J. McLintock	Children's Hos- pital, Winnipeg, Man.
Portage la Prairie, Man. - Casualty Re-training Centre	Dr. R.D. Bird	Dom. Entomol- ogical Labora- tory, Brandon, Man.
Medicine Hat, Alta. - P.O.W. Camp	Dr. J.G. Rempel	Asst. Prof. of Biology, Regina College, Regina, Sask.
Edmonton, Alta. - RCAF (at Airport) Hospital	Prof. E.H. Strickland	University of Alberta, Edmonton, Alta.
Harrison Hot Springs, B.C. - Casualty Re-training Centre	R. Glendenning	Dom. Entomol- ogical Labora- tory, Agassiz, B.C.

Location of Hospital
Casualty Re-training Centre,
or P.O.W. Camp

Name of
Co-operator

Address

Vancouver, B.C. -
RCAF (#5 Convalescent Hos-
pital)

J.D. Gregson

Dom. Entomological
Laboratory,
Kamloops, B.C.

Patricia Bay, B.C. -
RCAF (on Station) Hospital
Esquimalt, B.C. -
RCN Hospital
Victoria, B.C. -
Army Hospital

W. Downes

Dom. Entomological
Laboratory,
Victoria, B.C.
