

MALARIA IN THE VASILIKA VALLEY IN 1925, WITH ESPECIAL  
REFERENCE TO THE REACTION OF ANOPHELES BREEDING WATER;  
AND A PLEA FOR ANTI-MALARIA EDUCATIONAL WORK IN  
MACEDONIA TO-DAY.

by

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Thesis for the Degree of M.D.

1927



C O N T E N T S.

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SECTION I.

	<u>Page.</u>
I. THE VASILIKA VALLEY AND ITS POPULATION.	1
II. THE REFUGEE PROBLEM AND THE HEALTH OF THE REFUGEES. . . . .	6

SECTION II.

I. INSTITUTIONS AND VILLAGES IN THE VALLEY	10
The American Agricultural School	10
The Greek Agricultural School	15
Arsakli . . . . .	16
Sedes . . . . .	17
Kran_kajatsali . . . . .	21
Matzarides . . . . .	23
Lutra . . . . .	24
Vasilika . . . . .	26
Sirroti . . . . .	27
Aya Paraskivi . . . . .	28
Tagadtjides . . . . .	29
Neon Ryssion . . . . .	29
Peraia . . . . .	31
Epivatis . . . . .	32
Aya Triada . . . . .	32
Michaniona . . . . .	33
II. THE SPLEEN RATES . . . . .	35
III. THE ANOPHELINE OF THE VALLEY, AND TYPES OF BREEDING PLACE. . . . .	38
IV. THE REACTION OF ANOPHELES BREEDING WATER.	41

SECTION III.

I. ANTI_MALARIA MEASURES. . . . .	49
II. A PLEA FOR ANTI_MALARIA EDUCATIONAL WORK IN RURAL MACEDONIA. . . . .	57

APPENDIX.

## C O N T E N T S (Contd.)

ILLUSTRATIONS MAPS AND TABLES.

	<u>Page.</u>
MAP I. PART OF MACEDONIA. . . . .	1
THE VASILIKA VALLEY FROM PERAIA . . . . .	3a
TABLE I. STATISTICS OF SEDES GROUP OF VILLAGES	8a
RAINFALL AT AMERICAN AG: SCHOOL . . . . .	11a
TABLE II. MOSQUITOES CAUGHT AT AMERICAN AG. SCHOOL	12a
TEMPERATURE AT AMERICAN AG. SCHOOL . . . . .	13a
TABLE III INCIDENCE OF MALARIA AT SCHOOL	14a
VIEW OF SEDES AND THE VASILIKA VALLEY . . . . .	19a
SEDES STREAM, FIXING "NAIL DRIP" . . . . .	19a
THE KRAN SCHOOL . . . . .	22a
THE KRAN STREAM . . . . .	22a
FOUNTAIN AT MATZARIDES . . . . .	23a
FOUNTAIN NEAR PERAIA . . . . .	31a
THE PERAIA STREAM . . . . .	31a
NEW TAPPED WATER SUPPLY FOR PERAIA . . . . .	32a
MAP II. THE VASILIKA VALLEY . . . . .	35a
TABLE IV. SPLEEN RATES IN VASILIKA VALLEY	35a
THE QUININE PARADE AT PERAIA . . . . .	37a
TABLE V. pH. OF ANOPHELES BREEDING WATER IN DISTRICT.	47a
POSTER A. THE CHAIN OF MALARIA . . . . .	52a
POSTER B. . . . .	53a
POSTER C. . . . .	54a
PAMPHLET USED FOR ANTIMALARIA EDUCATION.	62a

BELASHITSA PLANINA

PART OF  
MACEDONIA.

Scale 1/500,000.

Miles 5 0 5 10 Miles.



## SECTION I.

### I. THE VASILIKA VALLEY.

The Vasilika valley lies in the north west of Chalcidique; it is a wedge shaped plain bounded on the north by the Hortach Dagh Mountains and on the south by low nameless hills which further east join the Koloman range. The Vasilika River rises in central Chalcidique and flows due westward to the Bay of Salonika, and its course is divided naturally into two parts. The first part has been called the Galatsista basin; from it the river descends into the plain, or Vasilika basin. This essay is only concerned with conditions in the latter region, for little colonisation has been done in the higher land of the Galatsista basin.

The river flows slowly through the plain; in some places it has cut its way a few feet into the soft soil, and at intervals it is joined by field drainage ditches, mill streams, and tributaries. The tributaries are, almost without exception, dry during the summer months. The river has not the force to clear its mouth, so during the rain time the mouth becomes deltaic and swamps develop along the bay margins, and a great part of the land west of the road across the valley becomes temporarily inundated.

The/

The blocking of the river mouth is aggravated by the prevailing wind which blows the waves in the Bay of Salonika south eastward, and a ridge of sand is banked up along the shore.

It has been shown that there is a geological fault in the Valley along the line where the Hortach Dagh Mountains meet the plain, and another along the line where the hills bound it on the south.<sup>16</sup> These faults are marked by the appearance of springs arising from great depth: in several places in the Valley these are mineral springs and some of them are warm. They will be referred to later in connection with mosquito-breeding water in the district.

One good road runs up the Valley, and another, the road to Aponomi, crosses it a short distance from the sea. The other routes are tracks, and most of them are impassible for wheeled traffic at some time during the rain periods. The only reliable bridges in the Valley are on the two good roads.

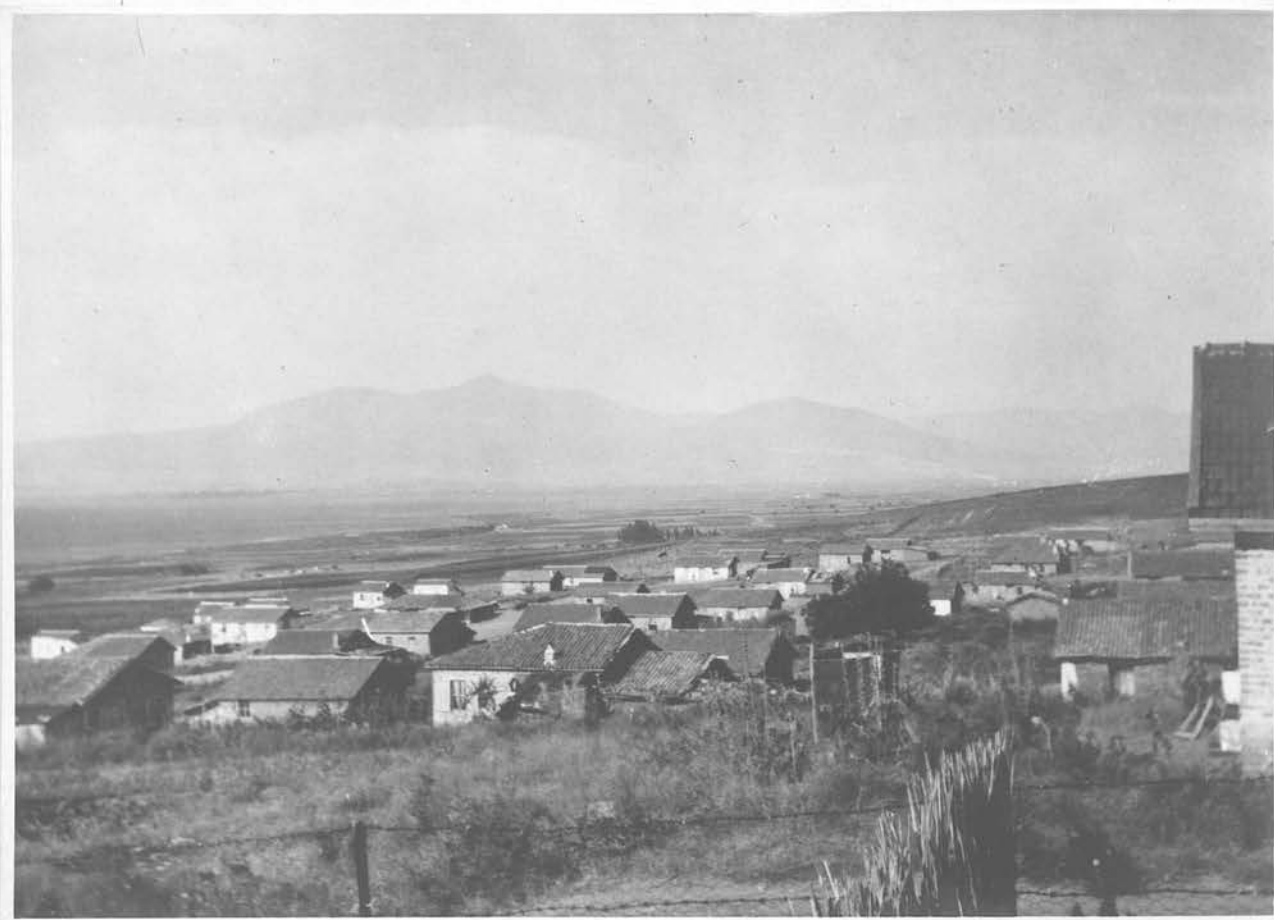
With the exception of Vasilika, which is an old village populated by indigenous Greeks (Macedonians), the villages in the Valley are new refugee settlements. Some of them do contain old Turkish quarters and a few Macedonian families but certainly by far the majority of the houses are new and the inhabitants are refugees. Many/

Many houses are still being built, others are being rebuilt, and none of the new ones are finished. The writer had the opportunity of watching one village, Aya Triada, develop from the time when the first sack of cement was dumped on the bare soil.

The villages are almost all placed on the hillside just immediately above the plain, so the streets and gardens are steep. The inhabitants cultivate the hillsides around and the fields in the plain which have been allotted to them; these latter are often quite a distance from the village which owns them. As the result of an enormous increase in the population of the Valley all the available land is gradually coming under cultivation. Each year sees ploughing a little higher up the hillsides and further down into the plain, and one can foresee the day when the now bare hillsides will be terraced for orchards and vineyards. In 1926 it was reported that the arable land in Greece had been trebled within the last four years.

The plain is very fertile, the common crops are wheat, oats, maize, rye, cotton, tobacco, melons, and vegetables, and orchards and vineyards are being planted. There is a conspicuous absence of trees everywhere except in the neighbourhood of the Agricultural Schools and Vasilika. In both these localities there are mulberry orchards and other fine trees.

Fuel/



THE VASILIKA VALLEY.

View from Peraia looking north-east to Mt. Hortiach.  
The shore of the Gulf of Salonika is seen on the left.



Fuel consists mainly of scrub and the grasses of the fields, and charcoal is brought in donkey loads from the wooded parts of Chalcidique. Most of the village transport is done with mules, donkeys, and ponies, but each day seems to see an increasing number of motors on the good roads and they can reach all the villages when the tracks are dry.

The Valley contains a great variety of water supplies. Some villages draw water from wells, others have continually-running fountains, a few have installed piped supplies, while others depend on Springs in ravines, and here and there are artesian supplies.

This essay is concerned with malaria in the Vasilika Valley, and it can now be understood that it is a fortunate locality in which to study the subject. It is isolated geographically, and presents in miniature the problem of malaria in Macedonia, containing as it does, a slow flowing river, hill streams, small swamps, and a great variety of water supplies. In addition to these facts the geological formation is unusual, as is that of a large part of Macedonia, and the reaction of the natural waters has a wide range, making it of great interest to the student of mosquito bionomics. Economically the district is of great importance. It is part of the market garden of Salonika; it contains three important institutions, namely, /

namely, the Greek Agricultural School, the Aerodrome, and Lutra, a health resort; and it is rapidly becoming a popular holiday resort for all classes in Salonika.

The observations to be recorded are based on information collected during almost two years' residence in the district. Even in so short a time, because of the rapidity of the settlement, and the astonishing enterprise of the refugees along many lines, it was possible to foresee what measures should be taken if malaria is not to become worse, at least in some of the villages.

and in 1925, Greece, whose population numbered five million souls, was suddenly faced with a million and a half refugees, an increase of her total population by three per cent. The first of these had fled from Asia Minor before the advance of the Turkish army; and the rest came from Asia Minor and Eastern Thrace ----- for the Exchange of Populations Scheme of the Convention of Lausanne.

A small percentage of them had means to establish themselves in new homes; exchanged families usually managed to bring some of their goods with them; but those who fled from Smyrna left almost everything behind. So it came about that enormous numbers of people arrived in the Greek and Macedonian ports in varying degrees of misery, often without sufficient clothing or means of obtaining food. They were housed in every available empty building, theatres, churches, empty

II. THE REFUGEE PROBLEM AND THE HEALTH OF THE REFUGEES.

Although it was by no means an uncommon fate for numbers of peasants to be refugees in Macedonia both before and since the Balkan Wars, if they happened to be in the territory which was being fought over or fought for, the refugee problem had never before approached the magnitude which it reached in 1922 after the sack of Smyrna, and the subsequent events. In that year, and in 1923, Greece, whose population numbered five million souls, was suddenly faced with a million and a half refugees, an increase of her total population by three tenths. The first of them had fled from Asia Minor before the advance of the Turkish army; and the rest came from Asia Minor and Eastern Thrace some time later under the Exchange of Populations Scheme of the Convention of Lausanne.

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empty villas, railway station buildings, and the corridors of government offices. From these they were distributed, usually to refugee camps in the vicinity of the ports, to wait until arrangements were sufficiently advanced for them to be sent up country to the new settlements. It must be remembered that, at the same time, refugees of other nations, especially Russians and Armenians were pouring into the country.

Sickness was terribly prevalent, and malaria was epidemic. For practical purposes it may be assumed that at one stage or another, before they reached their final destinations, all the refugees were infected with malaria; and having got it they died in great numbers; and those who survived carried it with them to the remotest corners of Macedonia which the colonisation reached.

The severity of the malaria is best brought home by the following short quotations from the 'Greek Refugee Settlement'. "During the last months of 1923 the mortality among the refugee population was 45%; 70% of the deaths were due to malaria". "In the Chalcidice, Yeniji, Kilkis, Ekaterini and Serres one fifth of the population died in 1924".

These people, arriving in Greece from other regions of the Near and Middle East, apparently constituted a population non-immune to malaria just as the/

the Allied armies had done not ten years before; and in addition they had against them the factors of want and misery.

When the writer arrived in Macedonia in the late Autumn of 1924 the epidemic malaria was really over, but it was commonly stated in the villages that the men had lost days of work every week that summer from its ravages.

During 1925 and 1926 it was possible to keep a few elementary medical statistics of some of the villages in the Vasilika Valley. Those of the villages on the north side of the river, the "Sedes group", were most reliable, and are given in Table I. They are interesting and surprising and are the outcome of unique conditions and circumstances. Although they cannot be considered very reliable, two things are so noticeable that they cannot be overlooked. The first is the low death rate, and the second is the absence of serious disease apart from malaria. These can only be explained thus, firstly, that the migration had eliminated all the weakly and sick; and secondly, that the villages were almost entirely new and therefore extraordinarily clean. The unusual healthiness, apart from malaria, was possibly also influenced by the outdoor existence and fresh air which were enforced, to a degree unusual even in Greece, by the unfinished state/

TABLE I.

	Deaths.	Births	Cases of Malaria and Relapses.	Black water fever.	Tuberculosis	Typhoid	Dysentery	Carcinoma
March 1925	1	6	121	-	-	-	1	-
April.	2	13	198	3	-	-	1	-
May.	1	6	271	-	-	-	1	-
June.	1	8	349	-	1	-	5	-
July.	4	4	293	-	-	-	5	-
August.	2	15	366	-	-	-	-	-
September.	3	15	339	-	-	-	5	-
October.	4	15	215	1	-	-	4	-
November.	6	15	226	-	-	1	2	-
December.	3	13	90	1	-	-	2	-
January 1926	3	16	117	1	-	1	-	-
February.	3	8	82	1	1	-	-	-
Total	33	134	2267	7	2	2	26	-
Incidence per 1000.	10.2	41.68	29.8	2.1	0.6	0.6	8.0	-

Exanthematic fevers occasional  
odd cases only.

Elementary medical statistics of "Sedes group"  
of villages.

Total population of group in January 1926, 3214 souls.

state of the houses.

Many of the facts in this section are taken from the "Greek Refugee Settlement"<sup>27</sup>.

In order to illustrate the control of malaria during the past few years in the settlements and institutions of the Vasilika Valley they will be described individually. In each case where special observations were made, or anti-malaria measures were adopted they will be described. These were limited because the staff and funds for the work were small. Anti-malaria measures were only undertaken when it was more or less certain that they would be effective and very occasionally they were adopted without the certainty that they would be of use when it was obvious that they would lead to multiplicity of educational value.

The American Agricultural Colony. (See Map III)  
p. 25

This colony is situated on the Sedes Kapudilar road, 800 feet above sea level, on the undulating land which lies between the Bay of Salonica and the foothills of the Harkach range. The total population is about 20 souls, eighty of whom are pupils drawn from all over Greece, many of them belonging to refugee families.

The whole water supply of the colony comes from two wells and is pumped into a cement tank from which it is distributed to the various houses. There are also

## SECTION II.

I. INSTITUTIONS AND VILLAGES IN THE VALLEY.

In order to illustrate the problem of malaria during the past few years in the settlements and institutions of the Vasilika Valley they will be described individually. In each case where special observations were made, or anti-malaria measures were adopted they will be recorded. These were limited because the staff and funds for the work were small. Anti-malaria measures were only undertaken when it was more or less certain that they would be effective; and very occasionally they were adopted without the certainty that they would be of use when it was obvious that they would lead to publicity of educational value.

The American Agricultural School. (See Map II)  
p. 352.

This colony is situated on the Sedes Kapudzilar road, 200 feet above sea level, on the undulating land which lies between the Bay of Salonika and the foothills of the Hortach range. The total population is about 120 souls, eighty of whom are pupils drawn from all over Greece, many of them belonging to refugee families.

The whole water supply of the colony comes from two wells and is pumped into a cement tank from which it is distributed to the various houses. There are also/



also two large underground rain water tanks. A water carriage drainage system is installed in the buildings, and the effluent of the septic tanks is used to irrigate two small patches of land. Otherwise there is no irrigation on the farm. There is no river nearer than the Sedes stream which is at least 2 kilometres away, and no permanently running water-supply nearer than a fountain on the main road beside the sea.

This Farm School was the only place where regular observations could be made, and they are of interest because the School is equivalent to a small village, and what was learned and accomplished there is applicable to some settlements in Macedonia. It can be seen at once that it was an ideal place in which to control malaria, for the water supply was limited and the settlement quite isolated.

During the summer of 1924 malaria was very bad in the School, almost all the staff and boys had it. The writer arrived in the autumn and was led to understand that there had been an *Anopheles* breeding place in the orchard during the summer. It had disappeared before October but there were plenty of mosquitoes to be found in the houses and outhouses during that month. Malaria was very prevalent and a case of black water fever occurred in November and another some months later.

During the winter 1924-1925 the unscreened houses  
on/

RAINFALL IN INCHES 1922 - 1926.  
AT AMERICAN AGRICULTURAL SCHOOL.

YEAR	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1922	11.97 $\frac{1}{2}$	1.16	1.19	0.27 $\frac{1}{2}$	0.38	2.06	0.56 $\frac{1}{2}$	0.0	0.0	1.34	2.64 $\frac{1}{2}$	1.94	0.52
1923	15.29 $\frac{1}{2}$	2.40	1.48	2.70 $\frac{1}{2}$	0.83 $\frac{1}{2}$	1.59 $\frac{1}{2}$	1.05	1.47	0.23	0.13	0.33	1.48	1.63 $\frac{1}{2}$
1924	16.41	0.22	1.64 $\frac{1}{2}$	0.25	0.17	1.83	2.77 $\frac{1}{2}$	0.27	1.35	1.03	3.40	2.18	0.29 $\frac{1}{2}$
1925	17.15	0.05	1.43	2.78	0.13	1.54	1.02	3.03	0.0	0.7	3.03	1.71	1.73
1926	15.69	3.69	0.32	2.76	0.79	1.32	0.74	0.91	1.51	0.48	0.52	0.0	2.65
		8	6	8	2	8	6	5	3	3	10	7	5

The writer is indebted for these records to the Director of the American Agricultural School, Salonika.

on the School were screened, the regular catching of mosquitoes was started, and the systematic treatment of all cases of malaria begun.

Table II gives the records of the mosquitoes caught during 1925 which is the only year for which the records are complete. It notes also the breeding season of Anophelini in other parts of the district, which checks the observations at the School.

Anophelini were caught regularly all winter but by April they had disappeared. Where they went to can only be guessed. Perhaps they died, having found no suitable breeding place near the School, or possibly they flew far away in search of suitable water. Breeding started elsewhere in the district in April, but no adults were caught on the School until September when they began to appear. At first they were all *A. superpictus*, and then *A. maculipennis* was caught also. It was presumed that they came from some place near the buildings, and a general search was made, in vain. The unpleasant conclusion was that these mosquitoes were flying from a distance and that the idea of keeping the School mosquito free was impossible. This was the writer's opinion in September when one day it was reported that a small shallow pool about one foot square had been found in a grassy field beside the School. It was caused by a small leak in an/

TABLE II.

Anopheline Mosquitoes caught on American Farm School in 1925.

	<u>Total.</u>	<u>Classification.</u>		
Jan. 5th	26	S. 50%	M. 50%	
12th	8			
21st	25	S. 32%	M. 68%	
26th	16			
Feb. 2nd	9	S. 22%	M. 78%	
9th	22			
17th	40	S. 47%	M. 53%	
29th	34	S. 24%	M. 76%	
Mar. 2nd	?	S. 32%	M. 68%	
May 18th	none			(On April 25th mosquito larvae were first found in the Vasilika Valley.)
Apr. 8th	none			
May 13th	none			
June 6th	none			
13th	none			
Jul. 2nd	none			
17th	3	S. 66%	M. 33%	
Aug. 3rd	3	S. 100%		
30th	none			
Sep. 15th	8	S. 100%		
21st	17	S. 100%		
28th	27	S. 100%		
30th	27	S. 97%	M. 3%	
Oct. 1st	6	S. 83%	M. 17%	
7th	28	S. 100%		(Anopheline breeding pool on school found in the middle of October.)
14th	26	S. 96%	M. 4%	
21st	9	S. 78%	M. 22%	
28th	18	S. 95%	M. 5%	
Nov. 2nd	27	S. 60%	M. 40%	
7th	7	S. 62%	M. 28%	
26th	2	S. 50%	M. 50%	
Dec. 3rd	5	S. 60%	M. 40%	(By the end of November no Anophelinae were breeding in the Valley.)
6th	8	S. 75%	M. 25%	
15th	9	S. 60%	M. 40%	
20th	10	S. 80%	M. 20%	
30th	12	S. 60%	M. 40%	

S - A. superpictus.  
M - A. maculipennis.

an underground water pipe and was swarming with anopheline larvae. It has been suggested that when the natural breeding places of mosquitoes are scarce for any reason, they may adopt unusual or artificial places.<sup>9.8.14.</sup> This grassy pool resembling the natural breeding places of the local Anophelini is evidence that that suggestion is probably not applicable to the common Anophelini of Macedonia. It was the one Anopheles breeding place found on the School during two years, while Culicini turned up in any place or thing in which water could lie for a few days, including old tins, the rain water tank, the cement tank for drinking water, one of the wells, the septic tanks, and the irrigation channels.

The pool was dealt with and still Anophelini were caught for the rest of the season. Certainly they were few in number, and it was difficult to decide whether they had all hatched from that pool; or as the season advanced, had some enterprising insects flown from the nearest breeding places over a kilometre away. There was no evidence during two years that flights of mosquitoes occurred, the writer slept out of doors all the year round and would certainly have noticed flights had they taken place.

There is just one other way of accounting for the mosquitoes, if they did not all come from the one pool, which was suggested by an old peasant who said that/

## TEMPERATURE AT AMERICAN AGRICULTURAL SCHOOL 1922 - 1926 (DEGREES FAHRENHEIT).

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
1922	AVERAGE	-	36.2	60.9	65.4	72.6	86.4	93.6	90.2	81.4	71.7	47.6	43.9
	MAXIMUM	-											
	AVERAGE	-	22.3	41.6	44.4	51.1	62.1	72.7	69.9	59.7	54.5	36.2	30.2
	MINIMUM	-											
1923	MEAN	-	32.3	51.2	54.9	61.8	74.2	84.8	80.1	70.5	60.5	41.9	37.2
	AVERAGE												
	MAXIMUM	47.3	53.8	60.3	65.2	78.6	85.7	91.4	92.8	83.6	76.9	68.6	55.1
	AVERAGE												
1924	MINIMUM	34.0	39.6	41.9	47.0	58.6	64.3	61.9	68.3	64.1	53.1	53.2	50.7
	MEAN	40.6	46.7	51.1	56.1	68.6	75.0	76.6	80.5	73.8	65.0	65.9	52.9
	AVERAGE												
	MAXIMUM	37.9	46.0	55.8	74.0	81.8	85.4	90.7	90.2	87.6	67.3	55.2	51.5
1925	AVERAGE												
	MINIMUM	29.7	34.3	52.2	52.6	59.2	65.7	69.6	68.6	70.2	56.6	42.5	37.2
	MEAN	33.8	40.5	54.00	63.3	70.5	75.5	80.1	79.4	78.9	61.9	48.6	44.3
	AVERAGE												
1926	MAXIMUM	57.41	58.28	52.34	66.74	74.37	82.4	89.24	90.14	77.9	71.42	65.12	48.43
	AVERAGE												
	MINIMUM	32.17	41.11	42.44	48.74	56.73	61.52	68.0	68.36	65.8	56.48	51.98	32.18
	MEAN	44.9	49.68	47.39	57.74	67.55	71.96	78.62	79.25	67.37	63.89	58.55	41.05
1926	AVERAGE												
	MAXIMUM	44.72	58.64	58.28	69.95	75.56	85.65	88.5	87.36	84.14	77.48	69.08	53.15
	AVERAGE												
	MINIMUM	37.05	41.81	41.18	50.63	56.84	64.4	67.49	65.5	63.01	55.67	56.28	41.68
1926	MEAN	41.88	49.56	49.73	69.33	65.7	73.02	77.99	77.13	73.57	66.27	63.38	47.58

The writer is indebted to the Director of the American Agricultural School Salonika for these records.

that the cattle brought mosquitoes to his village at night when they came up from the plains. Now the School is situated on the old highway up the Vasilika Valley and the route is still used for village transport. The troops of donkeys, and mules, and the flocks which roam the country, pass that way continually and stop to drink at the School watering place. Possibly they bring mosquitoes with them.

During 1925 and 1926 the health of the School improved enormously. In 1924 it was said that almost all the staff and boys were ill at one time or another. During the session of 1925, when anti-malaria work was already in progress, there were 45 admissions to the School hospital for malaria, most of them relapses. In the session of 1926 the number was 25, a decrease of almost 50%. As all the pupils may be reinfected each time they go home to their villages for holidays, such figures are not of much value as an index of the healthiness or otherwise of the School. The evidence that is of value is this. The place had become what might truly be called a black water fever locality after the summer of 1924. But after that autumn when anti-malaria work was started, the English, American, and Greek staff of a Relief organisation, and the permanent resident staff of the Farm School lived for two years without one of them contracting malaria; and prophylactic quinine was not taken.

It/

TABLE III.

Incidence of malaria in the Boys of the American  
Farm School during sessions 1924-25 and 1925-26.

	<u>1924-25.</u> <u>total 78 boys.</u>		<u>1925-26</u> <u>total 83 boys.</u>
Oct.	15	(after summer holidays)	7
Nov.	6		1
Dec.	3		5
Jan.	1		4
Feb.	7		6
March	5		1
April	4		-
May	1		-
June	4		1
	<hr/>		<hr/>
	46	total	25

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It must be said that this was only attained by the most unceasing vigilance, which will have to be maintained, because the School is continually admitting infected boys from elsewhere in Greece, who are liable to be reinfected during each holiday spent in a malarious village.

The problem of malaria control in the Colony will become further complicated because the land all round the School territory is being developed by new settlers. As gardens and vineyards spring up, each with its well and irrigation system, it will be increasingly difficult to keep down Anophelini within a radius of even half a kilometre on all sides of the buildings.

#### The Greek Agricultural School.

This School is situated in the centre of the Valley at the point where the two main roads diverge some 8 kilometres south of Salonika.

It has been closed to students for some time on account of malaria. It is surrounded by fine trees, and has a beautiful walnut plantation and a large mulberry orchard. The extensive gardens are overgrown, the drainage ditches are blocked, and the land is in part let out to peasants from villages some distance away.

The water supply for the School and its gardens comes /

comes from various fountains and wells, and after escaping it collects in a small swamp between the lower end of the gardens and the sea.

Anopheline larvae were found in the unkept courtyard fountain overflow, in the overgrown irrigation ditches, and in the swamp. They were also present in the ornamental tanks, and open reservoirs, which contained floating vegetation. One shallow garden well where a few enormous goldfish lived, was free from larvae.

From the medical history of this institution and the American Farm School it seems likely that the sine qua non for a successful agricultural school in Macedonia at present is permanent and efficient anti-malaria work on the spot.

#### Arsakli.

Arsakli is a refugee village with a population of about 600 souls. It is placed high above Salonika on the main road from the city to the Hortach Plateau. The site is superb for it looks far and wide over the Bay of Salonika and beyond to the Olympic range. It is outside the Valley but is included in this study because its history is instructive.

The water supply comes from pipes laid by the Allies to bring water from Hortach, and it is distributed to several taps in the village.

During/

During 1925 the Head man of the community ruled with wisdom and courage, and knowing well the danger of mosquitoes, fined those who left the water taps running. In 1926 he was replaced, and in the late summer of that year the taps were dripping, and water lay in the garden boundary ditches, and in the roadside ditches, and anopheline larvae were found in them. The school spleen rate was 6%, the lowest in the district, but it is not unlikely that it will rise if the water is not controlled. The village is relatively 'rich' which with the fine situation accounts for the low spleen rate. The people would not be so exposed to infection during the migration for they could afford to choose lodgings, and having been well fed since they settled they have been more able to resist and throw off disease than their poorer countrymen.

With such a site and with a tapped water supply the control of mosquitoes could hardly be easier than in this village.

#### Sedes.

Sedes is a large village about two kilometres south of the American Farm School. It has an old Turkish quarter as well as new settlements and is distinguished by being the only place in the district which has got a minaret.

The /

The population in January 1926 was 1020.

The whole water supply for the community comes from the Sedes stream which flows beside the village. As mentioned above, most of the streams in the valley are dry in summer. The Sedes stream is no exception but it contains an unusually large spring in its bed some distance above the village; and the water which rises there flows for a mile down the ravine before it dries up. The drinking water is drawn from pipes driven deep into the ravine at the spring, and is conducted by a stone aqueduct and pipes, to various permanently running fountains in the village. These lead to a considerable amount of stagnant water in the garden boundary ditches. There is a mill in the old quarter and its mill stream is led from the ravine a short distance below the spring. The channel runs along the outskirts of the village and passing through the mill reaches the ravine again by a circuitous route. In the whole length of its course this mill stream is liable to be tapped for irrigation by people whose gardens and fields border on it. The wastefulness or otherwise with which the water is used seems to depend on the character of the individual gardener. Frequently the mill stream banks are not properly repaired by those who have made openings in them, and pools are left, and trickles can be found here and there where the water escapes by short cuts back/

back to the ravine.

The school spleen rate in 1925 was 60%. Anophelini swarmed in the stream in its whole course of a mile; they were also found occasionally in the grassy village ditches and in the leaks from the mill stream.

The village scout troop drained some of the ditches and repaired the mill stream, but this was obviously of little use when the stream was full of mosquito larvae. So in 1926 it was decided that it would be worth while for the sake of publicity and the training of the scouts to install oil drips in the ravine.

The first drip was set up at the spring and in a day or two cleared about 200 yards of the stream but the oil did not seem to get much further, so other drips were put up at intervals and were quite as efficient. Sometimes the oil became blocked on a ridge of floating debris, but it spread well and tended to collect in the eddying corners where larvae abound. A drip of 'gas' oil working at 40 drops a minute cleared about 200 yards of the stream completely of larvae in about two days in midsummer when the stream was very slow and shallow. The 'gas' oil spread very well and was almost invisible except to the expert eye. However much the shepherds had been convinced of the good faith of the experimenters they would probably/



View of Sedes and the Vasilika Valley from near the American Farm School, showing treeless undulating country, and Mt. Karatepe a spur of the Hortiach Range on the left.



Fixing 'Nail Drip' at a small water fall of the Sedes stream some yards below the spring in the ravine.

probably have removed the drip if they had seen any change in the water which their flocks were drinking. It was not of the least use to install a drip until publicity had been given to the matter through the Scouts, the local doctor, and others; and until all concerned, gardeners, shepherds, goose girls and swineherds were convinced that it could bring no harm to their live stock or plants. When all was explained these people became consumed with curiosity to understand what was happening, and were willing to help to regulate the drip, and to protect it from thieves.

Such a stream constitutes a very difficult problem for the anti-malaria worker. At the present time it is essential for the village life that it should remain above the surface of the ravine bed, so the only applicable measure is to make the water unattractive for mosquitoes. So far as is known oiling is the best means of doing this, and there is no doubt that it would not be too costly for a village such as Sedes when the community is settled.

An oil engine for grinding flour is being set up by an enterprising refugee family so there will always be a supply of oil and waste oil in the village.

The problem is to persuade the people that the supervision of the village water, and of a few oil drips, is a matter of sufficient importance to be included/

included among the other communal undertakings which village life demands.

It is interesting to note that during the War the spleen rate of Sedes was reported as 51<sup>28.</sup>%. That was when the village was quite small and housed a mixed Turkish and Macedonian population.

#### Kran\_kajatsali.

Kran and Kaja Tsali were two very small old villages, about half a mile from one another on the low foothills of Mount Hortiach. A new settlement of houses was built on the hillside between them in 1925 and 1926 and the whole was renamed Kran\_kajatsali. In 1926 the population numbered 68 families, 234 individuals.

The water supply for Kajatsali was a well, while the Kran families and the people of the new settlement drew water from a spring in the ravine which lies between them. The water from this spring runs for about 200 yards before it disappears into the soil and then it reappears for a few yards lower down in the ravine before finally 'the sun takes it' as the local expression is. It is called the Kran stream. At its source it is used for drinking, a little lower down for village washing, and lower still for watering flocks and herds and turkeys. In 1925 the incidence of/



of malaria in the new settlement was very high, and the stream was full of *A. superpictus*. The spleen rate of the children drawn from the whole community was 35%. In 1926, when the mosquito breeding season began, an oil drip was set up in the stream beside the spring, and the Schoolmaster, and indeed the whole village, took a lively interest in it. Gas oil was used and in a few days larvae were hardly to be found.

It has been observed that village washing may diminish larvae in mosquito breeding water<sup>13</sup> but such was not the case here, they were present in numbers a few yards below the washing place. It was noticed that the oil spread unusually well on the stream, perhaps that was due to a small percentage of indiffer-ent soap.

This village is superbly situated, and could be kept mosquito free with very little effort, for there is no water near except the short stream. A piped supply which is going to be introduced to the Kajat-sali portion may lead to complications, but at present the situation is simple.

The village was very poor, but with characteristic devotion the people arranged that someone should teach their children, and a small room with a few seats was set aside for the school. The writer has seen the children go up to the master's desk, one by one, /



The Kran School with the teacher and some of the children.



The Kran Stream a few yards below the source of the spring. Women washing clothes; oil 'Tap drip' fixed to bank overhanging a small pool below the washing place.

one, to read the lesson from the single copy of the reading book which the school possessed. The Schoolmaster showed great devotion. He undertook to give quinine to the children every day, and if they did not attend he went to their homes and to the fields to distribute it, knowing well what a difference it would make to their attendance at school, and their general appearance. This is a digression to emphasise the fact that often progressive and intelligent people are to be found among the refugees, who by their individual effort could probably control the malaria in a village, and would do so gladly.

#### Matzarides.

This settlement has a population of 760, and lies on the main road of the valley below Mount Karatepe. It is almost entirely new, all that remains of the old regime being a Beys house and surrounding courtyard.

The water supply comes from a spring in the Kran stream bed, in iron pipes, to a perpetually running fountain in the centre of the village. The overflow from the fountain runs along the roadside, passes under it, and is lost in a series of pools where mud bricks are made below the village. The inhabitants cultivate the fields round about and their land extends into the centre of the valley. The cattle graze here and there/



Matzarides.  
The perpetually running water supply. Photograph taken  
in midsummer when supply of water very low.

there on uncultivated patches. Less than half a mile below the village there is a small spring and from it a long drainage ditch runs west and joins the North ditch of the Valley (see map). Anophelini breed in the overflow from the fountain and in the long drainage ditch which is overgrown with vegetation.

The spleen rate in 1925 was 50%. It was a peasant here who said that the cattle brought mosquitoes with them at night when they returned from the plain at dusk.

It was possible to prevent mosquito breeding in the fountain overflow by clearing out the vegetation. Experiments in the long drainage ditch gave the same result.

During 1926 the picture became more complicated. The more prosperous families began to dig shallow wells in their fields in the valley, in order to water the special crops; and these contained some Anophelini although Culicini preponderated. Little huts also sprang up in the fields which meant that the people were sleeping down there, probably to guard the melon crop.

#### Lutra.

This is an old institution about one and a half kilometres further up the Valley than Matzarides. It is a popular health resort on account of four hot springs/

springs over which baths have been built. During the winter it is almost deserted, but for a few months in summer it is invaded by rheumatic and sick folk from Salonika and further afield. It is pretty generally recognised that the treatment there is to have hot baths and malaria!

The four baths lie on the south side of the road and the effluent water from them trickles down into the plain by a maze of channels and ditches. Some of it ends in a small swamp while the rest finds its way into the North ditch (see map). The water in the baths is alkaline and warm and will be discussed later in the section on the reaction of the natural water in the Valley. It is sufficient here to say that the maze of ditches breeds Anophelini in numbers, and that one of them near the smallest bath was the earliest Anopheles breeding place in the whole district both in 1925 and 1926, probably because the water in it is slightly warm. A little oiling was done here as a practical demonstration to draw the attention of the visitors in the place; not because it would diminish the numbers of mosquitoes, although the inhabitants claimed that it had done so.

Lutra is one of the most malarious localities in the Valley, and it was such a menace to the public that the writer addressed a letter to the town council of Salonika drawing its attention to the matter.

Lutra/

Lutra is municipal property which is let out to hotel keepers and caterers during the season. It is within the bounds of possibility that the great reputation of the place as a health resort may be partly due to the therapeutic action of malaria, acting in rheumatism and other chronic conditions, in much the same way as it has been shown to do in the treatment of general paralysis of the insane.

Vasilika.

Vasilika is an old Macedonian settlement. It is the largest village in the district, and gives its name to the Valley. It has a population of 3500. The houses cluster irregularly along either side of the river, and are surrounded by fine trees and orchards. The main crops are cereals, tobacco, cotton, fruit, and the local silk is celebrated. There are two doctors resident in the village and it may be said of them, as of many in Macedonia, that they make their annual income during the summer months, and from malaria. The spleen rate, which is the only 'static' spleen rate in the valley is given opposite. It is only in old established communities that separate classes can be examined; in refugee schools the children are still all taught together in one room, and older children cannot be examined because they have to work in the fields.

There/

## Spleen Rate in the Vasilika School. 1926.

Youngest Class.	16%	
Second Class.	10%	
Third Class.	25%	(16 years of age usually)
Average.	17%	



There is abundant water in Vasilika, particularly from running fountains, and the overflow finds its way back to the river rapidly.

On the north side of the main road about half a mile from the houses there is a spring in a small overgrown pond, and the water from it wanders through gardens, and orchards, and is led off for irrigation here and there before it finally straggles into the river. The whole area breeds mosquitoes.

There is another source of mosquitoes on the south side of the village. It is the Sirroti mill stream where it is broken down and leaking. Neither this source of Anophelini nor that on the north side is very near the houses, so although the place is thoroughly malarious it is not so bad as Lutra and the Greek farm school sites.

Briefly the Anopheles control in Vasilika is the control of irrigation water and the clearing of irrigation channels. Now, such an old settlement has irrigation laws and traditional water rights, and it would be a much more difficult matter to introduce new irrigation laws there than in a new settlement, whose community life has still to be arranged.

Sirroti.

There is little to say of this settlement, it is not entirely new, and the population in 1926 was 218. The spleen rate in 1925 was 34%, and at that/

that time water was drawn from wells and the supply was inadequate. In 1926 a piped supply was brought in from a large fountain on the hills some distance away. The water was acid, and the pipes iron, and they rapidly became corroded and leaked all along the line. In any case the village could not drink the water, but they managed to use it for washing. No anopheline breeding place was to be found near the village, the Sirroti mill stream in the Valley far below was the nearest possibility.

It is possible that the new water supply, leaking along the pipes as it does, will constitute a danger, because the water has only to run for a few yards through the grass to become neutral or alkaline. The supply has been too recently installed for an opinion on this matter to be formed. The writer tends to think that this village and Aya Triada, where new breeding places have been made possible, and which are not near any old natural breeding place, will have to be colonised by Anophelini. And that will occur in an unusually wet season, or by transport. The acid water supply is one of the mineral springs which appear in the line of the geological fault, on the south side of the plain.

#### Aya Paraskivi.

Aya Paraskivi supported a population of 333 in January 1926. In 1925 the spleen rate was 50%.

The/

The spring of the Saint Paraskivi is some distance from the village, and will be referred to again because of its unusual reaction. The water supply comes from wells, and no Anopheline breeding place was found near the village. In 1925 and 1926 no water lay between this village and the Vasilika river, during the summer.

#### Tagartjides.

Even in the summer of 1926 the building here was not far advanced and no school was organised. So the spleen rate was not obtained, and no very definite idea of the amount of malaria infection present was established. The water supply for the settlement will be supplied from wells. There is a short sandy stream some distance from the settlement which was not much investigated. As in Aya Paraskivi the peasants cultivate the fields far into the valley. In the summers of 1925 and 1926 the nearest permanent water in the plain was the Ryssion mill stream.

#### Neon Ryssion.

This settlement is entirely new. It has a population of 589, and is not at all flourishing, because the groups of refugees which it contains have not been able to organise themselves into a community

as others have succeeded in doing. The water supply, during the settlement, was drawn from an old well a short distance away. More recently a supply was brought in pipes from a spring in the ravine which forms the west boundary of the village. It was led to a central village tap. The spring is small and all the water was used so the ravine bed was practically dry. In midsummer 1926 the pipes began to leak so badly that the fountain stopped running, and the people, unable to organise themselves to repair it, began to draw water directly from the spring. An overflow then began to run down the ravine and soon swarmed with *A. superpictus*.

An oil drip cleared the stream of living larvae in a day. It was not longer than 200 yards but it was so near the houses as to constitute a real danger. This was the only permanent water near the village. The nearest water in the plain was the Ryssion mill stream. The Ryssionites cultivate the fields down to the Mill, which is mosquito infested. The spleen rate in 1925 was 75%, the highest in the Valley. The writer is of opinion that, although there is no doubt that the people were heavily infected during the migration, their economic distress is accountable to a large extent for it remaining so high.

Peraia.

Peraia is also an entirely new village of 800 inhabitants; it has had the advantage of being comparatively harmonious, and is a progressive community. Situated on the hillside half a mile from the sea, it could be a health resort. Two years ago the water was drawn from a spring in the ravine which bounds the houses on the east, and some was also carried from a fountain half a mile away. Now water has been brought in pipes from the hills to a large tank whence it is distributed to taps in the village. Any overflow runs through the gardens and disappears in them, or collects in a pit in the field below. The spring in the ravine is therefore only used now for washing and watering animals and it swarms with *A. superpictus* larvae in summer. There is no other water near the houses and there is none between them and the sea, so the mosquito problem lies in the spring in the ravine and the small stream which trickles from it for about 100 yards. A worker resident in the village was able to control the water in 1925 and 1926, and the local Scouts oiled and trained the stream in the ravine regularly. As the result it can be truly said that mosquitoes were a negligible quantity during that time. The peasants maintained that there were none, but that was not quite correct.

The/



Large fountain half a mile from Peraia, troughs overflowing perpetually.



The Peraia stream.  
The original water supply of the village being cleared and rechannelled by the local Scout troop.

The village could easily be kept healthy as regards malaria. It must always be remembered, however, that as prosperity grows irrigation systems may be set up. The spleen rate in 1925 was 60%.

Epivatis.

Epivatis is divided into two parts, one group of houses is situated on the hillside, and the other is on the shore beside the pier. It is in many ways like Peraia, except that here there is even less chance of mosquito breeding. The water supply is well tapped in the lower part of the settlement. A fountain, with a storage tank for the overflow, which supplies some of the higher houses was never found to harbour Anophelinae. The spleen rate in 1925 was 30%.

Aya Triada.

The writer saw this village grow up from the day when the first building material was dumped on the bare ledge of land between the sea and the hills. It was placed there possibly because of the presence of an old fountain of good water. As time went on the water was piped from the fountain to various taps, but before midsummer 1926 the taps were in dis-repair and water was standing about in the garden boundary ditches, and they were full of Culicini. No Anophelini were found in 1926 but, so far as can be seen, there is/



Two of the new tapped water supplies for Peraia.





is no reason why they should not breed there sooner or later. The reaction of the water is suitable for them, and as in Sirroti they may have to be imported. The spleen rate in 1925 was 41%, so that if Anophelinae appear the conditions are favourable for the spread of malaria.

#### Michaniona.

Michaniona is not in the Vasilika Valley, but may be mentioned for the sake of comparison with others. The population numbers 1763 souls and the whole settlement is entirely new. There is no stream anywhere near it and the water is drawn from wells, some of which are covered and fitted with windmills. There is a farm a quarter of a mile away which breeds thousands of Culicini in its garden tank, but no anopheline larvae were seen in it.

In the late summer of 1925 the local doctor was convinced that some new cases of malaria were occurring in the village in spite of the apparently perfect site, and the absence of mosquitoes. The villagers were rather vague about the mosquitoes and suggested that if there were any that they had flown across the sea from Thessaly or the Vardar swamps, 30 miles away. The village lies on the sea side above sandy cliffs, and at the foot of the cliffs there is a belt of shore where the boats lie. On this narrow shore an Anopheles breeding/

breeding place was discovered in an overgrown disused mud brick pit.

The spleen rate in 1925 was 18%.

If no unforeseen complication arises the site of this settlement could hardly be better, from the malaria point of view.

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MAR. II



GULF OF SALONIKA.

LAKE LANGADA.

AY VASSILIOS.

SALONIKA

KALAMARIA

KAPUDZILAR

KIRECKOJ

Hortackoj Plateau

HORTACKOJ

ARSAKLI

Mt Hortack 1199

Am. Agr. School

Agr. School

MAP OF VASILIKA VALLEY  
 SHOWING ANOPHELES  
 BREEDING PLACES 1925-1926  
*marked in red.*

SEDES

KAJATSALI

Mt Kavatepe 728

KRAN

Off. Agr. School

AERODROME

MATJARIDES

LUTRA

TRHANLI

JENKLER

French Road

Mill Stream

NORIK Stream

Tsair-Ts

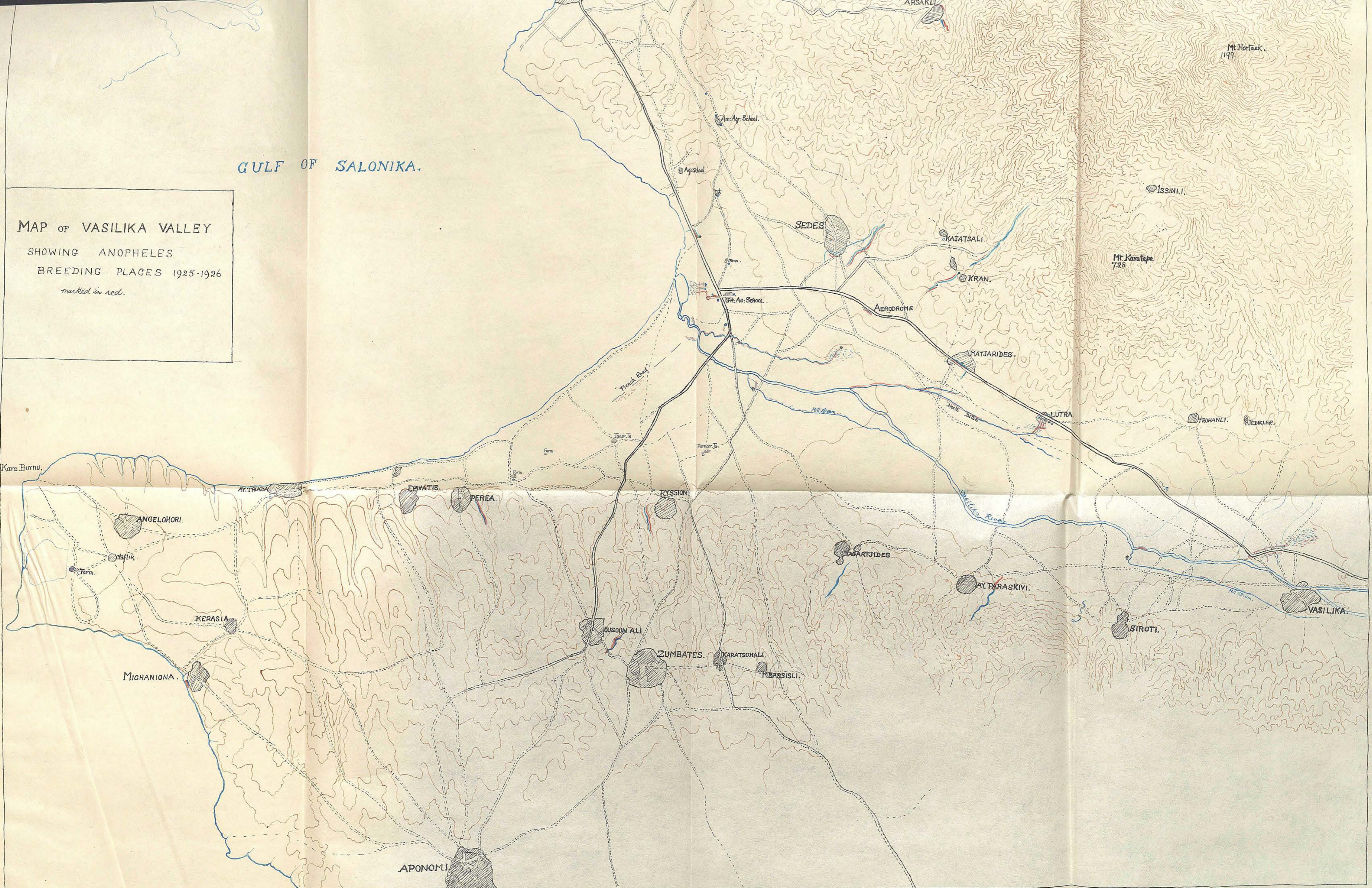
Pantir-Ts

Kara Burnu

GULF OF SALONIKA.

MAP OF VASILIKA VALLEY

SHOWING ANOPHELES BREEDING PLACES 1925-1926 marked in red.



MAP II.

⊗ Mill.  
⊕ Church.

Scale - 1:50,000



MAP II.  
A. Russell.

## II. THE SPLEEN RATES.

Table IV gives the spleen rates in the Valley in the villages where schools were in existence in 1925.

The children were usually between six and thirteen years of age; older children could not be collected for they were scattered working in the fields.

The rates are of interest but are not of the significance of spleen rates in long settled countries. They are a record of 'imported' malaria, of the degree of infection acquired by the communities during the migration, which has of course been modified by various factors since they settled. They are not a reliable index of the malariousness of the village sites; but when coupled with a knowledge of the localities, they are of value to those who would foresee the future health of the settlements, and they will be of undoubted interest to the student of malaria in the Valley years hence.

The factors influencing the spleen rates in one or two of the villages during the settlement are unmistakable, and are worth mentioning. For example Arsakli had the lowest spleen rate in 1925. The village no doubt has an almost unique site, and probably very little reinfection occurred in it on that/

TABLE IV.

Spleen rates of School children in the Vasilika  
Valley in 1925.

	<u>1925.</u>
American Farm School	18%
Arsakli . . .	6%
Sedes . . .	60%
Matajrides . .	50%
Kiatsali Kran . .	35%
Vasilika . . .	17%
Sirroti . . .	34%
Aya Paraskivi . .	50%
Peraia . . .	60%
Epivates . . .	30%
Michaniona . . .	18%
Aya Triada . . .	41%

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that account, and because of the wise leadership of the Head man. But most important was its economic well-being: it was the 'richest' refugee village in the district.

Michaniona on the contrary was poor, but its site is as nearly ideal as any site could be, and the chances of the people becoming reinfected after they settled were almost negligible, so the malaria tended to die out.

Neon Ryssion had the highest rate of all, 72%, and its site is far from being the worst. It was the poorest, least hopeful colony in the district, and there is no doubt that for long the people had not nearly enough to eat.

The spleen rate in the American Farm School was still 18% in the Spring of 1925 after mosquito catching and regular treatment with quinine had been going on for months\_ evidence of the severity of infection in 1924.

The Vasilika rate is the only 'static' one in the Valley.

Taking the Valley generally it was concluded from the knowledge of the spleen rates and the village sites, that the villages north of the river, namely, Sedes, Lutre, Matjarides, and Kran-kajatsali, would, in the natural course of events remain very malarious; while those south of the river, Sirroti, Aya Paraskivi, Tagartjides, /

Tagartjides, Ryssion, Peraia, and the others would improve very much. This was shown to be already in progress in the summer of 1926 when the doctor in charge of the north villages was hard worked, while his colleague who visited the south side of the Valley had much less to do.

In the early summer of 1925 when the spleen rate of the children in the school at Peraia was 60%, it was decided to hold a quinine parade because reliable supervision was available. For two months all the children were given quinine each morning while at school. The dose was 10 grains for all over ten years of age and the same for the younger children who could take so much, and most of them were able to do so. A few of them took 7 grains only. Watson has said that 6 grains a day is not much use if the spleen rate is as high as 75%.

Some months later, in the autumn, the school was again examined and the spleen rate had fallen to 30%. There was probably little reinfection during the summer or it would not have shown such improvement. Everyone witnessed the improvement in the general appearance and health of the school children.

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The Quinine Parade at Peraia.

### III. THE ANOPHELENI IN THE VALLEY AND THE TYPES OF BREEDING PLACE.

The common species of Anopheles which were found in 1925 and 1926 were *A. superpictus* and *A. maculipennis*. The former was more frequent in the hill streams but appeared also in the plain; the latter was specially prevalent in the plain but was also found in the hill streams. *A. bifurcatus* was taken in the North Ditch and in the Vasilika ditches at the beginning of the breeding season. The breeding season started in the end of April in 1925 and about the same time in 1926. The first larvae found in the whole district each spring were in the grassy channels at Lutra, possibly because the water there was slightly warm. The breeding season ended late in November in 1924 and 1925.

It was apparent from weekly observations at the American Farm School that the hibernation of the mosquitoes is a very irregular habit depending on the weather. They go out and in during the warmer spells and feed at intervals during the winter. Specimens of *A. maculipennis* were noticed to attain an enormous size sometimes in winter, and Table II. shows that this species survived the winter more successfully than did *A. superpictus*. No mosquitoes were found wintering as larvae, but *A. bifurcatus* adults were/

were not caught in winter so the writer thinks that they were missed when hibernating as larvae. Wenyon found *A. bifurcatus* at the larval stage in winter in Macedonia during the War.<sup>25.</sup>

The *Anopheles* breeding places in the Valley are marked in Map II, and almost without exception they can be classified as 'permanent' and 'natural'.

'Temporary' breeding places were not of importance at least in 1925 and 1926. The Macedonian summer is dry and after the occasional rainfalls the water dries with amazing rapidity for there is little dense vegetation to retain it. Rain water seldom lies for a week after it has fallen even in low localities. In late October in 1924 Anophelini were found in a borrow pit of the embankment marked 'French Road' after heavy rains. This shows that temporary breeding places can occur in a mild autumn when the breeding season is not over before the rains set in. And of course an abnormally wet summer would lead to the same thing.

'Artificial' breeding places of Anophelini were found thrice, and will be mentioned because no one of them could be truly called artificial. The first were the cement tanks in the Greek farm School gardens, and they were full of plankton. The second was a metal barrel standing in the centre of Peraia; the water in it gave the reading pH 9 and a green water weed/

weed was growing in it. The third was a shallow garden well in the Angelochori farm which was full of vegetation and registered pH 8.

concentration of ...  
and a vast literature on the subject is available, and details of this reaction are given in the literature. The reaction is already known to be of the functional group ... of delicate ...  
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responsible for the ... received within the last few years.

It is ... in this field, perhaps because ... of the reaction of the ... appreciated.

The reaction of the ... studied both in relation to ... formations. It is ... of the reaction of the ... and shows that the hydrolysis ... definite influence on plant ... species are only found in ... concentration of which will ... species, and within this range ... where the species ...

weed was growing in it. The third was a shallow garden well in the Angelochori farm which was full of vegetation and registered pH 8.

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#### IV. THE REACTION OF ANOPHELES-BREEDING WATER.

During the last twenty years biologists have been investigating the influence of the hydrogen ion concentration of environment on diverse forms of life, and a vast literature on the subject is accumulating, and details of this factor in plant and animal life are being slowly pieced together to make plain some of the fundamental laws of Ecology. The introduction of delicate colour indicators has made hydrogen ion observations comparatively easy and has been greatly responsible for the stimulus which the subject has received within the last few years.

Botanists appear to be ahead of the Zoologists in this field, perhaps because for ages the importance of the reaction of the soil in plant growth has been appreciated.

The reaction of the soil has been extensively studied both in relation to plant growth and plant formations. Olsen holds that plants are indicators of the reaction of the soil in which they are found, and shows "that the hydrogen ion concentration has a definite influence on plant formations, and single species are only found in soil the hydrogen ion concentration of which lies within a range for that species, and within this range is a narrower range where the species has its greatest frequency".

Much/

Much work has also been done on the influence of hydrogen ion concentration on the bionomics of algae in sea and fresh water.

1. Arrhenius investigating earthworms found that the optimum environment for them is a soil giving the reaction pH 7. 22. Shelford found that various aquatic animals react definitely to variations in hydrogen ion concentration and that each species tolerates a rather wide range with a definite optimum. Snails were investigated by Atkins and Lebour 6, who showed that each species lives in soil or water of a certain pH range, and further, that because the reaction of the soil and natural waters is dependent on the geological formation, it is possible to predict the distribution of snails to some extent from knowledge of the geological formation alone.

12. In 1920 Macgregor started to investigate the matter in relation to mosquito larvae. He found, that in the laboratory, three species of English mosquitoes could survive an alkalinity of pH9.6 and died in acid water of pH4.4. Two other species developed in pH4.4. 13. Later in Mauritius he found that local Anophelini in water ranging from pH9.5 to pH 8.4 and rarely in places giving the reading 7.4; and maintained that the pH reading of any water there was a reliable index of the presence or absence of anopheline larvae. 21. Senior White in Ceylon found the local/

local Anophelini in water with readings from pH 8.6 to pH 5.8 and decided that on the whole the local Culicini had a more restricted range. Buxton,<sup>8.</sup> in Palestine found six species of Anopheles in water varying from pH 9.2 to pH 7.4, and of these only one occurred in water less alkaline than pH 8. He notes that Nablus, where the water supply is unusually acid for Palestine (pH 7-7.35), is free from malaria. Home<sup>29.</sup> has observed that various malaria-free parts of the tropics have a slightly acid water supply. He noted that when the Wag water in Jamaica changed from alkaline to acid after heavy rains a species of Anopheles disappeared from it for two months. Atkins,<sup>3.</sup> working from certain known facts of the correlation of the distribution of animal species and the hydrogen ion concentration of the soil and water, sought to explain the surprising absence of malaria from various places by suggesting that the local waters might be of an unsuitable reaction for the mosquito carriers of the disease there. Williamson<sup>26.</sup> has recorded that Anopheles breeding almost ceases in the rice fields in Malay when the acidity of the water reaches pH 6. He is of the opinion that a change in hydrogen ion concentration, irrespective of the chemical cause, definitely influences larval counts.

It is not unlikely, therefore, that further observations/



observations on the pH of Anopheles breeding water in different parts of the world will be of great interest and use to the anti-malaria workers. It is also possible that this study will be more profitable in some countries than in others because of variations in geological formation, and distribution of mosquito species.

During the summer of 1926 the opportunity arose of making a few observations on the reaction of the mosquito breeding water in the Vasilika Valley and in the Langada Beshik Valley.

Transport and other difficulties demanded that the technique should be as simple as possible, and the following method was adopted. A white enamel soup ladle was used as a dipper and after dipping about in the water for some minutes a small quantity was tested, in the ladle, with the B.D.H. Universal Indicator; and the observation was repeated two or three times.

It was found that the two valleys are of especial interest because the reaction of the natural waters has an unusually wide range. This probably applies to a large part of Macedonia because the geological formation there is exceptional. There are many faults in the formation and these are marked by the appearance of warm and cold springs which arise from great depths.

Three/

Three interesting places were investigated, Lutra, Aya Paraskivi, and Lake Langada. Each of them lies in the line of a geological fault.

Lutra.

This settlement has been described already. It is celebrated for four hot springs over which baths have been erected. When the water leaves the baths the reaction is pH 10 and it contains at least sulphur, but as it straggles slowly down the grassy drainage ditches this rapidly changes and pH 8 is reached a few yards below the buildings. It was possible to tell almost to a yard where anopheline larvae would be found; always at the point where the alkalinity had fallen to pH 9.5 and below it. A species of *Gulicine* larva was found once inside one of the baths.

Aya Paraskivi.

There is a stream near this village renowned for its healing properties, the water is said to contain iron and probably has sulphur in it also. At the source where it bubbles out of holes in the hillside the pH value is 6.5, and the ravine down which it escapes is sandy. The stream was searched and it was found that the reaction did not reach pH 8 above a mile below the source and there for the first time a few anopheline larvae were found.

A species of *Culex* larva was present a few yards below the springs. These observations at Aya Paraskivi were unfortunately made only on one occasion; but at the time several hours were spent searching the stream, and they were made in midsummer when the other sandy hill streams in the district were swarming with *A. superpictus* larvae.

#### Lake Langada.

The Langada Beshik Valley is very malarious, the spleen rate at Langadikia in 1925 was 62%, and it is generally thought that the evil comes from the marshes along the lake margins. On several occasions in the summer of 1925 and 1926 the water among the rushes on the south shore of Lake Langada was searched for Anophelini but they were never found. In August 1926 the water was tested with the indicator and found to give a value of pH 10. Culicine larvae were present but not in great numbers. Anopheline larvae were present in other water in the valley, for example, in the streams and irrigation channels at Langadikia, and in the ditches at the side of the main road to Langada. It is well known that the summer photosynthesis of algae lowers the hydrogen ion concentration of the sea and fresh water lakes, but the unusual alkalinity of Lake Langada is probably due to deep springs.

In/

In this connection it is interesting to note that Moore, Prideaux and Herdman, investigating an artificial sea water pond, recorded that the photosynthesis was so intense that the reaction of the water fell to about pH 9 and that the algae died at that degree of alkalinity. It has not been possible to find corresponding work in fresh water, but Kew Lake has registered pH 9.4 in summer, and diatoms have been grown at pH 9.4 and pH 9.7. Wehrle found that in the Breisgau district the richest micro floral growth was present in water of pH 5 to 7, but his observations do not extend beyond pH 8.2 on the alkaline side.

Table V gives the details of other breeding places in the district. Many more observations were made and not recorded, but at no time were anopheline larvae found in water registering alkalinity above pH 9.5 or below pH 8. Culicine larvae were found at the extremes mentioned above and were almost invariably present with Anophelini in their natural breeding places. In the district under consideration anopheline larvae were found once in an artificial collection of rain water. The vessel was an old metal barrel in the village Peraia, a green water weed was growing in it, and the pH value of the water was 9. Anopheline larvae were also/

TABLE V.

	Locality.	Description of water.	pH reading.	Species.
May	Matzarides	overgrown ditches	8.0-8.5	A. bifurcatus.
	Lutra.	do.	8.0-8.5	A. bifurcatus
	Sedes.	sluggish stream	8.5	A. superpictus
	Kran.	stream	8.5	A. superpictus
	Vasilika.	ditches	8.0	A. bifurcatus
	Peraia	sandy stream	8.5	A. superpictus
June	Sedes.	same stream	8.0	A. superpictus
	Kran.	same stream	8.5	A. superpictus
	Main road.	fountain overflow	8.0	A. maculipennis
	(N. of Greek school)			
	Oleander River.	Rocky hill stream	9.5	A. maculipennis
	Vasilika.	swamp	8.5-9.5	A. maculipennis
	Vasilika.	ditches.	9.0-9.5	A. maculipennis & A. bifurcatus.
	Matzarides.	fountain overflow	8.5	A. maculipennis.
	Lutra.	overgrown ditches	8.5	A. maculipennis.
	July	Sedes.	same stream	8.5
Angelochori		shallow garden well overgrown.	8.0	A. maculipennis
Peraia.		metal barrel	9.0	died.
Peraia.		same stream	8.0	A. superpictus
Kran.		same stream	9.5	A. maculipennis
Matjarides.		ditches.	9.5	A. maculipennis
August		Ryssion.	sandy stream	8.5
	Aya Paraskivi.	stream	8.0	A. superpictus
	Ryssion.	mill stream	8.5	A. superpictus
	Greek Agr. School.	overgrown ditches	8.0	A. maculipennis
	Kran.	same stream	8.0	A. superpictus

also present in the open cement garden tanks of the Greek Agricultural School; these had been long neglected and were full of vegetation so that they resembled natural pools.

These limited observations suggest the following:-

- (a) The common Anophelini of the district breed in alkaline water preferring a range of from about pH 9.5 to pH 8.
- (b) The local Culicini are not nearly so selective and are to be found in water giving readings from pH 10 to pH 6.5.
- (c) Whatever the factor in water which attracts Anophelini (be it the flora, fauna, or a chemical factor) the pH reading is sufficiently often an index of its presence and so of anopheline larvae, in the district under consideration, to be of practical value to the anti-malaria worker; and the most simple technique is all that is required in the investigation.
- (d) The geological formation of Macedonia is such that a study of the reaction of the natural water is likely to be of unusual interest to the student of mosquito ecology and of value to the malaria engineer there.

## SECTION III.

I. ANTI-MALARIA MEASURES.

Anti\_malaria efforts are usually divided into Measures of defence and Measures of attack.

Measures of defence are often necessary and helpful but they are more applicable to sojourners in a malarious land than to a permanent population. They will not be discussed further here for in Macedonia to-day all efforts should be directed to attack the malaria problem au fond.

Of the Measures of attack only the two most important will be considered, namely, the Elimination of Mosquitoes and Anti\_malaria Education.

## ELIMINATION OF MOSQUITOES.

In order to have a coherent idea of the problem of mosquito breeding, and how it may become modified, and how it can be controlled, the different types of breeding place which were found in the Vasilika Valley will be reviewed. The country is far from settled and there is no doubt that within the next few years new breeding places will appear and others will disappear.

Odd breeding places such as old tin cans and gutters need not be considered at all for the local Anophelini do not select them to breed in. Tree holes may/

may be of importance because *A. plumbeus*, which is a tree hole breeder in England, has been found in Macedonia. The writer did not investigate the matter in the Valley, but the mulberry trees at Vasilika and at the Greek Agricultural School are old enough to have large holes if the farmers do not attend to them and slit the trunks when such begin to develop.

Ordinary wells were never found to harbour *Anophelini*, but that may be accounted for by the fact that there was a shortage of water and the wells were in constant use. When piped supplies are introduced and the wells fall into disuse they may constitute a danger. They might become inhabited by *A. bifurcatus*. This species of *Anopheles* breeds in rock cisterns and wells in Palestine<sup>3</sup> and it is not infrequently caught in Macedonia. There is some evidence that a well-breeding *Anopheles* is responsible for the malaria in Corinth in Old Greece, but no definite data are available.

Shallow garden wells bred *Anophelini* when they contained water vegetation. They are usually broad shallow pits, often stone lined, and are difficult to keep clear of weeds. The apparatus for raising the water to the level of the garden is worked by an animal which treads round and round the well. Oiling is the best way to control mosquitoes breeding in these. Fish would be quite efficient as the example/



example in the Greek farm School showed, but it would be troublesome to avoid drawing the fish up with the water during irrigation.

The waste water from permanently running village fountains is often a source of Anophelini. There is no doubt that no untapped water supply should be introduced to a settlement in such a malarious land unless the overflow can be rapidly conveyed far away from the houses. The refugees are accustomed to running water supplies but they adapt themselves quite quickly to the use of taps.

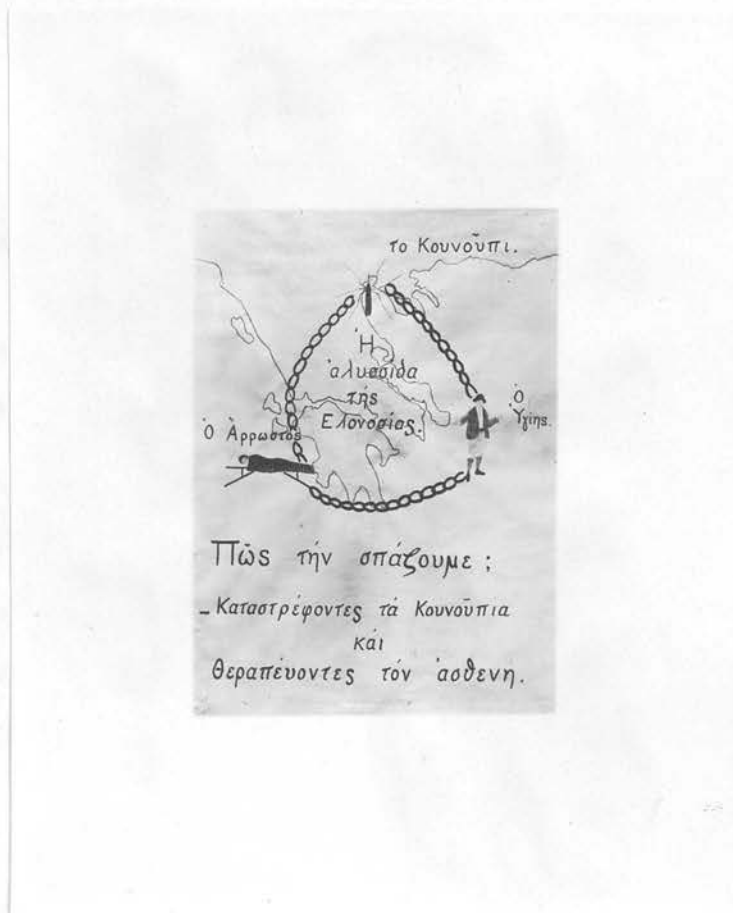
Irrigation channels are a prolific source of Anophelini. Irrigation is a matter of prime importance to the agriculturalist and the anti-malaria worker in Macedonia; the climate is such that irrigation is essential for the most valuable crops. Strict irrigation legislation cannot be introduced too soon in such a land, and agricultural schools should teach the subject.

The short hill streams, beside which so many villages are situated, and which almost invariably contain anopheline larvae, constitute perhaps the most difficult problem for the anti-malaria worker. During winter the ravines contain torrents and in summer they are dry except here and there where permanent springs occur which are the source of short streams. These streams are used by the villages for drinking, /



drinking, washing, and irrigation, and the flocks from far and near water at them. For the present therefore they cannot be buried in subsoil drains. Such streams could be trained, but the whole work would have to be redone after each heavy summer rain, and further, the work would be destroyed by the flocks trampling the ravine. Oiling, therefore, appears to be the best way of dealing with them so far as the knowledge of mosquito control goes to-day. Good Drips set up at intervals would probably give a sufficiently good film to reach the ultimate ramifications of irrigation channels.

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## POSTER A.

## The Chain of Malaria.

This poster was designed and drawn by the writer.

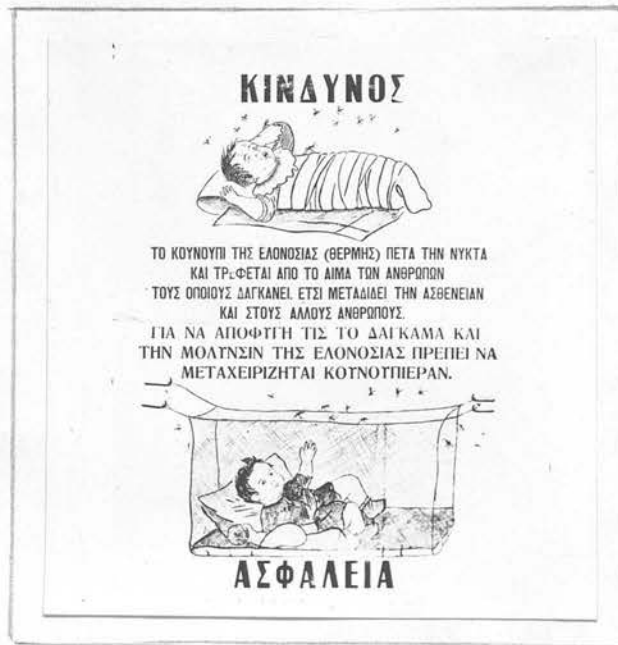
## ANTI-MALARIA EDUCATION.

This is by far the most important way of attacking malaria and will finally be the means of banishing it from the malarious parts of the earth.

It has been truly said that education along any line militates against malaria and it is the case that improvement in health is an invariable accompaniment of Western civilisation in the long run. But that does not mean that a problem like malaria can be left to solve itself with the slow advent of knowledge in other fields.

Malaria is a disease mainly of rural districts and so anti-malaria education should be as thorough in the country as in the towns, and in each land it should be adapted to the customs and mentality of its races. To be effective it must start in childhood; that is a platitude nowadays.

It is questionable whether anti-malaria education can be satisfactorily carried out unless it is made into a practical class, for it is almost impossible to convey much idea of what mosquito larvae and pupae look/



## POSTER B.

Translation.

**DANGER!**

The malaria mosquito flies about at night and feeds on the blood of the people whom it bites, and so the disease is spread from one to another.

In order to escape being bitten and avoid having malaria we should use mosquito nets.

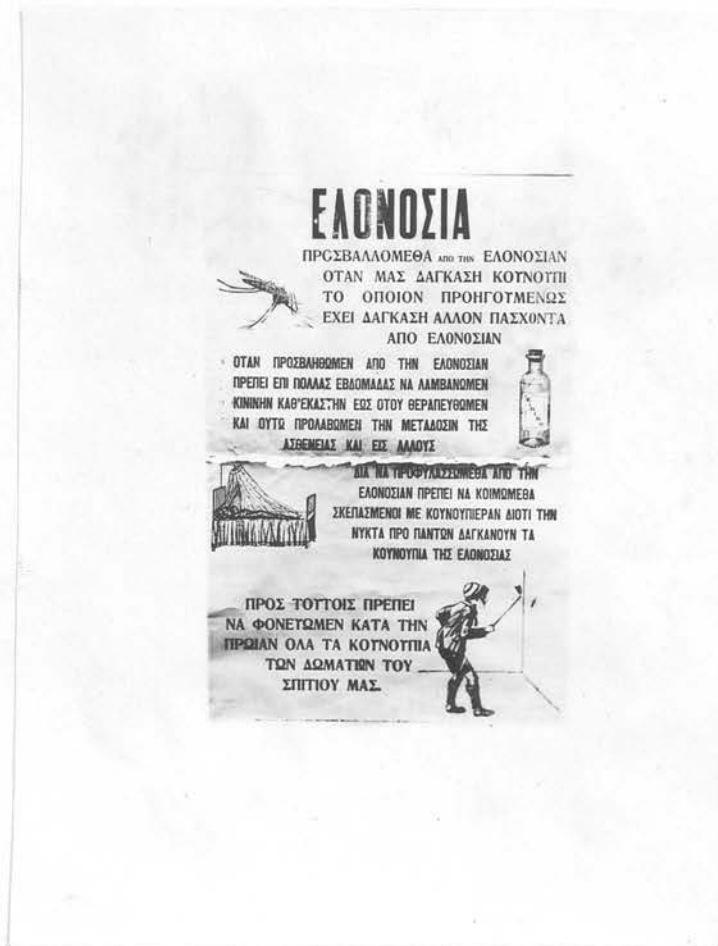
**SAFETY!**

This poster was designed by Miss D.M. Hughes and the writer, and was drawn by a German artist.

look like in nature to those who have never looked into a pool with understanding. It is therefore apparent that the Boy Scout and Girl Guide organisations are ideal institutions for training children in the subject. Firstly because they are tied to no class room, and secondly because their aim is to serve the community. It is possible that Girl Guide work would be the most valuable because the women in rural communities are the most permanent inhabitants.

Scout troops were raised in a few villages in the Vasilika Valley primarily with the object of starting anti\_malaria education.

In addition to the ordinary scout lesson at each meeting, the children were given a short anti\_malaria lesson. The poster A. was the basis of the lessons. The picture is adapted from "The Chain of Malaria" in Colonel James' book, and the chain is represented lying over the map of Greece. The three parts of the chain are held together by, (a) an anopheline mosquito, (b) a healthy child, and (c) a sick child. It is called THE CHAIN OF MALARIA and the question below is, HOW SHALL WE BREAK IT? The answer is, BY CURING THE SICK and DESTROYING THE MOSQUITOES. Obviously to be complete, BY PROTECTING THE HEALTHY, should have been added also. At the first lesson the picture was explained and a little of the history of malaria outlined. In the subsequent lessons the mosquito, the/



POSTER C.

## Translation.

We get malaria when we are bitten by a mosquito which has already bitten a malaria sick person.

If we have malaria we must take quinine every day for weeks, in order to cure ourselves and also to avoid transmitting it to others.

In order to protect ourselves from malaria we should sleep under mosquito nets, for it is at night that the malaria mosquito bites.

Especially we should kill the mosquitoes in the rooms of our houses in the morning.

This poster was designed by the writer and drawn by a Russian Refugee in Salonika.

the healthy child, and the malaria-sick child were studied in detail; and in the later lessons the methods of mosquito eradication, and protection of the healthy, and the treatment of the malaria-sick were taught. Pictures were shown whenever possible and after the lessons the Scouts searched their village for larvae, or did a little drainage of stagnant water, or investigated an experimental oil drip, and the whole subject had wide publicity.

In connection with what was said above about adapting education to the customs and mentality of a race, it was interesting to note that poster A. presented no difficulty to the Greek mind which appreciated its symbolism absolutely. It was also found that the metamorphosis of a mosquito was no new idea for Greek children to grasp, they understood it at once when it was compared with the life history of the silkworm with which they are all familiar from infancy.

Two larger posters B and C were printed for the general malaria education of the public, and were put up in schools and public places. It was also considered advisable to print a leaflet (See appendix) containing the fundamental facts about malaria, its cause, prevention, and treatment. This was done because although many pamphlets on malaria are available in Greek, the writer felt that they failed to lay stress/



stress on the most important points, and sometimes over-emphasised methods which were not particularly applicable at the time in the Vasilika Valley.

start with a...  
the new village...  
their new...  
the fact of...  
in fact...



where irrigation...  
Anopheles...  
from...  
fountains.

As the result of...  
has become...  
malaria in Macedonia...  
THE PROBLEM...  
essential to its progress...  
the attitude of...  
The...  
most, and the local...  
which are...  
There are no...  
during the summer...  
handicap of an...  
initiative.

Malaria in Macedonia is very much a...  
the/

II. A PLEA FOR ANTI-MALARIA EDUCATION IN  
RURAL MACEDONIA TO-DAY.

To the onlooker it seems that now is the time to start anti-malaria rural education in Macedonia in the new villages while they are still building up their new community life, and before they slip into the ruts of custom again. Great drainage schemes are on foot but they will not lessen malaria in villages where irrigation systems are unkept, and where Anophelini breed beside the houses in the overflow from running fountains.

As the result of War and Refugee experience, it has become rather the habit to talk with despair of malaria in Macedonia. It is indeed grave, it is THE PROBLEM before the country if the other great essential to its progress, peace, is maintained; but the attitude of despair is quite unjustifiable. The Anopheles breeding season is for seven months at most, and the local Anophelini are limited to few which are selective in their choice of breeding water. There are no 'streaming morasses' from tropical rains during the summer in Macedonia, and there is not the handicap of an utterly illiterate race without initiative.

Malaria in Macedonia is very much a place disease;  
the/

the spleen rates vary enormously within a few miles of one another, and the problem of mosquito and malaria control is hardly ever quite the same in two villages. It is unlikely that anything except rural education will lead to the solution of such a variety of small problems. Such education is likely to be very successful among settlements of people who are so experienced in community government as the Greek Refugees are.

Sir Ronald Ross has said that the true policy in anti-malaria work is the opportunist one, which can use any tool. It is certainly the policy for many villages in Macedonia, but it is essentially dependent on wide knowledge of the subject.

The Exchange of Populations which has taken place in the Near East is a heroic experiment in international history: the cost of it has been appalling: the success is already astonishing. It would be fitting if those, who decided that such was the best way of securing the future economic well-being of the races, should with as much foresight lay the foundations of their health in anti-malaria education.

My thanks are due to the staffs of the Society of Friends' Mission in Greece, and the American Farm School, for unfailing interest and help in these investigations.

I am especially indebted to Miss Alizon Fox for the photographs which she took for me.

I have to thank Mr Malcolm MacGregor for identifying *A. bifurcatus* for me, and for suggesting that I should investigate the reaction of mosquito breeding water. To Mr Alan Ogilvie I am indebted for the use of his maps and for information on the geology of Macedonia.

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Pamphlet used for anti-malaria  
education in the Vasilika Valley.

**ΠΩΣ ΠΡΟΛΑΜΒΑΝΕΤΑΙ  
ΚΑΙ ΘΕΡΑΠΕΥΕΤΑΙ  
Η ΕΛΟΝΟΣΙΑ**



Ἐξετυπώθη παρὰ τοῦ Συλλόγου τῶν Φίλων (ΚΟΥΑΚΕΡΟΙ) Θεσσαλονίκης

# ΕΛΟΝΟΣΙΑ (ΘΕΡΜΗ)

—ο·θ·οο—

Γιὰ νὰ γνωρίσωμεν τὰ κυριώτερα μέτρα πρὸς πρόληψιν καὶ θεραπείαν τῆς ἐλονοσίας παραθέτομεν τὰ ἑξῆς:

Ἡ ἐλονοσία προέρχεται ἀπὸ ἓνα πλασμώδιον, τὸ ὁποῖον ζῆ εἰς τὸ αἷμα τῶν ἀνθρώπων. **Τὸ πλασμώδιον αὐτὸ τὸ μεταφέρει ἓνα ὠρισμένον εἶδος κουνουπιῦ τὴν στιγμήν ποῦ δαγκάνει τὸν ἀνθρώπον. Καὶ ἔτσι μεταδίδεται ἡ ἐλονοσία (θέρμη).**

Ἄλλος τρόπος μεταδόσεως τῆς ἐλονοσίας δὲν ὑπάρχει.

Τὸ πλασμώδιον ἅμα μπῆ στὸ αἷμα τοῦ ἀνθρώπου εἶνε πάρα πολὺ μικρὸ, ἀλλὰ μεγαλώνει πολὺ γρήγορα καὶ πολλαπλασιάζεται εἰς πολλὰ μικρὰ πλασμώδια.

Ὁ ἀνθρώπος ποῦ πῆρε τὸ πλασμώδιον στὸ αἷμα του ἔχει πυρετὸ τὴν ὥραν ποῦ τὸ πλασμώδιον πολλαπλασιάζεται.

## ΑΝΩΦΕΛΗΣ ΚΩΝΩΨ



Τὴν ἐλονοσίαν ἡμπορεῖ νὰ μεταδώσῃ μόνον τὸ εἶδος τοῦ κουνουπιῦ ποῦ ὀνομάζεται Ἄνωφελῆς κώνωψ.

Τὸ θηλυκὸν τοῦ Ἄνωφελους κώνωπος τοποθετεῖ τὰ αὐγά του εἰς τὸ νερὸ ἢ τὴν λάσπη εἰς τὴν ἄκρα τοῦ νεροῦ. Ἐπειτα ἀπὸ ὀλίγας ἡμέρας θγαίνει ἀπὸ τὸ αὐγὸ ἡ προνύμφη (σκώληξ). Κινεῖται στὸ νερὸ καὶ μεγαλώνει γρήγορα. Εἰς αὐτὸ ἐπιδρᾷ πολὺ ἡ θερμοκρασία καὶ ἡ ἐποχὴ τοῦ ἔτους. Ὅταν ὁ καιρὸς εἶνε καλὸς, ἀρκοῦν ὀλίγες μέρες. Ὅταν ὅμως εἶναι κρύο, τότε ἀπαιτοῦνται μῆνες. Ἡ προνύμφη μεταμορφώνεται εἰς νύμφην καὶ ἔπειτα ἀπὸ ὀλίγας ἡμέρας ἡ νύμφη γίνεται τέλειο κουνουπι. Πετᾷ ἐπάνω ἀπὸ τὴν ἐπιφάνειαν τοῦ νεροῦ καὶ εἰς τὸ ἑξῆς ζῆ εἰς τὸν ἀέρα.

Τὸ κουνουπι αὐτὸ δὲν εὐχαριστεῖται στὸν ἥλιον. Ἀρχίζει νὰ δαγκάνῃ πρὸς τὸ βράδυ καὶ ἑξακολουθεῖ τὴν νύκτα καὶ τὰ ξημερώματα. Κατὰ τὸ δίαστημα αὐτὸ τρέφεται ἀπὸ τὸ αἷμα τῶν ἀνθρώπων.

Κατὰ τὴν διάρκειαν τοῦ χειμῶνος τὰ θηλυκὰ κουνουπία ζοῦν προφυλαγμένα στὲς σκοτεινὰς γωνίαις τοῦ σπιτιοῦ, στοὺς σταύλους καὶ στὰς ἀποθήκας. Ἀλλὰ μόλις ἀρχίσῃ ἡ ἀνοιξίς ἀρχίζουν καὶ αὐτὰ νὰ πετοῦν καὶ νὰ δαγκάνουν.



# ΘΕΡΑΠΕΙΑ ΤΗΣ ΕΛΟΝΟΣΙΑΣ

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Τὸ ἀποτελεσματικώτερον φάρμακον γιὰ τὴν θεραπείαν τῆς ἐλονοσίας εἶναι ἡ **κινίνη**, ὅταν ἐννοεῖται ξεύρωμεν νὰ τὴν χρησιμοποιήσωμεν ὅπως πρέπει. Ἡ κατάλληλος χρησιμοποίησις ἔχει ὡς ἀποτέλεσμα νὰ ὀλιγοστεύτῃ τοὺς πόνους τοῦ ἀσθενοῦς καὶ τὴν ἀνικανότητά του πρὸς τὴν ἐργασίαν καθὼς καὶ τὸν κίνδυνον τῆς μεταδόσεως.

Ἡ κινίνη πρέπει νὰ λαμβάνηται **τακτικά**.

Ἄν εἶναι δυνατὸν **πάντοτε ἐσωτερικῶς**.

Ὁ ἐνήλικος θὰ λαμβάνῃ τὲς τρεῖς πρώτες ἡμέρες τῆς ἐλονοσίας, τὴν ἡμέραν τρεῖς φορές κινίνην, ἀπὸ 0.65 γραμμάρια καθεστράν. Κατόπιν θὰ περιορισθῇ εἰς μίαν φοράν τὴν ἡμέραν ἀπὸ 0.65 γραμμ. ἐπὶ ἕνα μῆνα συνεχῶς, ἂν εἶναι δυνατὸν ἐπὶ τρεῖς μῆνας.

Εἰς ἐξαιρετικὰς περιστάσεις, ὅταν δηλαδὴ ὁ ἀσθενὴς κἀνῆ ἑμετὸν ἢ εἶνε ἀναίσθητος ἀπὸ τὸν πυρετὸν, τότε εἶνε ἀνάγκη νὰ γίνηται ἔνεσις κινίνης. Ἀλλὰ μόλις περάσῃ ἡ κρίσιμος περίοδος, ὁ ἀσθενὴς πρέπει νὰ λαμβάνῃ τὴν κινίνην ἐσωτερικῶς καὶ τακτικά.

Τὸ ἄτομον ποῦ προσβάλλεται ἀπὸ ἐλονοσίαν πρέπει νὰ πίνῃ ἀφθονα ποτὰ καθὼς νερό, τσάϊ, λεμονάδα, κτλ.

## ΠΩΣ ΜΕΤΑΧΕΙΡΙΖΟΜΕΘΑ ΤΗΝ ΚΙΝΙΝΗΝ

ΩΣ ΠΡΟΦΥΛΑΚΤΙΚΟΝ ΜΕΤΡΟΝ

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Ἄν εὑρεθῶμεν εἰς μέρος ὅπου δὲν εἶνε δυνατὸν νὰ ἀποφύγωμεν τὰ δαγκάματα τῶν κουνουπιῶν, τότε λαμβάνομεν τὴν κινίνην μετὴν ἐλπίδα ὅτι θὰ προλάβωμεν τὴν ἐλονοσίαν.

Ὅφειλομεν διὰ τοῦτο νὰ λαμβάνωμεν μίαν δόσιν ἀπὸ 0.65 γραμμ. κατὰ τὸ δράδυ, διὰ νὰ κυκλοφορῇ εἰς τὸ αἷμα τὴν νύκτα, ὅποτε τὰ κουνούπια δαγκάνουν τοὺς ἀνθρώπους.

## ΠΩΣ ΠΡΟΛΑΜΒΑΝΕΤΑΙ Η ΕΛΟΝΟΣΙΑ

### α) Όταν προφυλάγεται τὸ ἄτομον.

Ὁ ἄνθρωπος πρέπει νὰ ἀποφεύγῃ μὲ κάθε τρόπον τὸ δάγκαμα τοῦ κουνουπιοῦ. Ὁ ἄνωφελῆς κώνωψ δαγκάνει τὴν νύκτα.

Νὰ διαδοθῇ παντοῦ ἡ χρῆσις τῆς κουνουπιέρας.

Συνιστᾶται ὅπως τὰ παράθυρα καὶ αἱ πόρτες τῶν σπιτιῶν ἔχουν πυκνὰ συρματοπλέγματα, ὥστε νὰ μὴ μπαίνουν τὰ κουνούπια.

### β) Όταν καταστρέφονται τὰ Κουνούπια.

**Πρῶτον μέσθ στὸ σπίτι.** Πρέπει νὰ πικρατηρῶμεν τῆς γωνίες τῶν σπιτιῶν μιὰ φορά τὴν ἡμέρα, μήπως ὑπάρχουν κουνούπια καὶ νὰ τὰ σκοτώνωμεν. Αἱ νοικοκυρῆς πρέπει νὰ φροντίζουν γι' αὐτὸ, ὅπως φροντίζουν διὰ τὸ καθάρισμα τοῦ σπιτιοῦ. Τὰ παιδιὰ πρέπει νὰ βοηθοῦν τὴν μητέρα εἰς αὐτό.

**Δεύτερον ἔξω ἀπὸ τὸ σπίτι.** Ὀφείλομεν νὰ προλαμβάνωμεν μὲ κάθε τρόπον τὰ στεκούμενα νερὰ. Ὅσον ὀλιγώτερα ἔλη ὑπάρχουν εἰς ἓνα τόπον τόσο ὑγιεινότερος εἶνε ὅπου σχηματίσθησαν πλέον ἔλη μεταχειριζόμεθα τὸ πετρέλαιον τὸ ὅποσον ραντίζομεν εἰς τὴν ἐπιφάνειαν τοῦ νεροῦ. Διότι μὲ αὐτὸ καταστρέφονται αἱ νύμφαι καὶ παραλύουν τὰ πτερὰ τῶν μεγάλων, ὥστε νὰ μὴ μποροῦν νὰ πετάξουν. Ὅλα τὰ ἀναρριχητικὰ φυτὰ εἶνε βλαπτερὰ κατὰ τοῦτο, διότι δίδουν ἄτυλον στὰ κουνούπια τὴν ἡμέραν. Τὸν χειμῶνα πρέπει νὰ φροντίσωμεν μὲ κάθε τρόπον νὰ καταστρέψωμεν τὰ κουνούπια ποῦ ἐζήτησαν προστασίαν στὲς σκοτεινὲς γωνίες τῶν σπιτιῶν μας, στοὺς σταύλους καὶ τὰς ἀποθήκας.

Πρέπει πρὸ τῶν Χριστουγέννων νὰ ἀσπρίζωμεν. Ἔτσι σκοτώνονται τὰ κουνούπια ἀλλὰ καὶ ἂν διαφύγουν μερικά, θὰ καταστραποῦν, ἐπειδὴ μένουν ἐκτεθειμένα εἰς τὸ ψῦχος. Ἐνῶ ἀσπρίζωμεν δλέπομεν ποῦ εἶνε τὰ κουνούπια καὶ τὰ καταστρέφομεν εὐκολώτερα.

## Appendix.

Translation of leaflet used for anti-malaria education.

HOW TO AVOID AND TREAT MALARIA.

Malaria.

The most important means of preventing and treating malaria will be understood if we appreciate the following:-

Malaria is caused by a plasmodium which lives in the blood of man. This plasmodium is conveyed by a special kind of mosquito at the moment when it bites man, and so the disease is spread.

No other way of conveying malaria exists.

At first the plasmodium in the blood in man is very small, but it grows quickly, and multiplies into many plasmodia.

The man who has the plasmodia in his blood has fever at the time when it is multiplying.

The Anopheles Mosquito.

Malaria can only be carried by a special kind of mosquito, which is called the "Anopheline mosquito".

The female Anopheles lays her eggs in water or in the mud beside water. After a few days a pronymph emerges which moves in the water and grows quickly, depending on the temperature and the time of year. When the weather is fine it takes a few days (to grow) but/

but when the weather is cold it may take months. The pronymph changes into a nymph, and after a few more days the nymph changes into a perfect mosquito. Then it flies up from the surface of the water and the rest of its life is spent in the air.

The mosquito does not like the bright sunshine so it bites at dusk, and especially at night and just before dawn, and feeds on the blood of man then.

During the winter the female mosquito lives hidden in dark corners in houses, and stables, and barns, but as soon as spring comes she begins to fly about and bite again.

#### The Treatment of Malaria.

By far the best medicine for the treatment of malaria is quinine, when we understand how to use it properly.

The best use of it results in lessening the distress of the sick person, in removing his inability to work, and in lessening the danger of conveying the disease to others.

Quinine must be taken regularly.

When it is possible it must be taken by the mouth.

For the first three days of the malaria 0.65 gramme should be taken three times each day. After that 0.65 gramme should be taken once a day for at least a month, if possible for three months.

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In exceptional circumstances, that is to say, when the sick person is vomiting very much or is unconscious with the fever, it may be necessary to give an injection of quinine. But as soon as the severe period is over the sick one should take the quinine by the mouth regularly again.

The person who has malaria should take abundance of fluid, such as water, tea, lemonade, etc.

#### How to Take Quinine as a Preventive Measure.

If we happen to be in a place where it is not possible to avoid mosquito bites then we may take quinine in the hope that we may prevent malaria.

It is necessary for this to take 0.65 gramme quinine each evening in order that it may circulate in the blood at night which is the time when the mosquito bites.

#### How to Avoid Malaria.

##### (a) To protect the individual.

We must try to avoid mosquito bites by all possible means. The Malaria Mosquito bites at night so mosquito nets should always be employed. It is advisable also that the doors and windows be covered with fine wire gauze in order that mosquitoes may not enter the house.

(b)/

(b) To destroy the mosquitoes.

Firstly, in the house.

We must look in the corners of the house each day lest mosquitoes are there, that they may be killed. The house-wife should be as careful of this as she is of the cleanliness of the house, and the children can help her in it.

Secondly, outside the house.

We must avoid having standing water near with all care. The less there is in any place the more healthy it will be. Where there are wide marshes we can throw oil on the surface of the water and that will kill the nymphs and clog the wings of the grown mosquitoes so that they cannot fly. All wild vegetation is harmful also because it gives shelter to the mosquitoes by day. In winter we should try to destroy the mosquitoes which go for shelter into the dark corners of our houses, stables, and barns.

We should whitewash the houses before Christmas and so the mosquitoes will be killed, and even if a few fly out they will perish in the cold outside. Further when we whitewash we can see more clearly where the mosquitoes are and can destroy them more easily.