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OBJECTIVES AND ACHIEVEMENTS OF THE WHO MALARIA PILOT PROJECT IN THE AWASH VALLEY, ETHIOPIA: 1956 - 1959.

by

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1. INTRODUCTION.

The Awash Pilot Project was formed as the result of the Tripartite Agreement between UNICEF, WHO, and the Imperial Ethiopian Government. Main objectives of the Agreement were the establishment of a Pilot Project to demonstrate in Ethiopia control methods using residual insecticides with a view to stopping the transmission of Malaria: investigations were also to be made into the problems related to an eventual future malaria eradication programme for the country.

Previous to the establishment of the Malaria Project in the Awash Valley in the autumn of 1956, and the related I.C.A. project in the Kobbo Chercher plain, all information related to malaria had been based on surveys. Surveys had been made by Italian workers during the period 1936-1941, and by the Mobile Malaria Section of the East African Medical Corps during 1941-1942. A comprehensive survey was carried out during the autumn of 1955 by Sir Gordon Covell, WHO-Consultant, who maincained that malaria was widespread throughout the country. He also pointed out the important role played by altitude and considered that the endemicity is usually low at levels between 1675 to 1980 meters (5500 to 6500 feet), but that such areas were subject to regional epidemics. However on the whole very little was known of the feasibility of the interruption of malaria transmission by residual insecticides.

After the establishment of the Project and following the initial surveys, it was realised it would be a difficult task to make systematic studies due to the thin and scattered population groupings, and to the poor condition and lack of communications. National trained personnel were deficient, and one Malariologist (the writer) and a Sanitarian

were supplied by WHO. The Project was without an Entomologist until February 1958. Due to the difficulties of supervision with a limited trained staff, the programme of work had to be kept to a minimum.

From an assessment of the results over the past three years it appears that the interruption of malaria transmission is feasible in the plateau areas of the country, with however some reservations regarding that part of the population subject to population movements. It is however my belief that before eradication should be contemplated, the administrative, budgetary, and personnel policies of the Government relating to malaria should be revised in order to meet the exacting standards and demands required for an eradication programme.

2. DESCRIPTION OF THE AREA.

The Pilot Project is situated in the main along the depression formed by the Rift Valley and follows the course of Awash River. A small part of the Project continues along the upper reaches of the Awash River on to the plateau.

The area is formed of the laterites of the lava plateau which drop to the forest and arid savannah country of the Rift Valley. Savannah (steppe), forest, and desert predominate to the east, and forest and cultivated areas to the west. In the western sector along the Modjo-Sheshamana highway and towards the foothills of Mount Zuquala, the forest has been partly cleared and the land cultivated. Areas of forest are however spread all over the zone but in the east this is broken by savannah plains. To the east of Mount Meta in the Methihara-Awash area, are found savannah with high yellow grass interspersed with scattered trees.

In the forest areas the humidity is higher and more consistent and where dense vegetation is in conjunction with the alluvial plain the insect life is usually very intense.

The Pilot Project zone in the Awash valley extends over a distance of 180 kms. in length, and varies in width from 18 to 45 kms. Towards the northern boundary are the highway and the Addis Ababa-Diredawa railway, and along the southern boundary the River Awash flows. The western limit is a line bearing through Debra Zeit town, and the eastern limit terminates at Awash Station.

The altitude varies greatly. In the Debra Zeit area the higher elevations reach 1950 m. The altitude progressively drops from the plateau by broad terraces towards the east, and on the Danakil plain at the periphery of the zone, the altitude falls to 800 m. above sea level.

The area covered during the first year of the Pilot Project was estimated at 2300 square kilometers, and with the extension of the following year it was increased to almost double at 4,500 square kilometers. The zone, in spite of the increased area, does not have natural boundaries in all directions. This is especially the case to the south-west where the depression of the Rift Valley extends towards the lakes.

In the western part of the zone from Debra Zeit to Wolenchiti, cultivation with cereals is rather extensive. The area to the east of Wolenchiti is volcanic with bare hills and extensive bush and forest. It is thinly populated, the land being mostly used for the grazing of herds of cattle.

3. CLIMATE

Due to the high elevation of the Ethiopian plateau, there exists three main climatic regions: the tropical areas of the west, the arid areas in the north, east and south west, and the tropical highlands of the plateau. The Pilot Project zone is established between latitudes 8° - 9° north and belongs partly to the highlands and partly the arid areas of the east.

The dry season in the Pilot zone extends from October to June though some intermittent rains known as the small rains occur from March to May.

The south west monsoon rains commence towards the end of June until late September and form the main rainy season. The western and south western provinces of the country have the heaviest rainfall with an average of above 2,000 mm. (80 inches). The lowest rainfall is observed in Harrar and Sidamo Provinces and on the Red Sea Plains of Eritrea where the annual average is less than 500 mm. (20 inches). In the Pilot Project zone the average annual rainfall ranges between 600-1200 mm. (24-48 inches).

The relative humidity in general follows the rainfall and shows an annual average in the Pilot Project zone of somewhat more than 55%.

The average temperature ranges between 20° - 21° C. in the Pilot Project zone. In Awash Station the isotherm is 25° however. The mean annual temperature varies little and the absolute temperatures recorded in Nonji, 15 kms. south of Nazareth, over a period of seven years, were 6.2°C. and 32.4°C.; at Debra Zeit, 50 kms. north of Nazareth, were 6.0°C. and 31.7°C. The average minimum temperature for the coldest month was 15.8°C. and the average maximum of the warmest month was 25°C. At higher elevations on the plateau the isotherms range between 10°C. and 15°C.

4. COMMUNICATIONS

The Pilot zone has essentially one all weather road, namely the Addis Ababa-Awash highway which is not maintained east of Wolenchiti. The Addis Ababa-Djibouti railway is an important means of communication for the zone. Other all weather roads connect the zone with the southern province of Arrousi (Assella road), and the Shashamana road which runs past the lakes of the Rift Valley. These two roads facilitate communications in only a small part of the zone. All other districts in the zone are connected by tracks and paths formed mainly by the indigenous population and by cattle. Many of these dry weather tracks are passable by car but during the rains most localities can be reached only on foot or by animal transport.

5. POPULATION

The Pilot zone is inhabited mainly by the following tribes - Amharas, Gallas, Danakils, and Somalis. The western district from Debra Zeit to Nazareth and the towns especially, are inhabited by Amharas. The rural areas around Modjo, Nazareth, and Wolenchiti are settled almost exclusively by Gallas. Further to the east is found a tribe of Gallas known as the Karayu who are semi-nomads. In the Metihara to Awash sector are the Adal tribe of Danakils and some Somalis.

The area of the first year of the Pilot zone (1957) extended from Nazareth to Metihara, and included a population of 54,000, of which 17,000 resided in Nazareth town. The main occupation of this population is farming and livestock. The Project zone was extended for the second year's operation towards the northwest and to the east making a total population of 136,000. The population of the eastern sector, who are mainly Karayu and Danakils, do not cultivate the land and rely exclusively for a living on their animals, mainly cattle and camels.

6. HOUSING

Throughout the zone, the most common form of dwelling is the tukul or round hut surmounted by a conical thatched roof. Usually the walls are supported by a wooden frame of poles and branches and the interstices are plastered with a mixture of mud and straw. Often the tukuls of the Gallas have walls constructed only of poles and thin leafy branches. To the east among the Karayu and Danakil, the walls of the tukuls are formed of straw or grass mats. These walls are dismantled by the owners once or more during the year and are transported on camel back to distant areas to fresh pastures for grazing the animals.

The average diameter of a tukul is about 5 meters and the average height at the centre is 3.5 meters. In addition to the circular type of tukul, there is a rectangular type of hut often more than 10 meters long with a number of rooms in a row.

In the towns of Nazareth, Debra Zeit, and Modjo, a better type of dwelling is predominant with stout mud or stone walls and roofed with corrugated iron.

An important characteristic of the zone is the fact that the greater part of the rural dwellings are scattered with no semblance of community life, and not collected together in anything resembling villages. The dwellings and tukuls are spread out forming separate units of a few tukuls scattered usually at considerable distances from each other, and thus dotted all over the valleys of the zone.

7. AGRICULTURE

In the zone maize, "Teff", oats, wheat, and other crops flourish. The produce of the Dutch Sugar Cane plantation at Wonji supplies the needs of the country in sugar. Recently successful trials have been made along the River Awash and its tributaries for cotton, sisal, and coffee growing schemes.

Enormous herds of cattle are maintained in all parts of the zone. The population however who are dependant on livestock are not stationary. In all parts of the zone at certain periods of the year, mainly the rainy season, this population leaves its traditional localities and trek often long distances to fresh grazing grounds over a wide area. During this period the migrants erect temporary straw huts and later return to their own localities after an interval of two or three months.

8. MALARIA PREVALENCE

The initial survey in the Pilot zone was made during the period November, December, 1956 and January 1957. Children of ages 2 - 9 years were mainly examined although a number of infants, adolescents, and adults were also examined. Due to the almost non-existence of communities in the area, with the exception of a few settled villages, the greatest possible number of localities or groups of scattered dwellings were taken and a representative sample of children from such localities were examined. The endemicity of the disease was found to vary from hypoendemic to hyperendemic and holoendemic malaria. Along the River Awash and its tributaries, in the alluvial plains, and in areas where potential breeding places are found during the rainy season, the incidence of the disease is high. The highest elevation (1650 m.) in the zone during the first -- operations (1957) was not an obstacle to the prevalence of malaria. The results of this survey are included in Table I.

As a result of the difficulties and conditions already discussed, it required a tremendous exertion in order to be able to succeed in the examination of more than 2,000 persons (including adults) during the two months of the pre-operational survey. The highest spleen rates were found among the age groups 5- years. The rates for adolescents and adults in the hyperendemic areas were found to be relatively high - perhaps because immunity had not been acquired. In the holendemic areas at lower elevations - Mcti, Danakil plain, the rates among adults proved to be low and it was observed that many adults were suffering from malaria without marked clinical symptoms. During that survey and before spraying, the plasmodia prevalence was noted to be:

Pl. falciparum	59.3%
Pl. vivax	34.7%
Pl. malariae	0.6%
mixed infections	5.4%
	100 %

The appended Tables include data from the surveyed localities on the distribution of plasmodia species giving percentages. (See Tables II and III).

The parasite rate and the infant parasite rate furnished by the initial survey was relatively low and this was also the case in the check area. This is attributed to the fact that he survey was carried out in most localities after the transmission season had passed. The malaria incidence in the control area prior to residual spraying showed a general spleen index of 48.3% and may be rated as mesoendemic. It is estimated that half of this population lived in areas with moderate or low endemicity and was subject to periodical epidemics. The other half of the population lived in hyperendemic areas. However later observations, especially during the epidemic year of 1958, point to the probability of a greater potentiality to malaria in both the control and check areas than is indicated in the above rate.

9. MALARIA TRANSMISSION

From the first, entomological observations showed that A. gambiae was present in all captures made in all parts of the zone. It was found breeding predominantly in sunny open breeding places and irrigation ditches and sunlit pools. The density of A. gambiae is much dependent on the time of year and on the amount of rain-fall. Where breeding places are not perennial a marked increase in density is noted during and at the end of the rainy season. Along the River Awash and in vicinity of permanent breeding places, increases in density were marked with however little or no relationship to rains and temperature e.g. Sodore.

The adult is highly domestic and was frequently found in human habitations and very often during the day time, previous to the insecticide spraying. The impression was gained that it did not have any special resting preferences as to height on the walls of the dwellings. It seemed sometimes to prefer the lower sections when these gave more protection. If the habitation was suitably dark A. gambiae was commonly found up to heights over 5 ft. and on the thatched ceilings.

Serological examinations were performed by the Lister Institute, England, in early 1957, on 127 blood meals from Merti where numerous herds of cattle and other domestic animals are found. The examinations showed 71.4% positive for human blood and 28.6% positive for blood of mammals and birds. This confirmed A. gambiae as being highly anthropophilic.

The sporozoite rate for A. gambiae found in Methihara-Merti in January and February 1957 was 0.15% which is relatively low. (1/633). The dissections though restricted in number were made at the end of the transmission season for that area. Further dissections carried out by Dr. P. Jolivet over a period of six months in 1958 proved negative for sporozoites (0/630).

A. pharoensis is the second vector species found in quantity in the zone, and is especially prevalent along the River Awash. The larvae were found in irrigation ditches in sugar cane and rice plantations. The adults were often found in dwellings in densities exceeding those of A. gambiae at the commence of the dry season (November-December). A small number were dissected but proved negative for sporozoites (0/126). A. funestus and A. nili have been found by Dr. P. Jolivet in 1958 in the mosquito trap at Sodore and in some other places along the River Awash, but in very low densities. (10 A. funestus and 3 A. nili were collected in a period of six months).

The fixed population is in the main spending the night inside the dwellings. In view of the endophilic habit of the main vector, malaria transmission occurs mostly within the dwellings. Conditions, therefore, are for the most part favourable for the protection of the population by residual spraying. However, some of the semi-nomads who make up a minor proportion of the population, travel at certain periods during the night. Such night movements may set a minor problem.

The transmission of the disease is related to the ecology of the vector in each locality. A. gambiae appears to be highly attracted to human dwellings and characteristically the higher rates coincide with the higher densities.

Observations have shown that when this species is found alone, the transmission season is related to the fluctuation in its numbers depending greatly on the weather conditions (rainfall, relative humidity).

The transmission season in Wolenchiti and Borchota, where the breeding places are available only during and after the monsoon rains, is of shorter duration having a single peak from September to early December.

On the other hand in the lower levels of the River Awash, in the area Merti-Awash, the transmission season is definitely longer with two peaks. One peak takes place in April and May and the second from September to January following the small and the monsoon rains. Positive newly born infants have been found in this area during January.

10. SPRAYING OPERATIONS.

Spraying operations have been carried out in the Pilot Zone for three consecutive years. All the interior surfaces of all structures and tukuls have been sprayed including walls and ceilings without regard to height. Spraying operations in the rural areas are extremely difficult mainly due to the fact that the dwellings are widely dispersed, with the result that a great deal of time is taken up in reaching the scattered tukuls. It is common in the zone to treat dwellings which are vacated at the time of the spraying operations and which may be occupied for only several months in the year. However, during the campaign, all surfaces are treated in order to ensure a blanket spray.

As there is little or no water in most localities, it is necessary in most cases to transport the water required for the spraying in trucks over long distances. In areas inaccessible to motor transport, the problem of supplying the teams with water presents a serious problem. There is very little in the way of organised mule transport in the zone, and when this cannot be obtained the spraying materials and water are carried by porters.

There has been an insufficiency of competent subordinate field personnel. This gap will now be filled by staff being trained in the Malaria Eradication Training Centre in Nazareth and with Fellowships abroad.

The dates of the annual residual spraying campaigns were as follows:

First Year	-	April-June, 1957
Second Year	-	June-August, 1958
Third Year	-	April-July, 1959

75% DDT water dispersible powder was the insecticide in use during the three years, with the exception of a small area which was treated with dieldrin 50% wdp. during the first two years. However the results obtained by dieldrin appeared to be inferior to those obtained by DDT, and it was accordingly decided to treat the entire zone with DDT during the third year. One spraying cycle was carried out yearly starting two months before the commencement of the monsoon rains. Dosage of DDT: 2.0 grms. technical grade per sq.m. Dosage of Dieldrin: 0.5 and 0.6 gms. technical grade per sq.m.

Brief Analysis of Residual Spraying Campaign May-July 1959.

1.	Average superficial area treated per capita (sq.m.)	33.5
2.	Average superficial area sprayed per dwelling (sq.m.)	100.6
3.	Average number of inhabitants per dwelling	3.0
4.	Superficial area treated per man/hour of disinfector (sq.m.)	191.0
5.	Technical DDT consumption per capita directly protected (g)	67.4

Cost of Spraying Operations - 1959*

Item	Description	U.S. $	% of Total
1.	Salaries of spraying personnel and staff	10,972	43
2.	DDT including freight to Addis Ababa	7,640	30
3.	Spraying equipment - depreciation	528	2
4.	Transport - vehicle depreciation, P.O.L.	4,920	19.5
5.	Miscellaneous supplies and incidentals	1,386	5.5
		$ 25,446	100

Note

* The costs have been calculated on an annual depreciation of 25% for sprayers and on a monthly depreciation of 2% for vehicles. The figures also include the activities of the squads employed throughout July and August in checking and following up activities. Benzine costs US.$0.89 per Imperial Gallon which inflates transport costs.

The number of persons directly protected was 136,446 and the cost per capita for the spraying operations was U.S. $18. This figure is not considered high in view of the inaccessibility and scatter of the localities, that all water had to be transported, and that a blanket spray was given to all structures and premises whether inhabited or not.

11. EFFECT OF THE MALARIA CONTROL CAMPAIGNS

The spraying operations produced a marked decrease in the spleen and parasite rates over the sprayed zone. (See Table IV.) On the other hand an increase in the rates was found in the Check Area after the 1957 monsoon rains. In the sprayed zone only two infants of a total of 374 infants showed blood positive for malaria parasites after a period of 9 and 10 months and after the first spraying campaign (see Table V). These infants however lived in villages on the periphery of the sprayed zone near the Awash River. As this population is semi-nomadic it is not clear if they left the zone or not during the period.

The parasite rate dropped after the first year's spraying from 13.3% to 2.9%, after the second year to 1.0% and after the third year to 0.9%. These results must be considered as very satisfactory in those areas where the population remains static throughout the year. The impression is that malaria transmission very rarely takes place inside dwellings in the isolated communities where the people sleep indoors and where replastering and internal house repairs are kept to a minimum (e.g. Wolenchiti, Melcasillo, Bofe). It is more of a problem in the localities with widely dispersed dwellings having no community life, and especially with the semi-nomadic population.

The main vector A. gambiae decreased considerably in number after spraying. Along the River Awash where it is thinly populated, the density was not much affected. However the area of sprayed surface there is insignificant in relation to the extent and number of breeding places.

Bio-assay and Susceptability Tests

During a period of 14 months from March 1958 to May 1959 28 bioassay tests were carried out. Wall surfaces tested included ordinary mud, limewashed mud, both lain and limewashed stone and cement, and thatched roofs. Walls constructed of sticks or branches however presented difficulties and could not be tested. The bio-assay tests were carried out by Dr. P.Jolivet and Mr. K. Thymakis. In all, 4023 anophelines were tested. The mortality rate after 6 to 10 months after spraying ranged between 60% - 100%.

A. gambiae and A. pharoensis were tested repeatedly in the zone during 1958 and early 1959, and showed no signs of resistance to either DDT or Dieldrin.

12. MALARIA EPIDEMIC

In 1958 during and after the rainy season, there was an outbreak of a very severe malaria epidemic, mainly in the plateau areas of the country. The epidemic had the characteristics of a regional epidemic with abnormal morbidity

and mortality rates. The WHO protected area was not affected by the epidemic. Though a discussion of the epidemic is not within the scope of this paper, it however emphasises the need for decision and action as such disasters will otherwise continue to devastate the country.

13. SURVEILLANCE

After the recent third spraying campaign a programme of surveillance was established in the Pilot Project zone now sprayed for three consecutive years. It is anticipated that approximately a population of 39,000 will be under surveillance, 32,000 under active and 7,000 under passive surveillance.

SUMMARY

According to the Tripartite Agreement between the Imperial Ethiopian Government, UNICEF, and WHO, a Malaria Eradication Pilot Project was established in the Awash valley, Ethiopia and centred in Nazareth town.

The effects of the spraying campaigns carried out for three consecutive years proved to be very satisfactory. The general spleen index of the area dropped from 48.3 to 13.1, and the parasite rate from 13.3 to 0.9%.

The cost of the spraying campaign per capita directly protected was U.S.$0.18 per annum.

A. gambiae is the principal vector in the zone. A. pharoensis may have an importance as a secondary vector.

No resistance to the insecticides DDT or Dieldrin have so far been found in A. gambiae or A. pharoensis.

The project programmes demonstrated that the interruption of malaria transmission is technically feasible, with some reservations with regard to the population movements.

The writer concludes that malaria eradication is technically feasible in the plateau areas of the country but that it is dependent on the solution of the serious problems of communication and finance.

ACKNOWLEDGMENTS

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TABLE I

RESULTS OF THE PRE-OPERATIONAL SURVEY

IN THE AWASH PILOT ZONE, NOVEMBER 1956-JANUARY 1957.

LOCALITY	Children Examined 2-9	Infants	Spleen Rate %	AES	Parasite Rate Children 2-9 only - %
A. CONTROL AREA.					
Bobe	16	2	69.0	2:3	30:0
Dongoreh	31	3	25.9	1.4	12:9
Bofe	37	2	33.3	1.8	16.5
Wolenchiti	69	2	56.0	1.7	30.8
Godedera	28	0	35.5	1.4	14.3
Dere	43	1	26.0	1.7	9.3
Nurraherre	32	4	90.6	2.0	43:7
Bosset	63	4	43.5	1.9	14.6
Dache	24	0	100.0	2.7	33.3
Siffa	15	1	78:5	2.4	46.6
Soloke	24	0	25.0	1.5	0
Debbe	12	1	8.3	2:0	0
Didibissa	15	3	20.0	1.0	0
Galcchou	37	2	29:7	1.5	4.5
Infalou	22	1	31.8	1.4	16.6
Sodore	28	0	82.4	2.1	42.8
Metihara-Merty	58	4	55.1	1.9	13.3
Abomsa	112	12	52.6	1.6	23.0
W. Borchota	15	0	93.3	2.4	40.0
Nazareth	450	0	21:1	1.2	3.1
Melca-Jillo	63	3	69:0	2.2	22.2
Sera-Tibila	42	0	50:0	1.6	4.6
Gougza	23	1	26.0	1.1	0·
Borre	18	1	77.7	-	11.0
Total or Average	1277	47	48.3		13.3
B. CHECK AREA					
Awash	64	4	32.8	-	9.3
Dohino	16	0	80.0	-	31:2
Amadas	25	2	100.0	-	40.0
Melcadubra-Boleta	16	1	61.0	-	40.0
Alibeta	36	0	91.6	-	-
Arba	56	7	51.7	-	10.0
Total or Average	213	14	61.0		20.0

TABLE I -- Continued

LOCALITY	Children Examined 2-9	Infants	Spleen Rate %	ABS	Parasite Rate Children 2-9 only - %
C. EXTENSION AREA (and other neighbouring areas).					
Koka	29	3	65.5	1.8	-
Dugda	16	1	42.8	1.5	-
Chufa	18	1	83.3	2.2	-
Gundi	41	1	7.3	1.3	-
Hourouta	114	7	21.0	1.1	-
Tafarei-Braha	47	3	10.6	1.4	-
Ferekassa-Selassie	32	1	12.5	1.2	-
Total or Average	297	17			

TABLE II

PLASMODIAL SPECIES DISTRIBUTION AND PREVALENCE

Initial Survey in Awash Valley - Ethiopia

LOCALITY	Number of Positive Cases				Percentage distribution			
	P.falciparum	P.Vivax	P.malariae	Mixed Inf.	P.falciparum	P.Vivax	P.Malariae	Mixed Inf.
A. CONTROL AREA								
Bobe	1	5	0	0	16.5	83.5	0	0
Dongoreh	3	1	0	0	75	25	0	0
Bofe	4	1	0	1	67	16.5	0	16.5
Golenchiti	13	4	0	1	72.5	22.5	0	5
Godedera	3	1	0	0	75	25	0	0
Dera	1	3	0	0	25	75	0	0
Nurraherra	8	4	0	2	57	28.5	0	14.5
Siffa	5	1	0	1	71.4	14.3	0	14.3
Bosset	8	1	0	0	89	11	0	0
Dache	6	1	0	1	75	12.5	0	12.5
Soloke	0	0	0	0	0	0	0	0
Debe	0	0	0	0	0	0	0	0
Didibissa	0	0	0	0	0	0	0	0
Golechou	2	0	0	0	100	0	0	0
Infalou	3	1	0	0	75	25	0	0
Sodore	8	3	1	0	66.5	25	8.5	0
Metihara-Merty	6	2	0	0	75	25	0	0
Abomsa	4	19	0	0	17.4	82.6	0	0
W.Borchota	4	0	0	2	66.6	0	0	33.4
Nazareth	5	8	0	1	36	57	0	7
Melka-Jillo	12	2	0	0	86	14	0	0
Sera-Tibila	1	1	0	0	50	50	0	0
Gougza	0	0	0	0	0	0	0	0
Borre	2	0	0	0	100	0	0	0
	99	58	1	9	59.3	34.7	0.6	5.4
B. CHECK AREA								
Awash	3	3	0	0	50	50	0	0
Dohino	3	1	0	1	60	20	0	20
Amedes	9	1	0	0	90	10	0	0
Melcadubsa-Boleta	4	1	0	1	67	16.5	0	16.5
Arba	5	1	0	0	83.5	16.5	0	0
	24	7	0	2	73	21	0	6

TABLE III

Summary of Plasmodia Prevalence

Initial Survey - Awash Valley, Ethiopia

	P. falciparum	P. vivax	P.malariae	Mixed Inf.
A. CONTROL AREA				
No. of positive slides	99	58	1	9
Percentage	59.3	34.7	0.6	5.4
B. CHECK AREA				
No. of positive slides	24	7	0	2
Percentage	73	21	0	6

TABLE IV

RESULTS OF THE INITIAL SURVEY AND POST-OPERATIONAL SURVEYS

OF THE ALLEH PILOT PROJECT AREA DURING THE PERIOD 1956 - 1959.

Control Area	Surveys	Children 2-9 No. Examined	Children 2-9 Spleen Rates %	Children 2-9 Parasite Rates %	General Population No. Examined	General Population Spl. Rates %	General Population Parasite Rates %
Dongoreh-Dere Area.	Initial Survey 1956-57	71	25.3	11.2	-	-	-
	2nd. Post-Opr.Surv. 1957	30	6.6	0	-	-	-
	3rd " " " 1958	-	-	-	-	-	-
	4th " " " 1959	55	4	0	-	-	-
Wolenchiti	Initial survey 1956-1957	63	56	30.8	40	57.5	27.5
	2nd. Post.OPer.Surv. 1957	70	42.8	0	-	-	-
	3rd. Post Opr. Surv. 1958	84	33	0	-	-	-
	4th. Post Opr. Surv. 1959	98	11.2	0	-	-	-
Bosset Area.	Initial survey 1956-57	63	43.5	14.6	-	-	-
	2nd Post-Opr.Survey 1957	36	22.2	2.7	-	-	-
	3rd " " " 1958	-	-	-	-	-	-
	4th " " " 1959	48	11	0	-	-	-
Doche Area	Initial Survey 1956-57	24	100	33.3	32	81.2	37.5
	2nd Post-Opr.Survey 1957	18	100	27	24	54.1	-
	3rd.Post-Opr.Survey 1958	-	-	-	-	-	-
	4th.Post-Opr.Survey 1959	15	66.6	0	-	-	-
Nurraherra-Siffa Area.	Initial Survey 1956-1957	46	84.7	45.6	30	70	46.6
	2nd Post-Opr.Survey 1957	-	-	-	-	-	-
	3rd. " " " 1958	-	-	-	-	-	-
	4th. " " " 1959	43	76.7	4.6	-	-	-
Sodore-Bobe Area	Initial survey 1956-1957	44	81.2	37.5	48	50	35.4
	2nd. Post-Opr.Surv. 1957	40	55	10	72	33.3	-
	3rd. Post-Opr.Surv. 1958	-	-	-	-	-	-
	4th. Post-Opr.Surv. 1959	24	40	0	-	-	-
Metihara-Merty Area	Initial Survey 1956-1957	58	55.1	13.3	45	53.3	20
	2nd. Post-Opr.Survey1957	43	30.2	0	-	-	-
	3rd. Post-Opr.Survey1958	-	-	-	-	-	-
	4th. Post-Opr.Survey1959	57	26.3	1.7	-	-	-
Abomsa	Initial Survey 1956-1957	112	52.6	23	-	-	-
	2nd.Post-Opr.Surv. 1957	205	26.3	4.8	-	-	-
	3rd. " " " 1958	96	12.5	0	-	-	-
	4th " " " 1959	-	-	-	-	-	-
Nazareth	Initial survey 1956-1957	450	21.1	3.1	-	-	-
	2nd. Post-Opr.Surv. 1957	472	7.2	0	-	-	-
	3rd. Post-Opr.Surv. 1958	290	6.3	0	-	-	-
	4th. Post-Opr.Surv. 1959	500	3.0	-	-	-	-
Melca Jillo	Initial survey 1956-1957	63	69	22.2	40	22	-
	2nd. Post-Opr.Surv. 1957	28	39	0	-	-	-
	3rd. Post Opr.Surv. 1958	-	-	-	-	-	-
	4th. Post Opr. Survey 1959	44	20.4	-	-	-	-
Bofe-Gododera-Tibila Area	Initial Survey 1956-1957	107	39.2	11.2	-	-	-
	2nd Post-Opr.Surv. 1957	60	25	5	-	-	-
	3rd. Pst-Opr.Surv. 1958	-	-	-	-	-	-
	4th. Pst.-Opr.Surv.1959	42	14.2	0	-	-	-
Totals		3504	-	-	331		

TABLE IV - Continued

Area	Surveys	Children 2-9 No. Exam-ined	Sol. Rates %	Para-site Rates %	General Population No. Exam.	Sol. Rates %	Para-site Rates %
CHECK AREA							
[illegible], Dohino	Initial Surv. 1956-57	93	90.3	36.5	60	41.6	25
[illegible], Melca Dubra.	2nd Post-Op.Surv. 57	35	93.3	40.0	-	-	-
Totals		128	-	-	60	-	-

TABLE V

RESULTS OF INFANT PARASITE SURVEYS

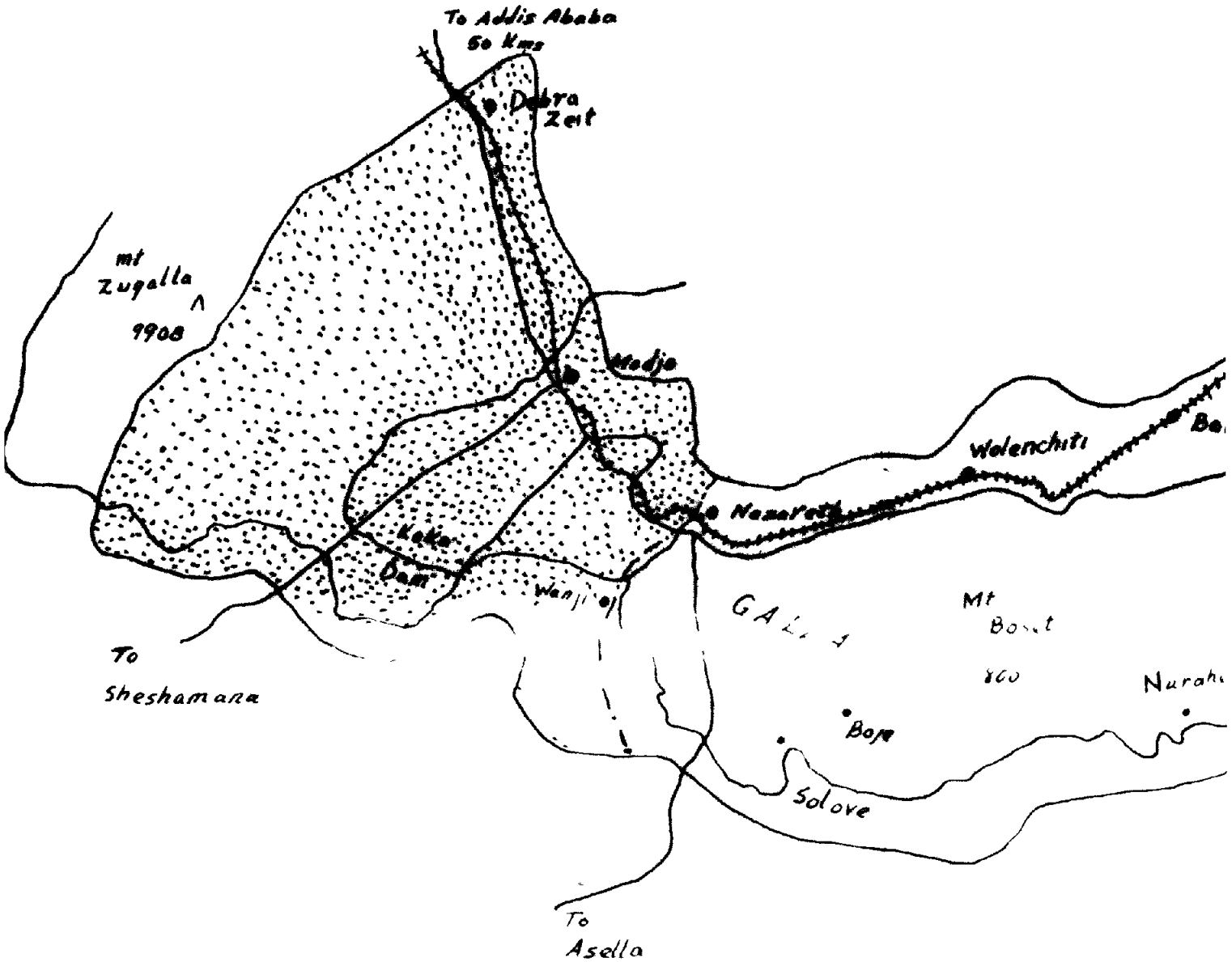
Date of Survey	No. Examined	F	V	M	Parasite Rate %
1956 - 1957 November-February (Pre-Operational).	78	6	1	-	9.0
1957					
September	9	0	0	0	0
October	49	0	0	0	
November	10	0	0	0	
December	23	0	0	0	
1958					
January	69	0	0	0	
February	72	0	0	0	
March	70	0	0	0	
April	44	0	1	0	
May	28	1	0	0	
[illegible]er	12	0	0	0	
October	151	2*	3*	0	
November	14	0	0	0	
December	-	0	0	0	
1959					
January	58	0	0	0	
February	18	0	0	0	
March	26	0	0	0	
Total or average	65[illegible]	3	[illegible]	0	1

Note

* These infants were investigated and it was found that they were born before spraying in the area which was sprayed two months previously for the first time.

1956 - 1959

SKETCH MAP OF PROJEC



kms 15 0

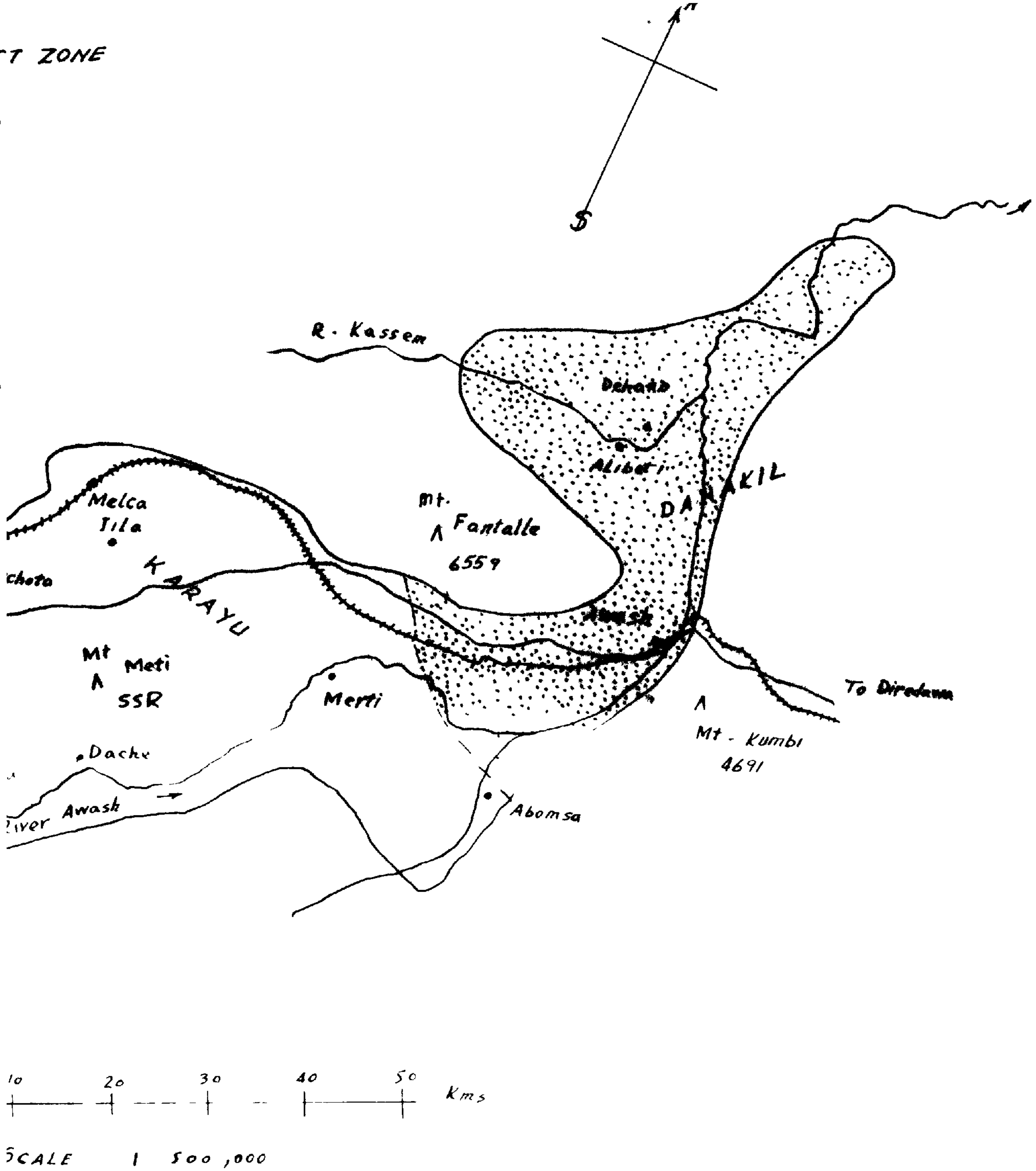
Zone Sprayed 1957, 1958, 1959

Zone Sprayed 1958, 1959

Railway

All weather Roads

River



T ZONE
R. Kassem
Melca Tila
Mt. Fantalle 6559
KARAYU
Mt Meti
Merti
Dache
River Awash
Abomsa
Mt - Kumbi 4691
To Diredawa
10 20 30 40 50 Kms
SCALE 1 500,000