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The Secretary of the Expert Committee on Malaria  
has the honour to communicate hereunder  
the following paper:

## METHODOLOGY OF MALARIA CONTROL

Maintenance of malaria eradication under continental conditions  
(Coastlands of British Guiana): Integration of national visible  
or invisible barriers by limited "strategic" use of DDT to close  
possible reinvasion routes.

by

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Malaria control by residual DDT house spraying was initiated in British Guiana in February 1945; by the end of 1947 the whole population living along 250 miles of coastland and estuary banks was directly or indirectly protected. The population of the colony aggregates 430,000 of which 90% are settled on the coastlands, between the Pomeroon and Corentyne rivers. To-day effective malaria control is being maintained over 99 + % of the population of the whole territory, including the most remote Amerindian settlements of the interior.

Since 1948 routine spraying operations throughout the densely populated coastlands have been curtailed progressively, according to a technique which has been developed taking into account local ecology and the biological characteristics of A. darlingi, the sole malaria vector of this region. On the coastlands eradication of Malaria and Anopheles darlingi, has been achieved; in the small and widely scattered settlements of the vast interior, malaria has been controlled to a very high degree but rare, occasional cases still occur in remote areas which are frequented by forest workers without being permanently settled; in such areas the absence of houses makes control by DDT residual methods impossible. Whether

A. darlingi exists in the interior, as a wild forest species, entirely independent of man, is as yet unknown. In British Guiana we have found this mosquito in uninhabited forest, but only in camp sites, along ancient and well-beaten lines of river or land communication. At the present stage, however, we must assume that A. darlingi exists in the interior, and that reinfestation of the eradication areas along the coast and on the lower estuaries is not only a possible but an actual danger.

The technique we have adopted was evolved on the following local conditions which have been under investigation for many years.

1. In British Guiana there exists a wide range of variation in the physical and chemical characteristics of soil types; surface waters originating from these various soils, likewise, present variable characteristics and the pH of natural ground waters ranges from 3.5 to 6.5. Under such conditions of variation there is obviously ample opportunity for biological adaptation of aquatic life to one type of water or the other.
2. During some 25 years of field and laboratory studies on A. darlingi, the sole active malaria carrier in British Guiana, this species has been found to select for its breeding sites, waters varying in reaction from moderately acid to neutral (pH. 5.5 to 6.5). In this colony this species is never found in the very acid waters draining from certain soils (peaty "pegasse" soils) and geological formations (White Sand Series), which are intensely acid and deeply stained by vegetable matter in colloidal suspension. Neither in the laboratory nor in the field, throughout a long series of varied experiments, has it been possible to rear this Anopheles in such waters.
3. The coastland of British Guiana is formed by a narrow alluvial plain, consisting of a northern or seaward zone of heavy, moderately acid clays, particularly suitable for cane and rice cultivation, and, further inland, a zone of very acid, peaty - "pegasse" clays. A. darlingi found ideal conditions and Malaria used to be hyper-endemic in the first of these zones, which is also the one of greatest agricultural development and permanent settlement (90% of the colony's population), it was absent however from the pegasse belt.
4. The White Sand Formation, runs obliquely, from N.W. to S.E., i.e. in parallel with the coastline, across British Guiana and Surinam; it lies immediately to the south

of (a) the inhabited alluvial clay zone and (b) the "Pegasse" Clay Zone. It consists of ancient fluvio-marine deposits of entirely leached quartz sand; this formation, originally a plain of moderate elevation, has been dissected by water action into a broad series of low, flat-topped sand hills, of uniform height and covered by a characteristic forest, known as Wallaba (Epeura falcata) forest from its most characteristic and prevailing tree species. The waters which drain from this formation are limped, deeply stained and highly acid. They are not suitable for the multiplication and survival of A. darlingi.

5. The "Pegasse" clay belt and the White Sand Series, thus constitute, through the nature of their ground waters, a natural though invisible barrier to the progress of A. darlingi; this barrier is nearly continuous and it is situated between the inhabited coastal strip and the vast continental hinterland. In Surinam the White Sand Series, commonly called Savannah, appears to have been of ~~itself~~ sufficient to protect the populated coastal plain from A. darlingi, which abounds in the "Bush" settlements situated further south, on lateritic soils. (Swellengrebel).

6. Both the Pegasse Clay Zone and the White Sand Series are traversed by numerous water courses, large and small, running northwards to the sea; on their alluvial clay banks, as in the coastal clay zone, excellent soil and ground water conditions exist for the multiplication and survival of A. darlingi. These river valleys constitute therefor breaches in the natural, invisible barriers which protect the coastal plain from possible reinvasion by A. darlingi from the hinterland.

7. Up to the introduction of DDT control, between 1945 and 1947, Malaria was hyper-endemic throughout the coastal frontlands, along all the inhabited river courses and throughout the inhabited interior.

8. Since 1946 - A. darlingi has been effectively eradicated from the inhabited coastlands, where 90% of the Colony's population is settled.

9. Beginning from 1949 spraying operations have been gradually and progressively closed down on the coastlands, and to-day they are limited to the upper river estuaries, and to settlements situated on the banks of all water courses traversing the "Pegasse" Clay Zone and the White Sand Series.

10. Further inland where settlements are small and scattered, where lateritic soils prevail and ground waters are widely suitable for A. darlingi production control operations by periodical spraying must be continued indefinitely.

11. We are effectively maintaining 100% A. darlingi and malaria control on our densely populated coastlands, by concentrating our DDT effort to the gaps or weak points in the existing natural barriers against A. darlingi reinvasion, by placing "strategic road-blocks" of DDT - sprayed houses on the only possible routes of reinvasion formed by the alluvial banks of the numerous water courses. Spraying operations during 1951 and 1952 were reduced by 51.5%.

From 1953 spraying operations are being further reduced by "rolling back" our strategic road-blocks further up the estuaries of the major water courses; this will signify an 82.4% reduction in the number of buildings to be sprayed periodically in respect to the number sprayed during the peak of the campaign.

Anopheles darlingi has disappeared from the colony's coastlands since 1948 and no confirmed autoctonous case of malaria has been recorded during the past two years among the close on 400,000 inhabitants of the sea coast and the great river estuaries.

The accompanying table, mainly based on data kindly collated by Dr. I.J. Charles, Chief Officer of the colony's Mosquito Control Service, gives a clear idea of the general trend of spraying operations to date and of the remarkable economies which are being achieved by this "strategic" use of residual spraying, still maintaining full protection for the 400,000 inhabitants of the coastal plain.

Showing the progressive reduction of premises sprayed routinely by adoption of "strategic" DDT control methods on the Coastlands of British Guiana

1947 - 1953

LOCALITY	INITIAL SPRAYING PROGRAMME 1946 - 1950		"STRATEGIC" CONTROL PROGRAMME 1951 - 1952		"STRATEGIC" CONTROL PROGRAMME July 1953	
	Existing Premises	Premises Sprayed	Existing Premises	Premises Sprayed	Existing Premises	Premises Sprayed
Georgetown City	16,769	1,111 <sup>1</sup>	17,044	1,115	17,044	135 <sup>2</sup>
Georgetown Environs	4,713	4,713	4,931	3,900	4,931	0
East Bank, Demerara	2,277	2,277	2,725	2,725	2,725	900
West Bank, Demerara	2,533	2,533	3,119	3,119	3,119	1,190
West Coast, Demerara	2,730	2,730	3,164	795	3,164	420
Essequibo Coast	3,651	3,651	3,843	1,682	3,843	420
Leguan - Wakenaam	1,590	1,590	1,701	0	1,701	0
Bartica	690	690	789	720	789	0
East Coast, Demerara	9,519	9,519	11,111	1,975	11,111	0
West Coast, Berbice	3,225	3,225	3,415	1,375	3,415	660
East Bank, Berbice	667	667	690	690	690	690
New Amsterdam - Canje	3,827	3,827	4,283	3,475	4,283	1,890
Corentyne Coast	4,713	4,713	5,721	2,051	5,721	1,590
Sugar Estates	17,130	14,037	17,747	5,378	16,963	2,537
TOTAL PREMISES	74,034	55,283	80,283	29,000	79,499	10,432
% SPRAYED		74.5	36.1		13.1	
OVERALL % REDUCTION from Peak of Campaign (1947-48)			51.5		82.4	

<sup>1</sup> Peripheral barrier spraying

<sup>2</sup> Water front buildings for control of ship-borne Aedes aegypti