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Cytogenetics of *Anopheles gambiae*

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The chromosomic map of *Anopheles gambiae* has been described in a previous paper,[a] which also pointed out the effects of changes in breeding temperature on the chromosomic rearrangements in two batches of the same strain.

Thanks to the kindness of Professor G. Macdonald, Director of the Ross Institute for Tropical Medicine, London,[b] I have recently been able to examine the chromosomes of the *A. gambiae* strain originating from Lagos, Nigeria (mother-strain of the one studied in Pavia) as well as the chromosomes of the dieldrin-resistant Sokoto (Northern Nigeria) strain, both maintained at the Ross Institute.

The chromosomes of the Lagos strain proved identical to the ones examined in Pavia: the bands and sequences correspond entirely to those of the map mentioned above and the same heterozygous inversions may be found without any variation, except in the percentage distribution. In Pavia, at the normal breeding temperature of 24°C (75.2°F), *gambiae* was characterized by the presence of a heterozygous inversion on sectors 39-41 of III G (in 10.6% of the specimens). This inversion was also found in London in 8.5% (9 out of 105 specimens). On only one occasion was the inversion found on II D. Nρ inversions were present on III D, II G and X.

On the other hand, the Sokoto strain, reared under the same conditions as the Lagos strain, revealed a great number of inversions. The results were as follows:

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[a] Frizzi, G. & Holstein, M. (1956) *Bull. Wld Hlth Org.*, 15, 425

[b] I wish to express my gratitude to Miss Wall and Mr G. Davidson for their invaluable help during my stay in the Institute.

(1) on II D: terminal heterozygous on 15-16; heterozygous on half of 7 and 8-9; heterozygous on 9-11; heterozygous, double, on 12-14 and 15-16
(2) on III D: heterozygous on 29-31
(3) on III G: heterozygous on 39-41
(4) no inversions on II G and X.

Among 186 specimens, the distribution of inversions was as follows:

Chromosomes	*Sectors*	*Inversions*		*Percentage of total inversions*
		Number	*Percentage*	
II D	7-9	5	2.6	7.0
	9-11	27	14.5	37.5
	15-16	11	5.9	15.3
	12-14, 15-16	7	3.7	9.7
III D	29-31	15	8.0	20.8
III G	39-41	7	3.7	9.7
	Total . . .	72	38.4	

It is worth noticing that the polymorphism which was found in the Sokoto strain is still more accentuated than that of the Lagos strain reared in Pavia at 31° C (87.8° F). On the other hand, when the inversions 10-11 and 13-14 on II D were found again in London, they were more widespread and concerned also the sectors 9 and 12; in addition, the 12-14 inversion was always found in association with the 15-16 inversion. The subterminal inversion on III G was identical. But all the other inversions encountered in the London colony had not previously been met with.

It is very difficult indeed to state whether all or only part of these chromosomic rearrangements are a result of the dieldrin-resistant character of the strain or whether they may be considered as an indication of geographical races within the species. The time I spent in London was too short to enable me to study the Sokoto-Lagos hybrids but I feel that such an investigation would be worth while; it may prove possible, by statistical analysis, to separate inversions due to resistance, if any, from inversions due to geographical races. However, to obtain an outline for an extensive study of the genetics of resistance and of natural populations, more work has to be done. The almost complete sterility of Sokoto-Lagos hybrids (which does not seem to be a result of insecticide-resistance), the sterility that was encountered, in Tanganyika, in hybrids of geographically distant strains of *gambiae* (so far, no valid data are available, owing to the interruption of the research work), the differences in the reactions of the species towards different insecticides in various parts of the African continent, the so-called behaviouristic resistance in some areas—all these facts make credible the existence of geographical races or populations of *A. gambiae*. In other respects, the genetic mechanism of insecticide-resistance needs further investigation.

In order to check the data given so far, it would be necessary to build up, in the laboratory, *gambiae* colonies originating from geographically and

climatologically different areas, and reared under standard conditions to eliminate the environmental causes of chromosomic rearrangements—*inter alia*, temperature, food, salinity. It would, of course, be most desirable to deal with strains as pure as possible. Crossing experiments would then more probably give valid information on the racial differentiations and the amount of geographical isolation within the species.

The subsequent inducing of resistance into one of these strains, followed by a study of the possible chromosomic rearrangements and of the fate of hybrids, would be yet another step forward.

Finally, the introduction of naturally resistant strains, the study of their chromosomic pattern and the carrying out of crossing experiments with other strains maintained in the laboratory would usefully complete the research programme.

This would be a very long and ambitious task, but I feel that it would be of considerable help in solving some of the problems which are a very real source of annoyance to many malariologists in charge of control projects.

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par

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