

THE INDISCRIMINATE FEEDING OF ANTHROPOPHILIC SIMULIUM UPON MAN AND DOMESTIC ANIMALS, AND ITS RELATION TO STUDIES ON THE TRANSMISSION OF HUMAN ONCHOCERCIASIS IN GUATEMALA^{1, 2}

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The three species of simuliids most frequently implicated in the transmission of *Onchocerca volvulus*, the causative agent of human onchocerciasis in Guatemala, are *Simulium (Simulium) ochraceum* Walker, *S. (S.) metallicum* Bellardi, and *S. (Ianea) callidum* Dyar and Shannon. For a number of years, investigators have realized that there is considerable variation in the anthropophilic tendencies of these three species, and that all of them will more or less frequently take blood from animals other than man. These species preferences have been exhaustively tested in the field and the results thereof, as well as a review of the literature, can be found in the monograph "The Simuliidae of Guatemala" by Herbert T. Dalmat (1).

Dalmat's studies clearly show that, although *Simulium ochraceum* is the most anthropophilic species of the genus in Guatemala, it can often be captured while feeding on horses or cattle. *S. callidum* and *S. metallicum* are much less anthropophilic and very frequently attack other vertebrates as well as man. The list of animals on which *S. metallicum* will feed is particularly extensive. It has not been clearly known, however, whether any individual fly will bite various

species of animals during its lifetime, or whether, having taken its first blood meal from a horse, for example, that particular fly will henceforth feed only on horses. Elucidation of this point is desirable in view of the knowledge (2) that at least three species of microfilariae of the genus *Onchocerca* occur in the skin of various hosts in Guatemala. These are *O. volvulus* (Leuckart, 1893), in man; *O. gutturosa* Neumann, 1910, in cattle; and *O. reticulata* Diesing, 1841 (= *cervicalis* Railliet and Henry, 1910), in horses. Therefore it is entirely possible that a fly which fed on various hosts in succession might ingest microfilariae of two or more species and thus exhibit a multiple filarial infection. This point would be of considerable practical importance in evaluating dissections of naturally infected flies in the onchocerciasis endemic zone.

The present study was undertaken to determine whether individual blackflies would take blood from two different species of animals in succession. Wild simuliids were collected in test tubes after they had partially engorged on human volunteers or domestic animals. They were confined in the tubes for periods of one to two hours, and were then given an opportunity to bite a different species of animal. The number which took blood and thus completed engorgement on a second host of a different species was recorded. In addition to man, the chief test animals were horses and cattle since they constitute the only known sources of non-human skin-inhabiting microfilariae in the onchocerciasis zone. However, a few additional experiments were performed using dogs.

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TABLE 1.—Results of offering two different host species successively to individual simuliid flies.

| Species of <i>Simulium</i> | Hosts offered | | Flies which fed on first host | Flies which fed on second host after partial engorgement on first host | |
|----------------------------|---------------|----------|-------------------------------|--|----------|
| | (First) | (Second) | | (Number) | (Number) |
| <i>callidum</i> | Man | Cow | 7 | 4 | 57.1 |
| | Cow | Man | 7 | 6 | 85.7 |
| | Man | Horse | 39 | 21 | 53.8 |
| | Horse | Man | 16 | 7 | 43.7 |
| <i>metallicum</i> | Man | Cow | 154 | 82 | 53.2 |
| | Cow | Man | 52 | 30 | 57.7 |
| | Man | Horse | 117 | 45 | 38.5 |
| | Horse | Man | 80 | 45 | 56.3 |
| <i>ochraceum</i> | Man | Dog | — | — | — |
| | Dog | Man | 30 | 14 | 46.7 |
| | Man | Cow | 60 | 4 | 6.7 |
| | Cow | Man | 52 | 0 | 0.0 |
| | Man | Horse | 16 | 9 | 56.2 |
| | Horse | Man | 59 | 23 | 38.9 |
| | Man | Dog | 55 | 11 | 20.0 |
| | Dog | Man | 55 | 5 | 9.1 |

Results are given in Table 1. In trials using man, cattle, and horses as experimental hosts, *Simulium callidum* and *Simulium metallicum* readily completed interrupted feedings on any two of the three host species, regardless of the order in which they were offered. In most cases, more than half the flies fed on the second host. It seems likely that a still larger proportion would have fed on the second host under more natural conditions where experimental confinement of the flies would not be an inhibiting factor.

S. ochraceum also readily accepted a second host species in combinations involving man and horse, but most flies of this species refused to resume feeding on the second host in combinations involving man and cattle.

Individual flies of *Simulium ochraceum* showed a slight tendency to complete their engorgement on dogs after having partially fed on man, but showed a strong distaste for man after incomplete feedings on dogs. *S. metallicum* readily completed its engorgement on man after an interrupted blood meal on dogs; the inverse combination of these two hosts was not tested, nor did we test the response of *S. callidum* to this combination of host species.

SUMMARY

It has been known for some time that the anthropophilic species of *Simulium* commonly implicated as vectors of human onchocerciasis in Guatemala (*S. ochraceum*, *S. metallicum*, and *S. callidum*) will bite animals other than man. It has not been known, however, whether an individual fly will bite various species of animals during its lifetime and thus possibly ingest microfilariae of both human and animal origin.

To establish this point, field-caught flies were captured after partially engorging on one host, and then were transferred to a host of another species. Cattle, horses, or dogs were used either before or after man as sources for blood meals. *S. ochraceum* showed reluctance to resume feeding on the second host in combinations wherein man alternated with cattle or dogs. Otherwise, all three species of flies readily resumed feeding on the second host, regardless of which host species was offered first.

REFERENCES

- (1) Dalmat, Herbert T.: The Simuliidae of Guatemala. Smithsonian Miscellaneous Publication. The Smithsonian Institution, Washington, D. C., (in press).
- (2) Gibson, Colvin L.: Comparative morphology of the skin-inhabiting microfilariae of man, cattle, and equines in Guatemala. *Amer. Jour. Trop. Med. and Hyg.*, 1:250-261, 1952.

LA PICADURA DEL HOMBRE Y DE LOS ANIMALES POR EL *SIMULIUM* ANDROFILO
Y SU RELACION CON LOS ESTUDIOS SOBRE LA TRANSMISION DE LA
ONCOCERCOSIS HUMANA EN GUATEMALA (*Resumen*)

Desde hace algún tiempo se sabe que las especies andrófilas del *Simulium*, consideradas ordinariamente como vectores de la oncocercosis humana en Guatemala, (*S. ochraceum*, *S. metallicum* y *S. callidum*), pican tanto al hombre como a los animales. No se sabe, sin embargo, si una misma mosca pica, a lo largo de su vida, seres de diversas especies y, de ese modo, es invadida por microfilarias de origen humano y animal.

Para determinar este punto, se capturaron, en trabajos de campo, moscas que se habían nu-

trido parcialmente de un huésped, y fueron transferidas a un huésped de otra especie. Con tal fin, se emplearon vacas, caballos y perros, antes y después de haber picado seres humanos. El *S. ochraceum* se mostró reacio a reanudar su alimentación a expensas del segundo huésped, en las combinaciones en que se utilizaron alternativamente personas y vacas o perros. En los demás casos, las tres especies de moscas se mostraron dispuestas a alimentarse del segundo huésped, cualquiera que fuese la especie del primero.