1923

E. AFRICA

C O
21646
Rec. 30 APR 23

FROM
SWYNNERTON, C.F.M.

DATE
25th MARCH 1923.

FOR CIRCULATION:—
Mr. Dougha
Mr. Strachey
Mr.
Asst. U.S. of S.
Perm^t U.S. of S.
Parl^y U.S. of S.
Secretary of State.

SUBJECT

"THE RELATIONS OF SOME E.A. TSETSE FLIES TO THE FLORA AND FAUNA."

Fwds copy of paper which is being published by Royal Socy of Tropical Medicine and Hygiene.

Previous Paper

MINUTES

I see nothing here at all [illegible] we need take exception.

? Sf. Lee. Royal Society of Trop. Medicine & Hygiene that there is no objn., so far as C.O. concerned, to the publn. of the paper.

ACP
2.5.23
2.5.23

Subsequent Paper

I have asked Dr Wray to write to you to ask your permission. Would you be very kind as to grant this, letting him know as soon as possible?

Thank the Lemon [illegible]

Yours

Yours Sincerely

C. J. Symmers

The Under Secretary of State,
Home Office,
Whitehall, S.W. 1.

UNION-CASTLE LINE.

R.M.S.P. WALMER CASTLE.

Dec 30 APR 23

Dear 28th April 23.

Sir

I have the honour to enclose a copy of one of two papers which I am sending back for publication to the Roy. Society of Trop. Med. & Hygiene. The other is merely a summary of the evidence by Local Practitioners on part of the Epidemic of Smallpox on the Mwanza Steppe. Both Sickness outbreak already published by me.

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I have asked Dr Wenyon not to publish without your permission. Would you be very kind as to grant this, letting him know as soon as possible?

I have the honour to be

Sir

Your obedient

Servant,

C. M. Fuggles

The Under Secretary of State,
Colonial Office,
Whitehall, S.W. 1.

The Relations of some East African Tsetse Flies to the Flora and the Fauna.

by C. F. M. Swynnerton.

1. Prefatory Remarks.

Tsetses, as is well known, are dependant on shade. They will travel on men or animals across strips of cleared country some miles in width and, in the case of G. morsitans, parties or "crowds" of male flies numbering often at least some hundreds, may be found, on the grass beside native or game paths, right out in the margins of seasonal swamps awaiting the passing of men or animals on whom there may be females. The natives shown in Photo.4 are capturing at such a crowd. In this case there is a little evidence that, as individuals, the flies may not stay there long; and, in general, tsetses are not found away from shade.

Secondly, and this is perhaps less well realised, each species of tsetse has its own particular requirements in the matter of shade and shelter. Discriminative clearing measures designed to banish tsetses would differ as between the different species.

Thirdly, it follows from the attachment of a species of tsetse to a particular type of vegetation that it becomes associated with a particular section of the fauna. Measures of game destruction that might be effective for one species will have little effect on another.

Fourthly, wild large mammals themselves, even within a single habitat are important in very varying degrees in relation even to a single specie of tsetse, as a result of differences in their habits. Some are tolerant, others less tolerant to its attacks; a few are wide wanderers and probable seasonal spreaders of tsetses many have localised beats. Finally, while some are probably exterminable, others appear to be inexterminable and the association of the tsetse with an inexterminable animal is likely to result in its own inexterminability by any measure of game

destruction.

Fifthly, tsetse preferences as between their food animals, man strongly at least in degree as between the different species of tsetse, and it follows from this, and from the differences in habitat already referred to, that, while it may be proved under laboratory conditions that particular species can act as vectors of a given pathogenic trypanosome, in nature some of those species will be far less dangerous to man and his stock than others.

The observations given in this paper are subject to revision and the paper generally, and the above remarks, intended merely as a brief introduction to a side of the subject on which more work and closer work is required. The concluding suggestion as to the lines on which the control of the flies of the morsitans group should be attempted was discussed more fully by me in the Bull. Ent. Soc. for January 1921, p. 103 et seq. In respect of this suggestion it may be noted that there are degrees in native settlement between one extreme forced on many tribes in East Africa in pre-European days for protection from their enemies or by powerful chiefs, and highly beneficial also in freeing areas from tsetse and encouraging pastoral pursuits, of the close type of settlement the result of which, on the bush, is shown in Photo 20; and the other, encouraged by our prevention of petty wars and obtaining more and more today over great areas, in which more family villages are dotted through an immense tsetse infested woodland. The first extreme represents the only condition under which freedom from tsetses is assured and the return to it through a policy encouraging the gradual concentration of the human forces in each locality, or (where feasible) their more judicious distribution, is what is now needed for the initiation of our good campaign against the tsetses.

2. The Plant succession and the main woodland divisions.

(a). Primary Forest

There is much indirect evidence that suggests that what today we call "primary" or "rain" forest once covered, in one form

destruction.

Fifthly, if tsetses (the) preferences as between their food animals, (including man) strongly at least in degree as between the different species of tsetse, and it follows from this, and from the differences in habitat already referred to, that, while it may be proved under laboratory conditions that particular species can act as vectors of a given pathogenic trypanosome, in nature some of those species will be far less dangerous to man and his stock than others.

The observations given in this paper are subject to revision and the paper generally, and the above remarks, intended merely as a brief introduction to a side of the subject on which more work and closer work is required. The concluding suggestion as to the lines on which the control of the flies of the morsitans group should be attempted was discussed more fully by me in the Bull. Ent. Soc. for January (Vol. XIII, No. 3, pp. 163 and 164). In respect of this suggestion it may be noted that there are degrees in native settlement between one extreme forced on many tribes in East Africa in pre-European days for protection from their enemies or by powerful chiefs, and highly beneficial also in freeing areas from tsetse and making cattle keeping possible, encouraging pastoral pursuits, of the close type of settlement the result of which, on the bush, is shown in Photo 20; and the other, encouraged by our prevention of petty wars and obtaining more and more today over great areas, in which more family villages are dotted through an immense tsetse infested woodland. The first extreme represents the only condition under which freedom from tsetses is assured and the return to it through a policy encouraging the gradual concentration of the human forces in each locality, or (where feasible) their more judicious distribution, is what is now needed for the initiation of our good campaign against the tsetses.

2. The Plant succession and the main woodland divisions.

(a). Primary Forest

There is much indirect evidence that suggests that what today we call "primary" or "rain" forest once covered, in one form

or other, a very great part of East Africa; but that it has in the course of very many thousands of years been ousted from this position through (in the main) the agency of man, who felled it for his cultivation (Photo. 1) and ate it away also by means of his burning of the annually drying-up areas of herbage that he had exposed to the rays of the sun. Periods of climatic desiccation, by assisting the fires, may well have hastened the destruction of this fire- fearing type over particular regions.

(b). Savannah.

As the forest was burned and cultivated away it was replaced by the types of vegetation which are comprised broadly under the term Savannah or pasture and some of which are shown in the photographs

"Savannah" is clothed with grasses, shorter or taller, which dry and are burned every year but spring again from the roots. Its woody members - trees and shrubs - may be burned back similarly while young, but they also shoot again and when they are once established they defy the average fire by means of adaptations of their bark.

Primary forest in East Africa has now been reduced to widely scattered patches small or very small. Savannah - with the stages which succeed it - has become proportionately ubiquitous.

(c). Secondary thicket.

The savannah formations are preserved as such by the annual fires. Where these fires are burned late in the year, and are therefore fierce, they tend to thin the savannah woodland and also to discourage shrub growth. Where on the contrary, they are lighted very early in the year, as they usually now are, and are therefore mild, the grass being insufficiently dried out to burn fiercely, thickets of shrubs spring up, and, with the annual continuance of the early fires, spread more and more, and may even in the end completely replace and oust the savannah formation, producing the result shown in Photograph 12.

A further type of secondary thicket is the cultivation coppice

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A further type of secondary thicket is the cultivation coppice

This springs up from the roots and stumps left in the ground by the native cultivators when (as they do every few years) they abandon their old ground for new. It is shown in Photo.15 and may be seen today covering great areas or small patches and indicating the presence of former settlements the history of which can commonly still be elicited from the natives. On some formations at least (e.g. that shown in Photos. 9 and 10) cultivation coppice may develop in twenty or thirty years into a type of dense and more or less high secondary forest one form of which is shown in Photo. 14. It will be referred to as cultivation forest.

"Re-invaded secondary" associations. Reconquest by primary forest takes place where the latter is near enough to supply its seeds either to the thickets which I have described, or, fires ceasing or becoming for a period very mild, by means of a more direct invasion of the savannah in the course of which the shade of the savannah trees themselves is utilised by the shade-needing seedlings of the forest trees, which later overtop and kill their nurse-trees, these being intolerant of shade. Little real reconquest is taking place today on our side of Africa, but in some small areas or patches of woodland, in which, owing to the suppression of the grass by shade ~~and~~ thicket, fires have become negligible, shrub-growth or trees of the primary forest may be found invading and mingled with the savannah elements. I judge from descriptions that such mixed formations, which sometimes may be very fine, are commoner in the tsetse forests of the East of Africa.

(d). Desert formations.

These might most naturally include all formations in which, as the result of climatic dryness, (and not merely as the result of smothering by shade or thickets), so little grass grows that grass fires do not take place.

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8. The chief subsidiary plant formations.

(a). Of the Primary division. These are (a) "mountain" or "temperate" primary forest, characterised often by the presence of conifers and in no way concerned with tsetse flies; (b) "heavy" or "Congo" primary forest, occurring up to four or five thousand feet (Photo. 1.) and characterised by mahoganies, and other splendid species, mostly evergreen, that tower often to a height of two hundred feet and overshade tiers of trees and shrubs of lower growth while woody lianas are usually abundant in untreated forest.
(c) A type that has in one district known to me successfully re-invaded areas of secondary wooding with the help of the natives and is thus no longer wholly primary. In previous papers I have referred to it as "ravine-type" forest, and this term might for the moment stand.

This association in the latitude of Beira, is dominated by the huge buttressed tree Piptadenia Buchanani (shown recumbent in Photo 2), and by a tall form of Albizzia fastigiata, both trees being deciduous. Its Landolphia rubber-vine which does not occur in the "heavy" primary forest, is L. Kirkii. I have nowhere seen Glossina brevipalpis more abundant than in this "ravine-type" wooding (photos 2 and 3.).

(b). The Savannah formations.

I mention only those that are of rather special importance. Savannah includes savannah woodland (with a close to fairly close stand of trees, Photos. 4,5,8,9,10,11,16 and 21), tree savannah where the trees are far apart (Photo.15) , shrub savannah (which may be combined with any of these (Photo.15), and may, by spread of its shrubs, reduce the whole to "secondary thicket" (Photos. 7,12 and 17) and open Savannah (Photos. 20 and 22) devoid in the main of trees and shrubs. The term "association" is used for the individual plant-societies contained within the formations. The following are the more important formations and I would draw special attention to my remarks under (v).

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(i). [illegible] woodland.

This is shown in Photos. 5 and 6 pq it occurs on the sedimentary rock and igneous gneiss, and a poorer type, on granite is shown in Photo 6. Brachystegia "Miombo" of the East African natives, "Itembo" in the latitude of Beira, is its dominating genus; comprises within itself a large variety of species and growths, and associations that are dominated locally by some other tree than Brachystegia. It covers continuously a great part of Southern and Northern Rhodesia, and Portuguese East Africa, over and Nyasaland and W. Tanganyika Territory, right from South East Rhodesia and Portuguese Nyasaland stretches across the south of that country and withdrawing two arms to the North. One of these, widely broken into patches by the "deposition" formations and existing mainly as a zone on the sides of the mountain patches extends towards Congo - for it is itself a "denudation" formation and associates, under a sufficient rainfall, with granite, gneiss, and sedimentary formations of sandstone, shale and quartzite - extends towards Congo. The other covers a great area of gentler hills and small plateaux and reaches the South west corner of Lake Victoria. I know of little Brachystegia wooding below an elevation of (say) 3000 feet that is not infested - and often it is heavily infested - with tsetses. These may be either G.morsitans , G. pallidipes , or G. brevipalpis, or two, or all three of them together, the presence or absence of thickets, and other factors which have not yet to be worked out deciding.

(ii) The Lonchocarpus - Combretum - Acacia formation, which, varying a good deal as to its locally dominant species and including sub-associations and a variety of genera in the same way as does the Brachystegia formation, covers, under a fair rainfall, large areas of "deposited" soil in the flatter, lower-lying parts of the Tanganyika Territory and in Portuguese East Africa. It is figured in Photos. 9 and 10 and harbours considerable populations of G. morsitans; also, under the respective right conditions as regards

thicket, G. pallidipes, G. brevipalpis and G.austeni.

(iii). Acacia Savannah woodland on granite under drier conditions (rainfall about twenty inches or half the figure for Brachystegia). The area more particularly illustrated in Photograph 18 is that section of the Mwanza district which is characterised by the new fly G.swynnertoni and in which a sleeping sickness epidemic of rhodesiense type has lately taken place. Broadleaved shrubs and trees clothe the granite kopjes that are scattered freely through the area, and enclosed as islands in the general acacia wooding, constitute a strongly contrasting association of their own, which, to judge from the finds of puparia, is at times not unattractive to the tsetses. The rest is essentially an association of acacias and acacia-like trees (Albizzia hypoleuca, Piptadenia Hildebrandtii, Dichrostachys) and though broad-leaved species are found with local differences it occurs in much of the central portion of the Tanganyika territory and in others of the drier areas of East and South east Africa. Acacia spirocarpa, of the drier conditions dominates under the more as between and about the bases of the kopjes with much rock below ground, ~~is the most prominent member~~. It is associated with a type of thicket which contains an xerophytic element (Photo. 15) and other acacias dominate under other conditions of depth and moisture and soil.

(iv). "Orchard bush" or "orchard steppe". I figure this formation in order to check an error that is becoming common. The term was coined for, and should be confined to, the very distinctive association of small thorny trees that grow in the remarkably orchard-like fashion that is shown in Photo 16. It is often wrongly applied to other savannah associations. The photograph was taken by me not very far from the type locality (Kilimanjaro region).

(v). Open Savannah. Open spaces and areas in East African woodland at the elevations concerned with tsetse are due to

ill-drained moisture, seasonal or permanent, that is sufficient to be inimical to tree growth (Photos 4 and 22); to grazing by great herds of game and cattle; and to native settlement, pastoral and agricultural combined, that is sufficiently dense to produce the effect shewn in Photo 20. It is capable also (grass growth being sufficient) of being retained or, I am convinced from the observation of many years (Photos 18 and 19), brought about, by the systematic postponement of grass burning to the end of the dry season. When brought about by native settlement, grazing or grass fires, it is impermanent, although, while it lasts, tsetses are banished and is likely that, with organisation, these factors could be used for their final, if gradual, expulsion. The tree roots continue to live below the ground and to send up shoots that are annually grased or burned off. Remove or merely thin the herds of game or cattle, or portions of the agricultural and pastoral population, and continue to burn too early, and the shoots grew up and in four or five years form young wooding that is sufficient to attract and harbour tsetses if it should be within carrying distance of country already infested. Such settled or grazed areas, in appearance open savannah, might more accurately be termed "suppressed woodland" (Photo. 20).

(c). Secondary thicket formations.

Any of the Savannah formations, excepting those from which woody growth is excluded by an excess of ill-drained moisture, may be turned into dense secondary thicket through the agencies described on page .

Photos 5 and 7 show thickets developing in Brachystegia woodland through unthorough grass burning, Photo 10, thickets commencing to form in Acacia-Lonchocarpus wooding and these thickets later become dominated by Grewia, and extensive, as in Photo 18; Photos 11 and 12 show the development of dense Grewia thicket in Combretum wooding, Photo 17 the invasion of Commiphora orchard

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steppe by a very highly xerophilous (dry) type of thicket, comprising Sansevieria, Crassulaceae and other succulents and eventually, often, turning into "Euphorbia - steppe", a ~~very highly xerophilous~~ haunt of rhinoceros; and 21 shows a somewhat less xerophilous type of thicket, still with much Grewia and some Acalypha, that is abundant, and increasing, in the acacia savannah woodland of the Mwansa sleeping sickness area. In the Kaguru Mountain foot-hills and near Kigoma, thickets of bamboo are making successful ~~in various~~ invasions of Brachystegia wooding.

"Cultivation coppice", and its eventual development on the richer "deposition" areas with fair rainfall, ~~into~~ namely "cultivation forest", is shown in Photos 13 and 14 respectively.

In some places cultivation coppice from thirty to ~~thirty~~ forty years old has taken on much the aspect of poor primary forest and may, it is possible, be composed of species that figured in the original primary forest of these plains. It is probable that the dense secondary forest types described by me on p.381 of the Bull. Ent. Res for March 1921 are also in all cases "cultivation forest". I have there given a more detailed history and description of interesting varieties of cultivation coppice, cultivation forest and other thicket types than I have space for here. Some of them cover great areas and comprise the Portuguese rubber forests. The dark and the striped areas in Map 1. indicate roughly the distribution of some of these types and of their associated tsetses in the area specially investigated by me.

(d). "Desert" formations.

(α) Fringing associations.

These may be broad or narrow, herbaceous or woody, of primary type or ~~merely~~ secondary savannah, characterised by or composed wholly of thickets or largely without them.

The tall reed and papyrus growth that fringes lakes and borders or fills some rivers, is of the herbaceous type, and seems to be of no real importance in regard to tsetses. Particular acacias

(as A.verrugosa) may form a narrow fringe in dry country, and A. campylacantha may present a fringe of savannah woodland as wide as the area annually flooded by the river, perhaps several miles. A large Fig, usually with undershrubs below, forms a very shady and conspicuous fringe, and, of primary forest trees, the splendid mahogany, Khaya nyasica, which in Portuguese East Africa especially, commonly fringes rivers in savannah country with or without another fine tree, Adina microcephala. Swamps have their own fringes. Odina humilis, young trees of which are shown in Photo 18, gall bearing and other acacias (A.despanolobium, and one or two others), combretums of the tetraphyllum-kilosanum affinity all small trees, are somewhat specially venturesome in their attempts to enter swamps, Eugenia latifolia, Uapaca sanguesharica and U.kirkiana, respectively like seasonally wet ground in particular areas or latitudes, though elsewhere (under better rainfall or higher latitude or elevation, they avoiding wet ground and occurring as savannah woodland on drained slopes.

Some of the woody river fringing formations harbour permanently in some cases G.palpalis and in some G.brevipalpis, but the fringing formations in East Africa generally are perhaps more important as a refuge and concentrating place during the height of the dry season for the flies of the morsitans group, for these then vacate much of the remaining country owing to the fall of the leaf and the grass fires and their consequent exposure to intense drought conditions. It has been suggested that the clearing of these "primary centres" might alone suffice to clear a belt of fly, and, for some types of belt at any rate, the measure seems promising enough to be tried.

4. The requirements of the different tsetses as regards vegetation.

Glossina brevipalpis, Newst.

A heavy-thicket fly. It is found especially in the "ravine-type"

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4. The requirements of the different tsetses as regards vegetation.

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A heavy-thicket fly. It is found especially in the "ravine-type"

forest (Photos 2 and 3 and Map 1); in secondary formations reinvaded by primary shrub-growth, in all the more heavily shady types of secondary thicket - that is, in cultivation forest of different kinds (as Photo 16); in sapling thicket and shrub thicket where these are overshaded also by the trees of the savannah woodland, and in such of these thickets as are not overshaded as supply the requisite amount of shade in themselves; and in such fringing formations as Ficus and Acacia and Albizzia with under-thickets. I also found it in dense bamboo thickets which, from hollows at the bases of the eastern foot-hills of the Kaguru mountains (Tanganyika Territory) , were ascending the slopes in invasion of the Brachystegia woodland.

Although it is thus essentially a fly of deep shade, I have myself only once found a few in the "heavy" primary forest type. It attacks animals entering its thicket or passing close at any time of the day, but it leaves the thickets more freely in search of food and females only from sunset on. The fact is worthy of study (see Map 2) that North of the Kenya colony border only G.fusca has been found of the large, dark tsetses, and south of it (as far north as Mara bay) only G.brevipalpis.

G.palpalis (P-D.9 a) is a lake shore and riverside fly that is banished by narrow long-shore clearing but that may extend back for some distance in dense wooding there this is allowed to come to the shore. To be found even in the lightest of shade fringing the water, provided as [illegible]. Fiske concluded from his observations on Lake Victoria, that scattered points of "massive" wooding are present here and there as points d'appui. The following are some points in my own very limited experience of this fly:-

(a) Scattered dense Grewia thickets twelve feet high appeared to suffice for the last named purpose on Kilengi Island in Lake Tanganyika, nothing more massive being present, and these would doubtless figure amongst the points that would have to be cleared for the eradication of the fly. Puparia were found in these

forest (Photos 2 and 3 and Map 1); in secondary formations reinvaded by primary shrub-growth, in all the more heavily shady types of secondary thicket - that is, in cultivation forest of different kinds (as Photo 14); in sapling thicket and shrub thicket where these are overshaded also by the trees of the savannah woodland, and in such of these thickets as are not overshaded as supply the requisite amount of shade in themselves; and in such fringing formations as Ficus and Acacia and Albizzia with under-thickets. I also found it in dense bamboo thickets which, from hollows at the bases of the eastern foot-hills of the Kagusu mountains (Tanganyika Territory) , were ascending the slopes in invasion of the Brachystegia woodland.

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thickets (under rocks and, in special numbers, in a cave that was hidden in one of them). Some were found also along intervening pieces of shore under small, dense, brushwood like bushes. The fly (palpalis) that came to me furthest from the shore was 70 yards from it under an Afzelia shading a Grewia thicket that extended over boulders to the water.

(b). Like Fiske I failed to find palpalis on the southern shore of the Speke gulf. This shore is mostly clear of woody growth as the result of native settlement (Photo) and such rare points of wooding as occur are neither dense nor extensive. On the other hand, in Mara bay, on the shores of which there is much more wooding, we took palpalis and its puparia freely on Muganiro island. While on Victoria I had the interesting experience of being taken by Mr Fiske through some fine primary type wooding by the lake shore near Entebbe and of seeing in it a number of G.palpalis waiting on trunks, logs the leaves of the undergrowth, the ground near a water-hole &c.

(c). Near Kirando on Tanganyika, eight flies were caught in a diminutive Grewia thicket co-extensive with the shade of a solitary Acacia spirocarpa that grew on a clear piece of shore which also was quite clear for a considerable distance in either direction. This may have been evidence of longshore ranging, the tree being used as a halting place, or the flies may have come from canoes arriving at a landing place close by.

An interesting position (noted near Kirando and at the wood-supplying station of Kibweza) exists on portions of the eastern shore of Tanganyika in the fact that G.morsitans and G.palpalis are there in contact. The shore for many hours together (as one travels by steamer) is a steep, high mountain slope that falls sheer into the lake and is clothed with open Brachystegia savannah wooding. Whitened boulders fringe the lake continuously and a thin line of (for the most part) light bushes fringes the boulders, but, wherever a glen or a little hollow comes down, thicker bush

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with lianas marks its contact with the lake and affords a perfect resting-shelter for G.palpalis. At many of these depressions a narrow sandy beach fronts the little scrap of wooding and the beds of some of the larger ravines, which include one or two considerable canyons, run back level with the lake, carrying the dense wooding (and perhaps palpalis) with them. Similar dense secondary wooding with lianas clothes one or two small stretches of foothills that intervene between lake and mountain, as at Kasodyi.

Glossina fusteni Newst.

A heavy thicket fly. I have taken this tsetse and its empty puparia sometimes in very great numbers (a), in broad fringing forest of dense secondary and "re-invaded secondary" types, and in three types of secondary thicket far from water- namely (b), that type of cultivation forest, thirty years old, that I have referred to above as simulating primary forest and that is sufficiently, though not actually, represented in Photo 14; (c), Acacias of a fine type (A.campylocantha or near it) that had sprung up on abandoned cultivation on "deposited" soil near Kikosa, and in a damp enclave in Brachystegia wooding in the Kaguru foothills, and become enshrouded densely with a Cucurbitaceous climber; and (d) some puparia, in heavy Grewia-type thickets in the savannah wooding shown in Photos 9 and 10.

Glossina pallidipes Austen.

This fly gives one the impression at first of being at home wherever any of the other tsetses occur, but experience of it shows that, like G.brevipalpis, it is essentially a thicket fly, though the types of thicket it affects are less deeply shady than those which are usually haunted by G.brevipalpis and do not

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require the overshading by savannah trees which is demanded by the latter fly in relation to its lighter thickets - in fact are preferred without. Two facts have struck me strongly. The first is that I have not yet found G.morsitans in large areas of continuous thicket, whereas these are haunted by G.pallidipes. The second is the fact that in savannah wooding on "silt" (Photos. 9 and 10) that is haunted by numbers of both flies, we (Mr D.W. Bisshopp and, later, myself) took puparia of the second chiefly in the thickets that are scattered broadcast through this wooding, whereas the position as regards G.morsitans, which was breeding mainly under the logs in the savannah wooding between them, was the exact reverse of this. Cultivation coppice (photo 13), of any of the rather lower types, is a particular favourite with G.pallidipes, which, in the areas in which it exists, will probably hold its own to a very late date with the assistance of the native cultivation that produce these thickets. I have gained the impression regarding this fly that it ranges in search of food to a greater extent than any tsetse with which I have worked much, and that this is the reason why it may be found in small numbers in the woodland generally, away from the thickets. Some of the types of wooding from which I have taken it in considerable or fair numbers together are shown in Photos. 4,9 and 10, 12 and especially 13; in smaller numbers, or as odd flies, in 2,3,5and 6, and 11. In 1, not at all.

Glossina morsitans, Westw.

A savannah woodland fly found in a variety of savannah woodland and shrubland associations, this fly has nevertheless, its considerable limitations. I have not found it in any but small thickets or the edges of larger ones, and it does not occur at all in the denser, heavier types of forest (as in Photos 1,2,3,14,15, 14) though it will sometimes "follow" in for a brief distance. Its seasonal limitations - the fact that in some fly belts at

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least it is driven by leaf-fall and drought conditions to ~~conditions~~ concentrate annually at certain of the moister or shadier spots - are well known.

That it has yet broader limitations seems likely from a glance at the accompanying maps. The area shown as occupied by it in Map 1 was visited by me twice at an interval of eighteen years and the fly on the second occasion was found still confined to that area. In the country to the west, into which it had failed to spread, G.pallidipes, and G.brevipalpis were present in numbers, though in varying proportions in sympathy with the type of thicket that was locally available. The suggestion conveyed by Map 2 is touched on under G.swynnertoni.

Glossina swynnertoni. Austen.

Map 2. (Mwanza) should be consulted.

What is the reason for the sharp demarcation here of the three species of the morsitans group - pallidipes north of Usha/shi (and the only fly of the group found in Kenya). swynnertoni in the Acacia wooding of the centre and morsitans in the Brachystegia of the west and south? Wooding is hardly the whole factor for in some parts of East Africa G.morsitans and G.pallidipes exist together or separatelt in Acacia wooding (Photo 8), while G. pallidipes is very extensively found in Brachystegia wooding (Photos 4 and 5), sometimes in company with G.morsitans, in other places separately from it. Is it climate ? It is interesting to note that the rainfall in the Brachystegia area marked as inhabited by G.morsitans is shown in German charts as double that of the Acacia area infested by G.swynnertoni. Climate is quite likely to be the dominant factor, but more needs to be done in investigation of this interesting point.

G.swynnertoni was found inhabiting a savannah area with very abundant thickets (which it utilized for resting and breeding),

but no continuous thicket areas. It is unlikely that it would resemble G.pallidipes at all completely in this respect and in general habit it never resembles G.morsitans. It was nearly practically absent from some particularly fine A. spirocarpa wooding near the Mbarangati River (L. Victoria) with heavy, but broken thickets containing brevipalpis.

(5). The Relations of the different Tsetses to the fauna and their probable pathogenic importance.

(a). As a result of their different requirements in vegetation.

While they obtain opportunities of feeding on the savannah animals where the thickets are not continuous, G.brevipalpis and G.austeni come into special contact with the animals which, at the elevations at which tsetses are found, freely enter or inhabit dense wooding and dense thickets. These , (amongst the larger mammals) are elephant, buffalo, bush-pig, bush-buck, Harvey's duiker, Kuni, baboon and monkeys. The last, it may be judged from their susceptibility to trypanosome infection, are not often successfully attacked, but there is evidence from several sources to suggest that baboons are freely fed on, and I have myself now found tsetses on shot baboons and come into the midst of tsetses on reaching a spot from which I had driven baboons. In fringing forest and fringing thicket G.brevipalpis and G.austeni would come into contact with hippopotami and (in places) water-buck, also, if they feed on them (as my finds of brevipalpis puparia on the little island of Mugazire in Lake Victoria suggest, is possible) crocodiles. I have already (Bull.Ent. Res. vol.XI. Pt.4.) given direct and indirect evidence for the view that pigs are much fed on by G.brevipalpis.

Owing to the fact that the latter fly at any rate confines itself to its thickets except in the evenings, it does not come

but no continuous thicket areas. It is unlikely that it would resemble G.pallidipes at all completely in this respect and in general habit it more resembles G.morsitans. It was nearly practically absent from some particularly fine A. spirocarpa wooding near the Mbarangati River (L. Victoria) with heavy, but broken thickets containing brevipalpis.

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Owing to the fact that the latter fly at any rate confines itself to its thickets except in the evenings, it does not come

greatly into contact either with man or (if they are carefully herded) his cattle and I am acquainted with a herd of cattle which has been running for many years, with alleged small loss, on pasture on which are patches of cultivation-forest that are infested by G.brevipalpis and G.austeni, and I found a very similar position in relation to the first-named fly on Lake Victoria.

The feeding habits of G.palpalis are well known. It probably comes into especially close contact with the Lake-shore and riverine populations of man when the absence of ungulates induces it to concentrate more on man and the reptiles.

G.pallidipes will meet with the food animals I have already enumerated as inhabiting or visiting thickets, but it is also found, ranging (as I believe) anywhere in the savannah woodlands containing its thickets and it has possibly, under undisturbed conditions, a wider range of mammalian food-animals than any other tsetse. It comes into contact with man.

G.morsitans, inhabiting the savannah woodlands and (in my experience hitherto) avoiding extensive thicket, is a game fly as opposed to a bush-pig fly, but it also comes very freely into contact with man, living, wandering and travelling in the same more or less open formations.

G. swynnertoni has, for practical purposes, the habits in this connection of G.morsitans. It comes into contact both with the game generally and with man, and, on the kopjes, may take toll of hyrax and probably of baboons, but bush-pigs would appear to be scarce in its country.

(b) As a result of their preferences in food.

G.brevipalpis does not readily attack man and I have been unable to get no reliable idea of its abundance, or even, sometimes, of its presence, without using cattle as bait to draw it out. To G.austeni even cattle do not seem to be a strongly attractive bait.

It has been shown experimentally that G.brevipalpis can act as vector of pathogenic trypanosomes, but, having regard both to its habits in relation to vegetation and ranging and to its food preferences, I believe that G.brevipalpis is unlikely to prove important in relation to human trypanosomiasis and will be of little importance (though of some) in relation to nagana.

G.pallidipes will attack man, particularly if food animals are scarce, but (my results hitherto, with and without bait cattle, suggest) is by no means so ready to attack him as are G.morsitans and G.swynnertoni. I think it is doubtful, though I should be sorry, yet, to state the view confidently, whether G.pallidipes will ever be of great importance in relation to sleeping sickness. It is, of course, of great importance in relation to nagana.

G.morsitans, G.swynnertoni (and, as may be stated from other people's observations, not my own, G.tachinoides and G.palpalis) are far less loath to attack man at any time than are the other species mentioned, and with food animals scarce, attack him very freely and very successfully. They have also, as we have seen, every opportunity of coming freely into contact with him. These flies are of the greatest importance, actual or potential, in relation to human trypanosomiasis, and the first two, where they occur, are of great importance in relation to nagana.

6. The re-actions of the different tsetses to game destruction.

So far as we can say at present game may be divided into two categories in relation to means of destruction other than dense human settlement (Photo 80), a European farming area: possibly exterminable, and inexterminable. The game of the unthicketed savannahs, including wartheg, is probably at last, exterminable.

That of the dense thickets, excepting elephant and buffalo, is

probably for the most part inexterminable, and the most inexterminable animal (and often the most abundant) is the bush-pig. That is to say, the thicket flies are probably inexterminable through any possible extermination of large mammals, and, in point of fact, I have seen large populations of G.brevipalpis in forests and thickets in which they must have been living almost entirely on bush-pigs, while it is interesting that G.pallidipes survives in some places in which population is considerable and little but bush-pig appears to be left, and is the factor, apparently, which still prevents the keeping of cattle. It is interesting to note further that its thickets and their bushpigs prevail especially in areas of native cultivation, and as a result of such cultivation, so that the extension of native settlement in the more open savannah woodland areas in which, let us suppose, it will have been possible to exterminate G.morsitans by means of game destruction will lead to the re-invasion of these areas by an inexterminable, cattle-prohibiting fly.

G.palpalis has the reptiles to fall back on and also readily turns to man.

G. morsitans and G.swynnertoni might, theoretically, be exterminated by means of the extermination of mammals in savannah areas from which bush-pigs happen to be absent, were it not that, unfortunately, like G.palpalis, they readily turn to man when game becomes scarce.

The Rinderpest. The reduction or disappearance of fly in some areas that took place coincidently with the passage of the great rinderpest epizootic and the possibility that it may have been connected with it must be given its full weight, but the matter was not investigated at the time and it is now so long ago that we can hardly expect to find out much about it. We know that only a few game species were decimated, the rest

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[illegible] to exterminate it a favour in prior epidemic

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of the animals, many of them in abundance, being left. We know also that in some areas (including one that I know well myself) the destruction of the susceptible species, though they had been abundant, does not appear to have conspicuously affected the fly. The presence of a human population may have helped to save the fly from extinction in some cases, as it might in the future again, by feeding it or by giving it its seasonal spread. The reductions recorded seem to have taken the form of severe localisation, and it is interesting to note here that the particular animals on which the fly could formerly depend to spread it annually from its dry season concentration-centres were the very ones that were destroyed. Buffaloes are great wanderers and also great frequenters of the type of seasonal swamp at which, in certain areas, but less in others, morsitans is collected in the dry season; and buffaloes were nearly exterminated, while another wandering species, the Eland, was very greatly reduced. It is quite certain, at any rate, that if it was the rinderpest that led to these reductions of the fly (and this, despite the absence of proof, I am strongly inclined to believe) it did so by something very far short of the destruction of all game animals. It is theoretically possible that its sparing of a section of the game animals may have saved the human population of some areas in which sleeping sickness may have been latent.

The recovery and extension of the tsetses in many localities after the rinderpest had passed will probably have been assisted by the going back to bush of areas that had previously been kept grazed down by the herds of cattle that succumbed (Photo 21).

(7). The control of the tsetses of the morsitans group.

(a) I do not myself think that game destruction, apart from its difficulty, its expense if thorough, and the impossibility of keeping further game from drifting in, is a feasible means of exterminating tsetses under natural conditions, if at all, though

particular herds (e.g. of buffaloes) that are wandering out of tsetse areas into cattle areas and apparently bringing in tsetses must be dealt with; and close investigation, which is needed before we do anything, might show that the exclusion of game, or of particular game, from the flies' dry-season centres might, by localising the tsetse out of reach of food as I have suggested in relation to the effect of the rinderpest, exterminate it or at least ensure that we should have the entire fly population of the centre stationary and at our disposal for the application to it whatever measures we might wish to apply for its destruction.

Secondly, I do not think that the extermination of the game will either disinfect the tsetse or put it beyond the reach of future re-infection, if human infects should be in the area or, later, enter it. Very much the reverse. The evidence of the moment suggests that rhodesiense infection is man-borne and quite possibly, for practical purposes, only man-borne. Here again we need more investigation.

I do think that with increasing population and no very destructive wars the tsetses will, some hundreds of years hence, be exterminated automatically over vast areas in which they exist today. Even now an invasion of tsetse-areas is taking place here and there through the presence of expanding populations of natives and cattle but there is great waste and, elsewhere in the very same areas, it is the tsetses that are invading the settled country, as the result of capricious shifting of settlements, reductions of cattle locally through disease or otherwise to a point below the minimum that can keep down the shoots of the "suppressed woodland" and thus keep the tsetses out, and the set-backs generally that must result from an entire lack of organisation. Meantime congestion in other parts of the same cattle-areas is killing thousands of head from failure of grazing in dry seasons and the diseases that accompany poor conditions. Organise - keep shifting the natives and cattle out of any localities that become congested into the margins of the fly, watch and reinforce threatened areas, especially foster the cattle

industry, for cattle are the material with which we consolidate our gains, encourage hand clearing on the part of the natives as it becomes necessary to gain additional grazing in this way and concentrate agricultural enterprise also in the margins of fly areas and it should be possible, subject to any vast losses of stock from diseases other than nagana, to inaugurate a steady reclamation of grazing land from the tsetses that will keep pace with the increase in the cattle. The problem is in the main an administrative one; it may be impossible at present in many areas from the point of view of policy or through lack of human material or the cost or difficulty of inducing the native to take part may now be excessive; but it represents a policy that will solve the problem and that, by propaganda amongst the natives and otherwise should be doggedly worked up to where it is not yet feasible. At the same time no promising auxiliary measures should be refused. Late grass burning will help and in given limited areas should be enforceable (see particularly Photos 18 and 19), the release of the parasites of the pupae of the tsetses may prove useful or the isolation of dry season centres or their clearing prove possible and decisive in a certain type of "belt". The last could be effected by settling natives at the decisive spots, native recruits who would have gone to reinforce the margin of their cattle-area being diverted instead to this discriminative settlement in the area selected; and a fair-sized piece of country might thus be reclaimed at once for cattle grazing.

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(c). The control of Tsetses through development by Europeans.

I have already (Bull. Ent. Res. Vol Pt. p.) sketched roughly a scheme for the pushing back of the fly through European settlement in a locality in Portuguese East Africa. I am acquainted in addition with areas of great richness, now swarming with tsetses, which only require the presence of European enterprise, with plenty of capital for the growing of cotton and other crops and using steam ploughs, to become free of the fly. Tsetses are a danger to farmers on their borders who own more land than they can readily subdue but they cannot face intensive development.

(d). The need of the moment. We have reached the stage at which we should select an area and attempt to clear it of fly by these and any other measures that may suggest themselves as good. The real point in favour of the suggested game destruction experiment was that it was intended as a practical, large-scale attempt to solve the problem and that, in making the attempt, we

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suggests the possibility of a practical large-scale experiment of a more comprehensive kind.

(8). SUMMARY.

1. Kinds of woodland. The main division today in the land vegetation is between the primary forest, consisting of pyrophobic plants, that is following disappearing and, in East Africa, is already rare, and the savannah or pasture formations that are swept through by the annual fires, but, consisting of "pyrophytes" or plants that individually resist or survive fire, hold their own, advance, and are now ubiquituous. "Heavy" primary forest and "ravine" forest are important primary types. The savannah, in turn, when the fires are as a rule early in the year and weak, or on the sites of abandoned cultivation, becomes invaded by "secondary thicket". This, in turn, or the savannah wooding itself, grass becoming scanty through dense shade and fires therefore weak, may become invaded by primary forest elements and be then termed a "re-invaded secondary" formation. The fourth division is that of the desert formations, in which there is not enough grass to burn. Finally, fringing associations, primary or secondary in composition, thicket or savannah, may traverse any formation.

2. The ultimate relation of the tsetses to the flora and the fauna:

G. palpalis — Fringing formations, primary or secondary; any woody growth at water side - the lightest sufficing if points of denser wooding are available. Ultimate prey reptiles and man (readily resorted to).

G. brevipalpis and, in general G. austeni. — Ravine type forest; secondary thicket of the heavier, shadier types or the lighter types if overshaded. Some fringing forest types; re-invaded secondary formations. Ultimate prey bush-pigs. Man avoided.

G. pallidipes — Secondary thicket, least so the heaviest types and those that are overshaded. Ultimate prey bush-pigs. Man not a favourite.

morsitans. { Savannah woodland and savannah shrubland with (compared with the other species) a minimum of reliance on thicket. Ultimate prey man (readily resorted to).

swynnertoni. { Savannah woodland with thickets. Ultimate prey man (readily resorted to and successfully used).

That is to say, if bush-pigs are inexterminable, as they seem to be, no amount of game destruction will exterminate G.brevipalpis, G.austeni and G.pallidipes. G.palpalis, G.morsitans and G.swynnertoni fall back on man (amongst other food animals, including often, for morsitans, a bush-pig element) when the game is destroyed and in the one instance in which game destruction has been carried out in a swynnertoni area it seemed possible that a resulting concentration of the fly on man may have helped to bring about the epidemic of sleeping sickness with which it coincided. The hope that the extermination of the game will lead to a disinfection of the fly is, to a large extent, negatived in any case if Trypanosoma rhodesiense should be a human trypanosome; and this for practical purposes, it would seem to be, even if it should still spring occasionally from T. brucei.

The control of the flies of the morsitans group would be brought about not by any general game destruction, but, (in the main) by clearing the bush gradually by means of native settlement and keeping it clear by means of settlement and grazing. This could be done, as fast as we could stock the pastures we reclaimed, organise if we should find it practicable anywhere to organise and push out continually the margins, the material of invasion with which an increasing native and cattle population will provide us, and so prevent the set-backs and waste of material through local overstocking and other causes that now occur through its not being organised. Auxiliary measures would be tried also- as breeding and release of parasites, late grass-burning where it can usefully be enforced, discriminative

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No. 21646/22.

S.A.

DRAFT.

DESPATCH.

Mr.
Mr.
Mr.
Mr.
Sir G. Grindle.
Sir H. Read.
Sir J. Masterton Smith.
Mr.
Dr.

Sir

I am a

Low Court, as the

Colonial Office is anxious, [illegible]

in the Protection of the

that [illegible]." As

of the

Relations of some East African

Tanganyika Territory and Kenya

on Zanzibar,

Secretary of State for the Colonies

Department.

I am Sir,

(Signed) H. J. READ

M.1.

2 1646/23

328

E.A.

May 1923

Sir

I am directed by the Secretary of State for the Colonies to transmit to you, for the information of the Royal Society of Medicine & Hygiene, the enclosed copy of a letter from the C.P.R. Investigation Team (Uganda Section) of the T.P.A., and to inform you that, so far as the Colonial Office is concerned, there is no objection to the publication of the paper referred to. As the paragraphs relating to some East African Tortoises refer to the Nile, the Zambesi, [illegible]

I am &c.

(Signed) REAL

DRAFT.

The Royal Society of Medicine & Hygiene

MINUTE.

Mr. [illegible] 3.5.23

Mr. [illegible]

Mr.

Mr. Davis.

Sir G. Grindle.

Sir H. Read.

Sir J. Masterton Smith

Mr. Ormsby Gore.

Duke of Devonshire.

Now despatch 25 March (without enclosure)