TRYPANOSOMIASIS IN AFRICA

IT is not always possible to contemplate with such pleasurable anticipation a series of Government publications such as those dealing with varied aspects of trypanosomiasis in Central Africa—a truly gigantic problem. This is discussed in the four important communications now published*. These reports form a series prepared for the Tsetse Fly and Trypanosomiasis Committee appointed by the Secretary of State for the Colonies and edited for publication by the staff of the Bureau of Hygiene and Tropical Diseases. It is right that it should be emphasized that this difficult task has been performed with that thoroughness and skill which are the hallmarks of this excellent institution. By so doing they have been embellished with a scientific *finesse* which will be appreciated all the world over.

The vastness of the trypanosomiasis problem which confronts the Colonial Governments and the Colonial Office to-day is emphasized in a popular appreciation. The havoc caused by tsetse flies in Nigeria, for example, extends over a country seven and a half times the size of England, so that one-fifth only of this huge territory is safe for men and cattle. On the Gold Coast, over the entire area of 91,840 square miles, these flies prevent the people from keeping the large-humped zebu cattle which should contribute enormously to their meat supply; thus they are compelled to rely upon their own native dwarf unproductive breed which is more resistant to trypanosomiasis. The third great West African Colony —Sierra Leone (27,500 square miles)—is quite over-run with tsetse, and endemic sleeping sickness in man occurs in one-tenth of the country, so that the same dire cattle problems present themselves and large numbers succumb to this disease. Though comparatively smaller, the whole of the Gambia (4,130 square miles) is infested with tsetse, while human sleeping sickness is sporadic; but nowhere can the larger and more economic cattle types be maintained.

One of the more drastic remedial measures which have been suggested is the extermination throughout 'fly country' of the numerous dog-faced baboons upon which these flies engorge themselves—a task more easily said than done.

In Uganda we learn of extensive pastoral areas which, some forty years ago, maintained flourishing herds of healthy cattle and now are clothed with impenetrable bush. In one epidemic, within three years, 200,000 natives, inhabitants of Busoga Province, were exterminated. To those who study the food problems of the world—and there are many at the present moment—it comes as a shock to learn that in all the East African Colonies there are said to be only some 14 million head of cattle to support more than 15 million people, and that this deplorable disproportion is to be ascribed to the tsetse fly alone.

The bionomics of some ten species of *Glossina* are dealt with in these reports. This is a field to which British entomologists have devoted special skilled attention. Each species has its own particular habitat and maintains its own peculiarities. Some can tolerate extreme ranges of humidity and temperature, whereas others avoid dry zones. Some thrive in the forest shade, others avoid it. Most of this information is contained in the exhaustive report by Dr. T. A. M. Nash—a document of some seventy-five pages, illustrated by sixteen topographical photographic plates, of outstanding excellence, and an appendix containing fifteen beautifully executed maps, which we understand are the most accurate and detailed ever published on this subject.

The largest of the West African cattle—the humped zebu—is the breed with the least resistance to trypanosomiasis, so that it cannot be kept in belts where *Glossina morsitans* abounds; therefore, bovine trypanosomiasis is most serious in northern Nigeria, where these cattle are dominant.

The riverine tsetses, *G. palpalis* and *G. tachinoides*, carry most of the sleeping sickness to man. The bulk of this human disease occurs in the savannah woodland zone and, broadly speaking, the disease appears to be absent from the main forest belt. Eradication of the tsetse with the means at present at disposal is a Herculean task, and it is not possible to go deeply into this subject. In short, it involves the clearing of vegetation against the tsetse, as each particular species preserves its own peculiar botanical association and only too often do these radical measures clash with the interests of the agricultural and forestry departments. This is gathered from Nash's own story of the Anchau Rural Development and Settlement Scheme. Here is unfolded a tale which should warm the heart of all true patriotic Britons. The Anchau district is in the Zaria province of northern Nigeria, where in 1934 it was found by Dr. N. E. W. Anderson that no less than one-third of the population had sleeping sickness and that the bulk of the area was infested by *G. tachinoides* The Anchau settlement is the first large-scale attempt at rural development to be made in British West Africa, and marks the first occasion in that country in which the fly has been eradicated from a corridor 70 miles in length and covering an area of 712 square miles. The carrying through of this complete scheme has occupied some ten years and has entailed the co-operation of the Forestry, Veterinary and Geological Departments of the Nigerian Government. The scheme has now been completed at the comparatively cheap cost of £95,000 spent over a period of five years. That it has been well spent, and that it has afforded a demonstration of paternal Colonial Government in the best sense, a study of this fascin ating account amply proves. In the Anchau district 3,700 people were moved out of 200 square miles of country, and eventually the whole population of 13,000 was settled into an area of 170 square miles.

We are given a glimpse of a primitive African town. It was indescribably filthy. Some 2,500 lived within a town wall which surrounded only 0·118 square mile, giving a population density rate of 21,200 to the square mile. On the weekly market days, about three thousand additional visitors would crowd into it, constituting a seething mob, all coughing, sneezing and spitting, owing to the peppers on sale in the tumble-down booths, so that any of the prevalent diseases spread rapidly to the surrounding villages after market days. The town was traversed by sunken footpaths winding between high mat fences, ankle-deep in expectorated sugar cane. Wooden clogs were worn because of the mud. Stinking borrow

* Colonial Office. Tsetse Flies in British West Africa. By Dr. T. A. M. Nash. Pp. 78+15 maps. 30*s*. net. The Anchau Rural Development and Settlement Scheme. By Dr. T. A. M. Nash. Pp. 22+4 plates. 3*s*. 6*d*. net. Trypanosomiasis in British West Africa. By Dr. T. H. Davey. Pp. 15. 2*s*. net. Trypanosomiasis in Eastern Africa, 1947. By Prof. P. A Buxton. Pp. 44. 3*s*. net. (London: H.M. Stationery Office, 1948.)

and dye pits mingled their smells with the all-prevailing stink of human excrement. For defensive reasons the town had been built on the edge of a marsh, with two tsetse-infested streams on the west and south and, in addition, these flies swarmed in the thicket-choked moat of the town wall which the people refused to clear because of ancient superstitions—but it *was* cleared and Anchau has survived. Mosquitoes came up at dusk from the marsh in their myriads. For years all beasts had been slaughtered on a piece of blood-soaked ground, which was littered with offal and bones, thereby providing a meeting-place for vultures and hyænas, and the dead had to be buried inside the town, to prevent desecration by these ghouls. In the wet season, the guinea corn, fourteen feet in height, choked the few remaining open spaces. Water was obtained from the swamp or from filthy wells sited within a few yards of a pit latrine.

Such is the lurid picture painted of old Anchau, the district headquarters. How all this has been changed, how a model township with brick-built bee-hive huts in model compounds, with standard types of new wells, spacious well-planned market-place, slaughter-houses, etc., has been built, are well illustrated by a series of excellent aerial photographs. There follows a number of suggestions from the lessons which have been learned. More than 18,500 fruit and shade trees have been distributed throughout the corridor. A successful pig-breeding industry has been started which brings much wealth to the peasant farmer. Tsetse have been eradicated from 610 square miles of country, necessitating the clearing of 540 linear miles of stream, so that now some 50,000 people can live out healthy lives in a tsetse-free country.

There are some amusing interludes, such as the conflicting interests between the afforestation enthusiasts and tsetse-minded entomologists. Thus the planting of innocent papaya trees provided an ideal breeding place for *G. tachinoides* in the middle of the town and they had to be cut down. The presence of sacred trees in the streams caused much trouble. The village headman would suddenly announce that the work was nearing a spot where any man would die who entered the grove, and then work would come to a standstill. This nuisance was soon avoided by inducing the old man to exorcise his evil spirits on to a neighbouring hill, when everyone appeared to be satisfied and the prestige of the gangman was proportionately enhanced. To mark the transition from the bad old days and the transformation from a sink of pestilence, the new town of Anchau has been named Takalafiya, which means "Walk in Health".

Dr. T. H. Davey's "Trypanosomiasis in British West Africa", a rather shorter document of some 15 pages, includes a general survey of West Africa and embraces the Anglo-Egyptian Sudan, French West and Equatorial Africa, the Belgian Congo and Liberia. Though not so detailed as the other reports, it contains a summary of useful information both on human and cattle trypanosomiasis.

In Prof. P. A. Buxton's "Trypanosomiasis in Eastern Africa, 1947", we are presented with a somewhat different problem. Many important points are discussed in the author's own characteristic and philosophical manner in a series of 275 paragraphs and in a space of 44 pages. The situation in East Africa differs in many important particulars from that in the West African Colonies. The geographical features of mountains, valleys and fertile plains present an entirely different picture with its own peculiar vegetation and fauna. Whereas sleeping sickness is conveyed from man to man direct by tsetses in the west, here the human disease is interconnected with big game and the fly which is their constant companion—*Glossina morsitans*. The cattle problem is even more serious, because the wild animals constitute a reservoir of trypanosome infection for them.

The fact has to be faced that, until some better preventive measures are devised, cattle and big game cannot co-exist. An alarming feature is that no doubt serious advances of the fly have recently taken place, especially by the closely related 'game tsetses' (*G. morsitans, G. pallidipes and G. swynnertoni*). This last-named insect was discovered by the late C. F. M. Swynnerton, who was the first to undertake tsetse survey, research and reclamation in Tanganyika in 1921. Swynnerton was a remarkable man, essentially a good naturalist, without any scientific training; but he possessed an immense knowledge of insects, game, plants and Africans, and he could envisage in his own mind the whole problem in a manner no one else has ever attained. More recently, particularly in Tanganyika, field workers have begun to mark flies with spots of paint. This has led to knowledge about their length of life under natural conditions and the distance covered by a fly. A system was then developed, depending on the use of more than one colour, applied to particular spots on the fly, so that it was possible to indicate where and when the fly was first caught, together with information about recaptures. By the use of these methods, entomologists were able to unravel the habits of *Glossina*. They showed that they had particular breeding places, feeding places and resting haunts, and they were able to determine these in terms of characteristic trees and bushes. Much interesting work has been done on the biology of *Glossina morsitans*. This insect lives in a large number of types of vegetation in different parts of its distribution. The greatest part of its range is in 'miombo', a thin deciduous woodland, composed of many types of tree, especially *Isoberlina* and *Brachystegia*; but in other parts it frequents *Acacia* thorn bush, whereas in Ankole, Uganda, it lives in thickets of thorn and other trees growing on large ant-hills in open grassy plains. In all these diverse environments the insect exercises a precise choice, and only feeds, rests or deposits larvæ in very limited spots. It is reasonable to believe that this precise choice, which renders discriminative clearing possible, is partly due to micro-climate.

In Central and North Africa, conditions are generally simpler than in East Africa. The immense geographical variety of Kenya and Uganda, with their high mountains, rift valleys, coastal plains and so forth, is absent. Although *G. morsitans* is the dominant species, yet *G. pallidipes* is also dangerous and has been overlooked in certain areas.

Entomological work in East Africa has been mainly directed from the Tsetse Research Department, Shinyanga. This has already resulted in the settling of large areas in Tanganyika which were formerly occupied by tsetse. The total area reclaimed by this Department is 1,300 square miles. There are now, in the Shinyanga district, 175,000 tax-payers and 525,000 cattle. It is an impressive experience to fly, as Buxton has done, over this area and see cattle and grass and villages where there was at one time only bush and tsetse.

In Uganda, successful control of *G. palpalis* by clearing its waterside breeding places has been practised for many years. Some of these clearings are important because they protect considerable centres of population, especially Entebbe, and they also render safe the ferries where numbers of travellers used to be exposed to the bites of this fly.

The control of tsetse in Southern Rhodesia is essentially a battle against *G. morsitans*. It is the problem of protecting cattle. The principal method employed has been the eradication of game from certain areas, mostly in the higher regions of this territory. Here the Government proposes to make a total of 300–350 farms, each of 3,000 acres, which will be on land formerly occupied by *G. morsitans*.

It has only been possible to select a few of the most important and interesting features which are presented in this most remarkable and original document; but it may convey to the uninformed reader a small idea of the immense effort, both physical and mental, that has been expended by a handful of enthusiastic scientific workers for the benefit and development of the Dark Continent.

It is by a happy coincidence that a summary of this fine preventive work should be published at this very time, furnishing, as it most certainly does, an appropriate setting to the introduction of 'Antrycide', a discovery published in *Nature* of January 15. Together they form a fine consummation of the work of this team of British scientific workers, and undoubtedly bring eventual victory over the tsetse considerably nearer. This is an achievement of which everyone who is interested in the welfare of Africa should be proud, although its full import cannot as yet be measured.

Finally, we venture to assert that these reports, so inadequately here reviewed, constitute a model for the world to emulate. By our good deeds shall we be judged by future generations. Scientific work of this calibre forms the kernel of potent propaganda. We can therefore look forward to such time as the British representative, at some stormy meeting of the United Nations Organisation, can confront his detractors with these mighty African achievements, for no other nation, by its self-effacing and patient labours, has done so much for the health, prosperity and well-being of the untutored Africans whom fate has placed under its care.

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BEE BEHAVIOUR*

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FOR many years it has been realized that a well-developed social organisation is exhibited by every colony of honey-bees. We now know, thanks to the work of G. A. Rösch and others, that a highly efficient division of labour exists among the worker bees of a colony, and that each worker bee has her own particular part to play in the economy of her colony. The nature of the duty which a worker performs at any given time is very largely, but not entirely, determined by her age, or, more correctly, by that state of physiological development to which she has attained at the time. But there are no hard and fast rules. If insufficient bees of nursing age are present to feed all the larvæ properly, the period of nursing is extended; similarly, if more than sufficient house-bees are present, their time is not wasted, and the position is readjusted by surplus house-bees becoming foragers at an earlier age than usual. The precise mechanism by means of which such adjustments are made is not yet fully understood.

By the time a bee is three weeks old, she knows the exact position of her hive relative to neighbouring objects in the apiary. If we take a bee of this age and release her a short distance away from her hive, she finds her way home largely, perhaps entirely, by sight. Later, however, as shown by the work of E. Wolf, when she becomes an established forager, two further senses come into play and aid her in finding her way back to her hive. These are a sense of distance travelled, and a sense of the direction in which she has travelled on her outward journey to a source of food.

Even after a bee has successfully relocated her hive on her return from a foraging expedition, she may experience considerable difficulty in finding the entrance if it has been altered in any way. For example, as shown by Butler, if the hive is turned through 90°, she will return to the exact place where the entrance has been hitherto. She settles on the nearest part of the hive to this position and proceeds to run about in all directions, frequently taking to the wing and re-alighting on the place where the hive entrance was situated previously. Eventually, after much running about she locates the entrance in its new position. On her return from subsequent foraging expeditions she does not go directly to the entrance but always goes first to the place where it was originally sited, alights there and runs round on the outside of the hive to the entrance in its new position. Ultimately she learns to fly round to the entrance, but never does so directly, always flying to its original position first and flying from there round the hive to its new location.

In a very similar manner to that in which she is able to find her hive on returning from the field, the honey-bee is also able to relocate a dish of sugar syrup or other source of food that she has found in the field. Provided that the source of food has not been moved, or its surroundings disturbed, the average honey-bee relocates it quickly and unerringly after she has visited it a few times. Let us suppose, for example, that we have placed a dish containing concentrated sugar syrup a short distance, say fifty yards, in front, north, of a fairly strong colony of bees living in an observation hive. It will almost certainly be a matter of hours or even days before a single bee finds the syrup. When a bee does find the dish, however, she settles upon it and proceeds to fill her honey stomach before returning to the hive with her prize. When she leaves the dish she performs a short orientation flight around it to help her to find it again the next time that she seeks it. Let us mark her with a spot of coloured paint so that we can recognize her again. If we watch her on her return to the observation hive, we find, in all probability, that she performs a little dance either on the alighting board of the hive or on one of the combs, every now and then pausing to pass some of the syrup that she has collected to other bees that have been paying close attention to her dancing. Presently, when she has given away the syrup she has collected, some to the house-bees for ripening and storage, and some to the bees of foraging age, she ceases to dance, cleans her eyes and antennæ, and leaves the hive, soon to reappear at the dish of syrup. A number of bees will

* Substance of a Friday Evening Discourse delivered at the Royal Institution on November 5.