beer plant. Though exceedingly interesting and important to botanists, these discussions are rather foreign to the main theme, and might with advantage have given place to a further treatment of definitely established diseases, and more unity and balance would thus have been secured.

In seeking for some convenient classification of various diseases, the natural division into three large groups is adopted:—(1) the vascular diseases; (2) the parenchyma diseases without hyperplasia; and (3) cankers, tubercles, and tumours, in which there is a more or less distinct hyperplasia. Under the general considerations involved in a study of these forms of parasitism, such as the methods of infection and progress of the disease, the destruction of tissues and dissolvent action of enzymes, abnormal development of host tissues, &c., a great number of bacterial diseases are dealt with by way of illustration, but only three specific diseases are fully described as such. These —the wilt of cucurbits, the black-rot of cruciferous plants, and the yellow disease of hyacinths—belong to the vascular group, and are discussed in fullest detail with respect to the specific characters of the organism, the etiology of the disease, the morbid anatomy, geographical distribution, and remedial treatment, including an estimate of financial loss for which they are responsible. The account of the cucurbit wilt represents Dr. Smith's own work, and he has also carried out much original research upon the other special diseases enumerated. The three are placed each in separate chapters, and together occupy more than one-third of the whole volume. Perhaps we may look forward at some future date to a third volume dealing more completely with other important types.

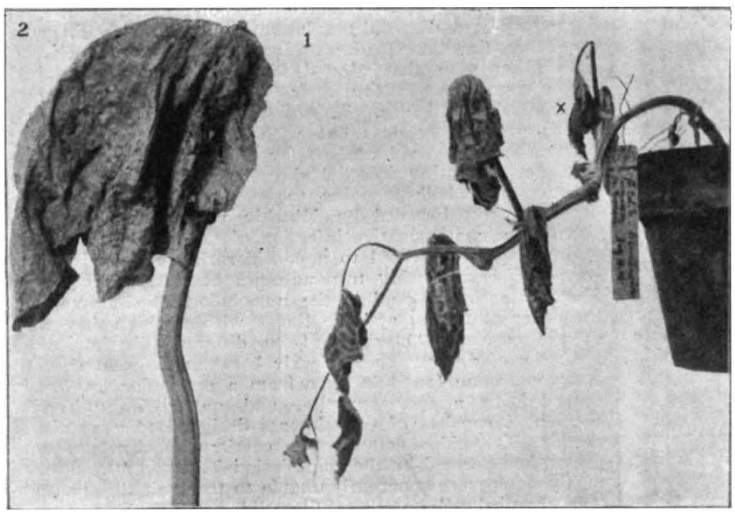

FIG. 2.—Wilt of cucurbits.

1. Cucumber-plant infected with a pure culture of *B. tracheiphilus* plated from the stem of a squash-plant. Plant inoculated August 10, 1905, by needle-pricks on blade of leaf marked ×. Photograph made on August 22. The vessels of the stem were plugged with a sticky white bacillus, which was plated out. Surface of stem sound. About one-sixth natural size.
2. Cucumber-leaf inoculated with *B. tracheiphilus* by *Diabrotica vittata* night of August 17, 1905. Blade shrivelled in some places and wilting in others. A natural infection. Photographed August 26, about half-size.

The most notable recent work on bacterial disease is that by Dr. Smith upon the crown gall, and a very interesting epitome of his latest paper is included here. This brilliant piece of investigation has established beyond all question that the tumerous disease known as the crown gall (Fig. 1) is of bacterial origin, and the phenomena in connection with this type of bacterial disease appear, in the author's own words, "to throw a flood of light on the mechanism of the development of malignant animal tumours."

The book is fully illustrated by expressive drawings and photographs, made chiefly from material in the author's own laboratory. Two of the illustrations are here reproduced.

M. C. P.

THE PROGRESS IN OUR KNOWLEDGE OF THE TRANSMISSION OF SLEEPING SICKNESS AND OTHER TRYPANOSOME DISEASES IN AFRICA.[1]

THE latest report of the British Sleeping Sickness Commission is the outcome of the work of Colonel Sir David Bruce, Captains A. E. Hamerton, H. R. Bateman, F. P. Mackie, and Lady Bruce, the members of the third commission to Uganda during the years 1908–10. It is highly satisfactory to find that, in the volume before us, a distinct advance is recorded in our knowledge relating to important etiological questions connected with the spread of sleeping sickness and of certain animal diseases due to trypanosomes.

An introduction, illustrated by photographs, describes the chief features and arrangements of the camp at Mpumu, which was made the headquarters of the commission. The body of the work is divided into ten sections, the more important sections each comprising several groups of experiments. In a few cases these subdivisions represent the continuation or elaboration of an experiment previously recorded (in Report No. x.); in such, the result obtained from the original experiment is first of all briefly recapitulated. At the end of the volume is a comprehensive analytical index (to both Reports x. and xi.) which will be found very useful.

The first section (A), which is in many respects of the greatest interest, deals with the development of *Trypanosoma gambiense* and other trypanosomes in *Glossina palpalis*, and the question of their transmission by this tsetse-fly. As regards *Trypanosoma gambiense*, the following important conclusions are reached by the commission. Mechanical transmission, that is to say, transmission by means of interrupted feeding, plays a much smaller part, if any, in the spread of the parasites (and consequently of sleeping sickness) than has hitherto been supposed. After the first few hours, the bite of the fly was found to be non-infectious until at least twenty-eight days had elapsed since the fly fed on the original infected animal.[2] At the end of this "incubation period" the fly may become infective, and may retain its infectivity for at least ninety-six days. This means that the developmental cycle of the parasites in the insectan host was found to take about twenty-eight days, and only when this development was completed could the infection be transmitted back again to the vertebrate host. Once a fly becomes infective, it appears only too likely that it may remain infective for the rest of its life. On the other hand, against this alarming result may be set the fact that only a small proportion of flies (laboratory bred) appear to become infective, the commission having found that the trypanosomes develop only in about 1 in 20 of such flies fed on an infected animal; and the proportion of infective to non-infective flies occurring wild in nature is very much less, probably not more than 1 in 500. An interesting account is given of the various developmental phases of the parasites observed in the different organs of the fly. Stress is laid by the commission upon one fact, namely, that in the salivary glands, and in them alone, were the trypanosomes found to revert to the blood-type. Further, the occurrence of this type of the parasites in the salivary glands was found to coincide, broadly speaking, with the onset of permanent infectivity of the fly. The commission consider that without this invasion of the glands there can be no infectivity, and that the reversion of the parasites to the blood-type is

1 Reports of the Sleeping Sickness Commission of the Royal Society. No. xi. Pp. 294+15 plates, text-figures, and maps.

2 It may be mentioned that Kleine and Taute, associated with the German sleeping-sickness Commission, have found that flies may become infective about twenty days after being fed. This variation in the incubation-period is probably dependent on variations in the surrounding conditions, food, &c.

a *sine qua non* in the infective process; in other words, the stumpy type of form developed in this situation is regarded as the essential propagative phase. It should be mentioned, however, that the commission found also that injection of the intestines only of infected flies, after twenty-four days or more had elapsed since feeding, produced an infection in some of the inoculated animals. Hence either the blood-type must occur in the intestine also,[3] or else some other form or phase is also capable of transmitting the infection. With regard to the latter possibility, there is one point upon which we should like to comment. A characteristic type of parasite, long and very slender and possessing a peculiar elongated nucleus, was found, but not very commonly, in the fore-gut or proventriculus at intervals after twenty days. This very distinct type of form is known to occur also in the life-cycle of other trypanosomes, from widely different vertebrates, when in the invertebrate host; it has been described, for instance, in the case of *Trypanosoma brucii* in *Glossina fusca*, in the case of fish trypanosomes in leeches, and in the case of an avian trypanosome in a mosquito; in these cases it is either known with certainty to be the propagative phase or else is regarded with some probability as such. We think, therefore, that the fact of its occurrence in *Trypanosoma gambiense*, as described by the commission, should be noted, and the possibility that it may be a propagative form also in this case borne in mind. At any rate, the occurrence of this type in very different species of trypanosomes suggests that it has an important significance

It is interesting to compare with the above account of *Trypanosoma gambiense* in *Glossina palpalis* the relations of *Trypanosoma vivax*, a dangerous parasite of cattle, to the same species of tsetse-fly, on which light has also been thrown by the commission. Flies were found to be able to transmit *T. vivax* after an incubation period of from seventeen to twenty-eight days, a shorter period, it will be noticed, than in the case of *T. gambiense*. The parasites develop, moreover, in a much larger percentage of flies—in about 20 per cent. A striking point of difference is that the development is restricted to the proboscis and pharynx of the fly, where the parasites occur in large numbers;[4] and, further, the predominating type of form met with is not, as in the other case, trypanosome-like. From this brief comparison it will be realised how greatly the developmental cycles of different species may vary even in the same insectan host.

The second section (B) consists of series of experiments designed to ascertain if, among various animals, including cattle, antelope, &c., there are any which can be regarded as a reservoir or source of *T. gambiense*; and the results obtained by the commission have already attracted considerable attention, and may prove ultimately to be of great economic importance. The conclusion arrived at is that it is possible both for cattle and antelope living in a fly area to act as a reservoir, and so maintain the infectivity of *Glossina palpalis* in regard to sleeping sickness; but up to the present the commission has not been able to prove that this actually takes place in nature. The facts brought forward in this connection, however, are very suggestive. In antelope the parasites are extremely scarce and difficult to find by microscopic examination of the blood, even when the animal was proved by experiment to be infective for flies. In one instance a buck was shown to remain infective for nearly three months. Infected animals remained apparently in good health, even though kept in captivity (in one case for at least four months). It is evident that in antelope and cattle the infection produced by *Trypanosoma gambiense* is of the chronic type, and apparently similar in character to the infection of wild game by *T. brucii*. In addition, there is the fact, shown by the commission, that the tsetse-flies from the lake-shore have now remained infective for three years since the removal of the population, the zone being given over to the wild game. Unfortunately, the commission was able to shoot only five buck, which were negative in respect of *T. gambiense*; from such a small number it was impossible, of course, to draw any conclusion. If the further investigation undertaken by Sir David Bruce proves that the wild game in the district is naturally infected with the parasites, a very serious etiological factor is introduced, since the removal of infected human beings from the zone of the fly will not be sufficient to cause the disappearance of the trypanosome.

We have dealt somewhat at length with the first half of the report in view of the widespread interest and importance attaching to all research that bears in any way upon the serious question of sleeping sickness. Consequently, we are unable to refer as fully as might be desired to the remaining half of the volume, which contains much that should be noted by workers on trypanosomes and trypanosomoses in general. It must suffice to indicate briefly the scope of the other sections, permitting ourselves to remark upon one or two particular experiments.

The third section (C) describes series of miscellaneous experiments carried out, for the most part in connection with *Glossina palpalis*. One of these series (No. 22) was to ascertain if laboratory-bred *G. palpalis* become infected with flagellates when kept in the same cage with, or in contact with cages containing wild flies infected with, *Trypanosoma grayi*. The commission found that the laboratory-bred flies did not become infected with *T. grayi* (or other flagellates) after being kept for six weeks in association with the infected flies, and after having had ample opportunity to foul their proboscides with the excrement of the wild flies. *T. grayi* is known to form cysts, which presumably pass out with the dejecta of the fly; hence the above evidence, so far as it goes, points to the flies not becoming infected directly from the cysts, the function of which remains to be determined. The idea originally put forward by Minchin was that they might serve for a contaminative infection of the vertebrate host.

Section D is devoted to a consideration of certain well-known disease-causing trypanosomes of cattle in Uganda. Much attention is paid to the morphological characters of the different forms, and the limits within which they vary in the case of "strains" from different districts, with the view of distinguishing clearly between different species. A trypanosome found in oxen from a particular locality is regarded as a new parasite, and named *T. uniforme*. Section E consists of experiments designed to ascertain if certain Tabanidæ act as the carriers of *Trypanosoma dimorphon* (termed by the commission *T. pecorum*). Species of Tabanus were apparently unable to transmit this parasite "mechanically," but these flies did not live long enough in captivity for it to be determined whether they could act as true hosts or not. We may point out that the flagellate parasites which were found in some of the (wild) Tabanids were most probably phases in the life-cycle of a trypanosome of some vertebrate, quite possibly a natural (*i.e.* harmless) parasite of the cattle themselves;[5] such a form would not be likely to live in rats. Sections F and G describe trypanosomes (including new species) and other parasites from various animals. Section H is concerned with the disease of natives known as "Muhinyo," which turns out to be Malta fever. Section I is a very useful account of the distribution, so far as it is known up to the present, of biting flies in Uganda, illustrated by a map in the case of the more important species. Lastly, Section J, together with the appendices, furnishes an epitome of the commoner diseases of cattle occurring in the different districts of the Uganda Protectorate.

It will be evident from the above digest that a mass of very useful information is contained in the latest report, which in our opinion is one of the most valuable of the series. No elaborate study of the numerous experiments is required to realise the very considerable amount of time and labour their prosecution must have entailed. The members of the commission are to be congratulated on the addition of an important quota to the ever-growing sum of our knowledge of the devastating trypanosome diseases of tropical Africa.

[3] Kleine and Taute found blood-forms (apparently not quite corresponding, however, to those referred to above) in the intestine of most of their infective flies. Further, these workers do not attach much importance to the presence of the parasites in the salivary glands; in view of the marked correspondence shown by the British Commission between the period when the Trypanosomes were found in the glands and the time when the flies became infective, this discrepancy is difficult to explain.

[4] This localised type of development has been termed by Roubaud "évolution par fixation directe."

[5] Knuth and Rauchbaar have recently shown that a Trypanosome occurs naturally in cattle in Germany; this is most likely transmitted by Tabanids (*e.g.* Hæmatopota spp.), from which, in fact, flagellate phases have long been known.