More than 90 per cent of the students benefit regularly from bursary grants, 17,000 reside in student hostels and 24,000 feed in student canteens. There is medical and social aid.

Prof. Tamas discussed curriculum reforms which have been introduced and brought closer in line with the country's economic and practical needs, and the extent of the advanced and research work undertaken in the Hungarian universities.

RED FOX IN THE UNITED STATES

AN evaluation of the red fox in the United States has been made by Thomas G. Scott, on behalf of the Illinois Natural History Survey*, which suggests that the fox has shown no sign of declining in numbers and that it has unusual capabilities for survival despite keen competition; the opening-up of forest lands and the reduction or elimination of wolves and coyotes seem to favour foxes. Some reports on rabies outbreaks in the eastern United States indicate that the fox is fully capable of reaching population-levels which are too high to serve its own interests.

The role of the red fox as a predator appears to be the most important of the various factors affecting the economic position of this animal. It tends to take the foods which are most readily available, and thus its diet varies immensely both with the season and the environment. The diet does not reflect precise, automatic adjustments to changes in population-levels of specific prey. For example, during the spring and summer, when prey such as rabbits, mice and birds are found in increasing numbers, the frequency of occurrence of these items in the fox's diet declines where acceptable fleshy fruits and insects are available. Thus it would be unwise to claim or expect an increase in numbers of prey species in response solely to the reduction or elimination of red foxes. A large-scale experiment with the reduction of a fox population as a means of increasing a pheasant population in New York State resulted in the conclusion that "despite reducing the fox population to a very low level, fox control on the Seneca County area did not increase pheasant abundance appreciably and certainly not to a degree commensurate with the cost". Though foxes unquestionably prey upon vulnerably situated poultry, and to a lesser extent on small pigs and lambs, it seems that poultry losses result largely from failure of owners to follow recommended poultry-husbandry practices.

Foxes are among the most important vectors of rabies in the United States, and herein probably lies their greatest nuisance. People living in an area where rabies has been reported experience great mental distress, and may even have to suffer the physical discomfort of Pasteur treatment if attacked. It is certain that losses occur among livestock infected through the bites of rabid foxes. When rabies breaks out in a locality of high fox population, the disease is likely to continue until the foxes in that general area are virtually exterminated; this may take from one to three years.

The most desirable method known for bringing rabies outbreaks among foxes under control has proved to be population reduction by means of organized trapping; but whether the several million dollars that has been paid out during the past twenty years on fox bounties has been money well spent is a question open to doubt. Experience in Pennsylvania indicates "that probably 50 per cent or more of the mammalian predators (red fox, gray fox, and weasel) would have been killed regardless of the bounty". The bounty system cannot be directed efficiently toward the reduction of specific, excessive fox populations because the administrative areas in which funds are approved for bounties seldom conform with the particular areas needing attention. The economic demand for red fox pelts is at present very low. The sport of fox-hunting contributes to the reduction of fox populations, and the survey, which is well illustrated, discusses the ethical and æsthetic values involved in this sport.

* Natural History Survey Division of the State of Illinois. Biological Notes No. 35: An Evaluation of the Red Fox. By Thomas G. Scott. Pp. 16. (Urbana, Ill.: Department of Registration and Education, 1955.)

STIMULATION OF YIELD FROM RUBBER TREES

A GOOD deal of work has been done at the Rubber Research Institute of Malaya, both before the Second World War and, more recently, on the stimulation of yield in the rubber tree *Hevea brasiliensis* by applications of vegetable oils (for example, palm oil) and various synthetic substances, and several aspects of this are described by E. D. C. Baptist and P. de Jonge in the *Journal* of the Institute (14, 355; 1955). A brief historical review is given of methods used for stimulating the latex yield of rubber trees, and experiments are described in which vegetable oils applied to lightly scraped bark below the tapping-cut resulted in large increases in yield.

The results of these early experiments provided a clear picture of the reaction of the tree to yield stimulation and led to the development and commercial use of yield stimulants. Similar application of a number of synthetic growth substances in an oil vehicle has also resulted in increases in yield and in the thickness of renewed bark above the cut. Repeated applications of the treatments at six-monthly intervals over a period of three years have not resulted in an increased incidence of 'dry' trees; but the yield response is found to decrease with each successive treatment. Monthly treatment with yield stimulants of renewing bark just above the tapping-cut has also resulted in greatly increased yields and in an increase in bark thickness; the latter is confined to the non-latex-bearing tissues of the outer bark. A study has been made of the effects of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) on the rubber extraction area of the bark on tapping, the incidence of brown bast, rate and duration of latex flow, anatomical structure of the bark, and the properties of latex and dry rubber.

The response of the rubber tree to yield stimulants is shown to be influenced by the condition of the bark, the type of planting material, the tapping system, the composition and method of application of the mixture. An extension of the area of rubber extraction in the bark of trees in normal tapping as a result of treatment with yield stimulant has been demonstrated experimentally and is thought to account for the increased yields obtained and for the low incidence of brown bast after repeated treat-

ment. The increase in bark thickness observed is caused by induced meristematic activity in the cortical and phloem regions, resulting in prolific development of undifferentiated parenchyma tissue, and not by activation of the vascular cambium. The rate and duration of latex flow are increased after treatment with a yield stimulant, and there is a slight decrease in the dry rubber content of the latex which usually reaches its lowest value in the second month following treatment.

PROPHYLACTIC ACTIVITY OF SURAMIN COMPLEXES IN ANIMAL TRYPANOSOMIASIS

By DR. J. WILLIAMSON and DR. R. S. DESOWITZ

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THE first, and still the most effective, prophylactic drug for bovine trypanosomiasis is 'Antrycide Pro-Salt' (a mixture of antrycide dimethylsulphate and antrycide chloride)[1,2]. Experience has shown that the maximum reliable prophylaxis obtainable with this drug is approximately two months[1-3]. The administrative work, however, required to locate and inject nomadic cattle six times a year at two-monthly intervals is usually too great to be practicable.

Some preliminary results of an investigation designed to extend the existing period of prophylaxis, using trypanocidal drugs in common use, are described here.

The possibilities of using a suramin–pentamidine salt complex to extend the pentamidine prophylaxis of human trypanosomiasis were indicated by Guimaraes and Lourie[4]. On the basis of an observation made by Lourie during a sleeping sickness campaign in 1939–41[5], these authors showed that suramin could inhibit many of the pharmacological or toxic effects of pentamidine, primarily by the formation of an inactive salt complex. Experimental confirmation of extended pentamidine prophylaxis in rats by this method has been reported by Schneider (see ref. 8), and by Cosar, Ducrot, Gailliot and Baget[6]; Beaudiment and Zozol[7] and Beaudiment, Cauvin and Leproux[8] have further shown that suramin can reduce the toxicity of pentamidine in man.

It seemed probable that suramin might form similar salt complexes with drugs active in bovine trypanosomiasis, which are all strongly basic compounds like pentamidine. Suramin was, in fact, found to form insoluble precipitates *in vitro* with solutions of ethidium and dimidium bromides, the *bis*-cinnolinium compound '528'[9], antrycide dimethylsulphate, and a new German diamidine-type trypanocide 'Berenil' (di-(amidinophenyl)-triazene (-N-1:3) diaceturate)[10].

As ethidium bromide is the most active member of this group, prophylactic experiments in rats and mice were begun, using combined treatment with suramin and ethidium bromide. At this time, Dr. W. E. Ormerod kindly made available to us the results of his experiments on the suramin detoxication of antrycide dimethylsulphate[11], following an analogy between the pharmacological effects of antrycide and curare; the toxicity of the latter was known to be reduced by prior administration of acid dyes such as congo red[12], which is related to suramin.

Although initial experiments showed that some degree of prophylactic activity was being conferred on ethidium bromide by suramin administration, the toxicity of the former drug was not markedly reduced by simultaneous or prior treatment with a separate injection of suramin under widely varied conditions. The quantitative basis of complex formation was therefore examined, since, theoretically, one molecule of suramin, with six sulphonic acid groups, could combine maximally with six molecules of ethidium or dimidium bromide, or with three molecules of antrycide, '528', 'Berenil' or pentamidine. Gravimetric analysis showed that the combining proportions did in fact approximate closely to the theoretical, and suspensions of the precipitated complexes prepared by mixing aqueous neutral solutions of the drugs according to these proportions were afterwards given throughout as a single injection.

Results in rats given a single subcutaneous maximum tolerated dose of the suramin complex of ethidium, dimidium, antrycide, '528', and 'Berenil', showed that there was a maximum decrease in the toxicity of these drugs of approximately 10-, 5-, 14-, 8- and 3-fold, respectively. Prophylactic experiments in rats and mice repeatedly infected intraperitoneally with a virulent strain of *Trypanosoma congolense* showed that suramin-complex formation induced or increased prophylactic activity in all the drugs tested, but to a varying degree. In the case of dimidium, ethidium, and '528' the increase was only of the order of a week or two; with 'Berenil' the increase was approximately five to seven weeks, and with antrycide dimethylsulphate, more than fifteen weeks.

Suramin complexes of three trypanocidal compounds have been tested in cattle for prophylactic activity; these were antrycide dimethylsulphate–suramin, ethidium bromide–suramin and 'Berenil'–suramin. Since the 'Berenil'–suramin complex showed little prophylactic activity even at a dosage of 40 mgm./kgm., it will not be discussed in this communication. (Dosages throughout refer to the amount of the basic drug present in the complex, and *not* to the total amount of the complex.)

The trials were carried out at the Institute's laboratories at Vom, which is in a tsetse-free area. The animals used were zebu cattle and each was given a *single* injection of drug-complex or, in the case of controls, the drug alone. The animals were then challenged repeatedly with cyclically transmitted trypanosomes. This challenge was delivered by *Glossina palpalis* reared in the laboratory, which had first been given multiple feeds on an ox or sheep heavily infected with *Trypanosoma vivax*; subsequent sample dissections showed that 90 per cent or more of the flies in each batch were infected. Batches of 100–150 infected flies were fed on each experimental animal for three consecutive days, and this challenge was repeated every ten to fourteen days until break-