CONTROL OF RATS AND MICE

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HOUSE MICE

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ABBREVIATIONS

A.R.C.	Agricultural Research Council
A.L.D.	Average Lethal Dose
Antu	α-naphthylthiourea
B.S.	British Standard
B.S.I.	British Standards Institute
L.A.	Local Authority
L.D.	Lethal Dose
M.A.F.	Ministry of Agriculture and Fisheries
M.O.F.	Ministry of Food
M.O.H.	Medical Officer of Health
M.O.S.	Ministry of Supply
P_3	Protected Poison Point
P.L.H.A.	Port of London Health Authority
R.C.T.	Rat Control Test
S.A.L.A.M.	Société Anonyme Levant-Africaine Méditerranée
W.A.E.C.	War Agricultural Executive Committee

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INTRODUCTION

THE work of the Bureau of Animal Population during 1939–45 was mainly concentrated on the biology and control of the brown rat. It was not until half-way through the war that any systematic and full-time research upon house mice was planned. Nevertheless, the possibility of such work was kept in view right from the beginning, and the formulation of the problem together with the discovery that methods developed for rats could not be merely adapted to mice were the result of preliminary work done by the Director, Mr. Charles Elton, between June 1940 and May 1942. After this H. N. Southern took over the house mouse problem as his main work. Miss E. M. O. Laurie assisted officially from the autumn of 1943, though she had helped for some months previously while she was working for a B.Sc. degree on the reproduction of house mice in various habitats. Finally, from August 1943 Dr. J. Rzóska also gave most of his time to house mice in collaboration with Southern and Miss Laurie.

The purpose of this introduction is, therefore, to outline the main contributions made by each member of this research team to the body of information contained in this volume. It is simplest to sketch the development of the research chronologically.

As early as April 1940 Mr. H. R. Hewer made a survey of urban (mainly shop) premises in Oxford for the purpose of estimating rat infestations and he included instances of serious damage by house mice. Partly as a result of this Elton started work in several grocers' shops and stores from June 1940 and continued intermittently until September 1941. Elton established beyond doubt the seriousness of the losses due to house mice in such places. Experiments were directed mainly to making rough estimates of populations, to testing the effect of trapping upon them, to studying the reactions of mice to bait boxes and plain baits, and to attempting control with permanent poison baits.

Since the last project failed, and since the technique of surplus prebaiting by then had been developed for rats by D. H. Chitty, from April 1941 the emphasis of the research veered to studying the daily consumption of surplus plain bait over a period and the effect of temporary inclusion of poisons. More intensive work was forwarded by using certain cellars and sheds in the Oxford Museum area where house mice could be liberated and studied on these lines.

Finally, between November 1941 and February 1942, Elton turned his attention to the difficult problem presented by bulk food stores and made preliminary observations at a M.O.F. flour store on the numbers of mice and their reactions when he provided plain bait for them.

In May 1942, when Southern started full-time work upon house mice, he carried on the 'field' tests of baiting and poisoning sequences in Oxford

shops, and at the same time initiated a series of laboratory projects to break up the 'field' problem into simpler components for separate study.

In the first place he started a series of group free-feeding tests upon house mice to gather preliminary information on the mode of action and acceptability of a wide variety of poisons at different concentrations, and on the amount of poison bait relative to prebait which mice would eat in a successful field trial. Throughout the rest of the work all poisons, as they came to the Bureau's notice, underwent a quick, exploratory test in this way.

Again, since the amount of plain bait eaten during field trials varied greatly and the results of poisoning were poor, two complementary lines of investigation were pursued: (1) the tracing of the mean daily range of house mice by means of dyes mixed with the food of an experimental, free-living population, (2) the determination of the order of preference between different plain baits by choice tests on another free-living population.

Southern pursued these investigations throughout the autumn and winter of 1942–3. The characteristic distribution of mice resulting from the smallness of each animal's range enabled him to classify infestations according to the distribution of cover and food, and this classification was important from the point of view of control. 'Easy' infestations were those in which shelter and food were separated so that baiting could intercept the mice travelling from one to the other; 'difficult' infestations were those in which cover and food were co-extensive, the worst examples being bulk food stores and corn-ricks. Here baiting could only be really successful if the bait was extremely desirable to the mice. In between these extremes fell the general run of urban infestations, where cover and food were distributed piecemeal and intermingled in various degrees.

Since the successful baiting of mice in these environments became a question of taking the bait to the mice (owing to their small ranges and lack of any notable food preferences) instead of drawing the mice to the bait, as can be done with rats, there was gradually built up a technique of prebaiting, after a preliminary choice test, with many small baits widely disseminated, so that the routes between food and cover stood out and the mice could be intercepted more successfully.

A further problem was how to ensure, even when all mice had been brought into contact with the plain prebait, that they should eat a lethal dose of poison when this was laid. Again what was the behaviour of any survivors of a poison campaign, i.e. were they thenceforward shy of the poison and/or the bait base?

Accordingly in February 1943 Southern began a series of laboratory experiments on feeding behaviour which lasted until February 1946. In these the normal feeding rhythm and the approach to poison bait were analysed by means of an electrical recording apparatus, which registered the number and frequency of visits to food trays.

From 1944 these experiments were linked with laboratory feeding tests by Rzóska, in which various doses of different poisons were given to domestic and wild mice and the resulting behaviour to plain bait and subsequent poison baits observed.

These two parallel lines of work established that shyness towards poison baits did occur in house mice, but did not extend to the bait base in which the poison was mixed. They also showed that the sporadic feeding habits of mice made it very difficult to ensure that all mice visiting the prebait ate a lethal dose of poison bait.

During the whole of this period field trials with progressive modifications were carried out in Oxford by Southern, Rzóska, and Miss Laurie until in all but the most difficult environments a routine poisoning system was evolved, which would kill 80–90% of the population.

While this intensive analysis of feeding behaviour was going on a determined attempt was made to tackle the really difficult environments such as corn-ricks and bulk food stores, where cover and food were one, even if this meant resorting to hit-and-miss methods.

From March to November 1943 Southern and Miss Laurie collaborated in an attempt to kill house mice in corn-ricks by large-scale baiting with moist sausage-rusk and zinc phosphide. The results, no doubt because of the dryness of the environment, were successful beyond expectation, and kills (verified at threshing) of between 60 and 90% were easily attainable. It proved impracticable, however, to recommend these methods because the small residues of poison bait exceeded the safety margin.

An attempt was made to circumvent this by using extract of red squill powder which had proved very toxic to house mice in laboratory tests, but in the field this poison proved useless. For the time work on corn-ricks was abandoned though between August 1943 and June 1944 Southern and Miss Laurie studied by means of break-back trapping the distribution of house mice in the fields around the ricks. This showed the presence throughout the year of a substantial number of mice living in the fields, so that even complete killing of mice in ricks before or after threshing would not prevent the next season's corn from being infested.

The other difficult environment—the bulk food store—was studied by Southern and Rzóska with help from Miss Laurie. In the summer of 1943 experiments began at a M.O.F. buffer depot on the outskirts of Oxford and these continued until March 1944. This depot contained sacked oats and white flour, which are peculiarly liable to damage by mice. Throughout a long series of tests no reasonably satisfactory results were obtained, although prebaiting was very successful.

Accordingly, at the suggestion of Rzóska, attention was turned to fumigation for killing house mice in these difficult, 'homogeneous' environments. Carbon dioxide was chosen since it could easily be obtained in solid form and was not dangerous to handle. The summer of 1944 was spent by

Southern and Rzóska in establishing the toxicity curve of house mice in carbon dioxide-air mixtures upon adequate laboratory data and in making preparations for field tests in a specially built stack of oat sacks which could be enveloped in a gas-proof cover. These field tests were carried out in the autumn of 1944 and were completely successful.

In consequence the use of carbon dioxide under a cover was extended to corn-ricks and a series of tests was made in the spring of 1945 by Miss Laurie and A. D. Middleton in Northumberland. The small round ricks characteristic of this area proved ideal for experimental purposes and again complete kills were obtained, provided the requisite concentration was reached.

Finally, during the summer of 1945 an attempt was made to extend this method to large corn-ricks. This work was done mainly by Middleton and Miss Laurie with assistance from Southern in the later stages. It proved possible to fumigate large ricks in this way, but the apparatus needed was becoming very unwieldy and it seemed that the project would hardly be economical without further research.

At this point the active part of the research was discontinued, but a further year was occupied in completing reports of the work for the Agricultural Research Council. Then in 1947 Southern began the task of writing up the results in their present form. Most of the chapters, as they stand, have been completely recast from the original reports and many are put together from data which never appeared in reports. Fortunately both Rzóska and Miss Laurie remained available for consultation until the volume was completed.

The second section of Chapter 15 (on gassing corn-ricks) was written by Middleton and Miss Laurie. Chapter 10 is based largely on Rzóska's report of his free-feeding tests. Otherwise the responsibility for the writing rests with Southern. Many of the original data are given, but there are naturally many records of experiments and field observations whose inclusion would be bulky and unnecessary. These are deposited in the Bureau of Animal Population.

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This research was carried out during the war under the auspices of the Agricultural Research Council. A fuller account of its history may be read in the first chapter of Volume 1. The publication of the results has been eventually achieved through the sympathetic attitude of the Delegates of the Clarendon Press and a generous gift by an anonymous donor.