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## SUGGESTIONS FOR COMBATING STARLING ROOSTS

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## INTRODUCTION AND PRESENT RANGE OF THE STARLING

The starling (<u>Sturnus vulgaris</u>), a bird of European origin, became established on this continent as the result of a number of importations by private individuals before 1900, when introductions were prohibited by the Lacey Act. Of the several attempts to establish the species here, those of 1890 and 1891 into Central Park, New York City, appear to be the ones from which the birds now scattered over the Eastern and Midwestern States and southern Canada originated. During the first six years after its importation the bird did not spread, as a breeder, beyond the limits of Greater New York. Since then, however, its progress has been more rapid. By 1910 its breeding range included the greater part of Connecticut and Rhode Island, the southern part of Massachusetts, the lower Hudson River Valley, most of New Jersey, and a limited area in eastern Pennsylvania. By 1930, it bred regularly from southern Ontario and southern Wisconsin to Missouri, Arkansas, and the northern parts of the Gulf Coast States, and during 1936 it was reported breeding in Minnesota, Iowa, eastern Kansas, and Oklahoma.

Migratory in its native home, the starling shifts seasonally from its breeding grounds in northern Europe and Siberia to its winter home in France, the Mediterranean countries, and points farther east. In North America the birds have developed in a relatively few years a seasonal drift or migration that has carried them far beyond the limits of their breeding area  $(\underline{1}), \underline{\underline{1}}/$ Although this movement is not carried out with the precision as to time or routes exhibited by the migratory movements of some of our native species, it constitutes a migration and a population shift that has important bearing on the matter of roost establishment and roost control.

## ECONOMICS OF THE STARLING

Despite certain objectionable habits that have become unduly emphasized by its great increase in numbers, the starling is recognized as one off most effective bird enemies of ground-inhabiting insects in the Eastern State  $(\underline{3}, \underline{5})$ . Equaling or excelling many of our native birds in this respect, it includes in its diet such pests as the clover-leaf weevil, the Japanese beetle, May beetles, cutworms, and grasshoppers. Its liking for cherries, other small fruits, garden truck, and some late fruits, however, has been to its discredit wherever it is over abundant. Objections also have been raised to its usurping the nesting sites of native birds and to its gathering in enormous roosts that constitute a nuisance or, under some conditions, a source of actual damage. It is with the view of presenting information useful in combating objectionable roosts that this leaflet has been prepared.

#### NATURE AND SIGNIFICANCE OF WINTER ROOSTS

Banding studies have shown that the population of large winter roosts in the Middle Atlantic States is composed not only of starlings that breed in the vicinity, but also many others that have come from the north. Starlings banded during winter at Washington, D. C., have been recaptured as breeders throughout Pennsylvania (even west of the mountains), central New York, New Hampshire, and Ontario ( $\underline{4}$ ). The general drift of the birds on the Atlantic seaboard, and to even a greater degree west of the Allechenies, is in a northeast-southwest direction. West of the mountains most of the breeding starlings of western Ontario, western New York, and western Pennsylvania become the wintering birds of Ohio, western Kentucky, western Tennessee, and sections even farther southwest.

In addition to the general seasonal drift, which plays an important part in concentrating winter populations of starlings, local and irregular movements also may lead to the occupying or the vacating of roosts. As soon as the breeding season is over the birds congregate locally at points throughout their breeding areas. In most cases they form tree roosts that may undergo shifting in response to the whims of the birds or to some outside stimulus. As cold weather approaches, the early roosting places are forsaken and many of the birds drift to the south or southwest on journeys that may take them several hundred miles. Even when they become established in winter roosts, they are still responsive to changes in weather that may increase or decrease the numbers there. In the city of Washington the number of starlings present in winter roosts is affected strongly by weather conditions in norther a Maryland and southern Pennsylvania. A sudden and heavy fall of snow or a marked drop in temperature in those States almost invariably increases the number of starlings in the Capital, and, conversely, a few days of mild temperature will often lead to a dispersal of many of the birds.

-Mumbors underscored in parentheses refer to Literature Cited, p. 16.

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Such movements, brought about by factors beyond human control, make the roost not a stable assemblage of a certain number of permanent occupants, but rather a fluctuating aggregation of individuals that may come and go. The numbers may be increased over night by an influx from the outside or the roost may be decreased with equal suddenness by a prank of the weather or a seeming whim of the birds. Each roost is but a unit in an aggregation of similar units throughout the winter range of the starling. The temporary elimination of a roost or a reduction in its size, although of benefit locally, must be viewed as only a local adjustment in the whole scheme of starling economy. Another season, another week, or even another day may witness a return to former conditions by an influx of birds from other districts. Although roost eradication often has produced good results, there is no assurance that the benefits will be lasting.

#### THE OBJECTIONABLE ROOST

Starlings (sometimes joined by other species) may cause marked damage both in urban and rural environments when roosting in trees. In country districts, by the weight of many hundreds, the birds have broken branches and split the trunks of fruit trees, and by the deposition of large quantities of guano have so altered soil conditions as to affect injuriously the growth of trees in groves or plantations. When tree roosts are in the residential sections of cities the disturbing noise and the odor and litter of droppings and regurgitated food not only have become highly offensive but at times have decreased real-estate values. When starlings roost in business sections of cities, similar losses may arise from the unsightly appearance of buildings and sidewalks and under some conditions, this may affect business adversely. In the case of public buildings the untidiness requires added upkeep cost, and is distinctly disagreeable to occupants.

Three methods of approach may be considered in attempts to eliminate objectionable starling roosts: (1) Measures of prevention or avoidance may be resorted to, whereby the individual property owner may obtain more or less permanent relief even though starlings are still abundant and troublesome on neighboring property; (2) frightening measures may be adopted with a view to some degree of immediate local relief but without assurance of permanent cure; or (3) the problem may be attacked on the theory that a nation-wide, or broad, regional program of control would so reduce the numbers of starlings and maintain such a decreased population, that objectionable roosts would be appreciably less frequent or troublesome. Each method has its merits, limitations, and objections. It may be possible, however, that measures of prevention or avoidance, as well as frightening procedures, may not only afford relief on the treated property but also may drive the birds to spots where they will not be so objectionable. On the other hand, the evicted birds may become even a greater nuisance on neighboring property.

## AVOIDANCE AND PREVENTION MEASURES

That damage by wildlife to farm crops may be evaded or prevented by changing harvesting or cultural practices, instead of attempting to kill all the real or potential offenders, is becoming widely recognized. The same principle may be applied under many conditions where roosting starlings become troublesome. Such steps have in their favor a degree of permanence not possessed by other measures and often are economically possible despite the initial cost.

## Screening

Where starlings (or pigeons) become a nuisance by reason of the filth and noise they create in towers, belfries, ventilators, and other enclosed places, the simple expedient of putting galvanized poultry netting over all entrances is the most effective, permanent, and often the cheapest means of relief. To exclude starlings the netting should not be of a mesh greater than 1 inch. For exposed situations, screen that has been galvanized after weaving will not only be more permanent than cheaper screen but it will be less likely to leave a rust stain on white stone or wood work with which it may come in contact.

Similar wire netting may be used to exclude starlings from ledges beneath eaves or other parts of buildings. As a rule the birds select ledges or window frames immediately beneath overhanging eaves or other projecting parts that afford shelter from rain or snow. Consequently most of the birds will be found at the level of or above the top-story windows. When the situation is not complicated by irregular contours or projections, a single strip of netting extending the length of the building from the edge of the overhanging eaves to the bottom of the top-story window usually puts an end to the starling nuisance on that property (pl. 1, <u>A</u>). Such a screen, installed smoothly and tightly, is not unsightly, and on buildings 8 to 10 stories tall is scarcely visible from the street. If the netting tends to obstruct the light entering the upper-story windows, the period of this inconvenience may be reduced by removing it when the roosting season has passed, or if the birds have definitely established themselves elsewhere, the screen may sometimes be taken down without the ledges being reoccupied.

As in the screening of steeples or ventilators the wire netting should be of a mesh no larger than 1 inch. Cotton cord netting of the type used for fish seines also may be employed. Although light, easy to install, and not subject to rusting, it deteriorates rapidly, and should be removed and stored as soon as the seasonal need has passed. If untreated, such netting will seldom last more than two seasons when exposed to the action of rain, frost, sun, and wind. If tarred, a treatment that will add approximately 20 percent to the cost, it will wear longer. Untreated cotton cord netting of 1-inchsquare mesh made of no. 9 cord costs approximately 2 cents a square foot, exclusive of marginal ropes or other "rigging" needed for its hanging. Poultry wire of 1-inch mesh, galvanized before weaving, costs approximately 3 cents a square foot, and in weight it will average about 10 square feet to the pound. That galvanized after weaving is more expensive.

## Eliminating Roosting Ledges

Since starlings ordinarily seek roosting ledges that are immediately below overhanging eaves, cornices, or other structural features, some buildings, by reason of their design, are less likely to be occupied than others. In fact some modern buildings with an absence of projecting ledges, deepset

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windows, or bold-relief ornamentation are wholly immune to the nuisance of roosting starlings. Conspicuous examples may be found in the very centers of large roosting districts in eastern cities. On the other hand, probably no type of architecture lends itself to starling needs better than the classic Grecian, with its deeply carved pediments, sheltered porticoes, and abundant columns, from the simple Doric to the highly ornate Corinthian. From such structures the elimination of roosting ledges or nooks is well nigh impossible.

Buildings of more simple design, where an individual ledge or two or the heads of a small group of columns serve as the sole roosting sites, may be permanently protected against starlings by installing "slope boards" on these ledges that will substitute for the flat surface a slope on which the birds cannot stand (pl. 1, B). Such slope boards, triangular in cross section, may be made of wood, cement, or other weather-resisting material, and should incline at least 30 degrees from the horizontal (45 degrees is preferable). They should be securely attached to the building, and the sloping surface should be smooth and close fitting so as to leave no foothold for the birds. Wooden plugs driven into the mortar-filled cracks between bricks or stones can be used for attaching the wooden slope boards; metal dowels (nails) set tightly into holes drilled into stone or concrete will anchor cement slope boards formed to fit. Local building codes should be conformed to in the installation.

This method of discouraging roosting birds, by no means a new one, was used many years ago in Philadelphia, where one builder installed sloping pieces of plate glass to prevent pigeons from roosting on the tops of columns at the entrance to a large bank. In the city of Washington it has been employed effectively above the entrance to several buildings formerly populated by both pigeons and starlings. When the boards do not slope more than 45 degrees from the horizontal their presence cannot be detected from below except when the observer is a considerable distance away; and when painted to conform to the color of the building they are scarcely discernible.

## Trimming Trees

Where starlings are roosting in such rapid-growing trees as sycamores or soft maples a severe trimming often will discourage them. As a rule roosting starlings occupy the topmost or outermost branches, and appear partial to the slender twigs that bend and sometimes break with the weight of their massed formations. When these are removed by a severe trimming the birds usually forsake them for trees more to their liking. A few years ago such treatment caused a large aggregation of starlings to leave a group of syccmore trees on Pennsylvania Avenue in Washington. In subsequent years, however, the trimmed trees sent forth a mass of small branches that again made them acceptable as roosting places. For that reason this measure of prevention is not permanent and resembles the frightening procedures that are good for only one season.

#### FRIGHTENING MEASURES

Although frightening measures often are temporary and of uncertain effect and have the tendency merely to shift the nuisance of roosting birds elsewhere, nevertheless, applied at the right time and manner, they frequently succeed in driving the birds to places where they are much less objectionable. It sometimes happens that removing the birds from a single tree or group of trees, or from above the entrance of a single building, will do away with most of the trouble.

Experience gained in attempts to move objectionable roosts under a variety of conditions indicates that success depends much on the promptness with which frightening operations are undertaken. If the birds are unmolested and the roosts allowed to increase until large numbers become firmly established, the difficulty of dislodging them becomes far greater. In areas where starlings are likely to establish objectionable roosts, property owners will save time and effort by vigilantly watching for the first indication of roosting on their premises and immediately taking energetic action against the birds.

Frightening measures range from aggressive action with prwder and shot, involving the killing of some of the birds, to the more harmless procedures of noise-making or tree-shaking that may be employed where more drastic action is neither practicable nor desirable.

# Shooting

Shooting with powder and shot is the most effective frightening procedure known. It has limitations, however, in that it cannot be used safely in certain metropolitan sections and may even be prohibited by law or police regulation. In any event this method should have the sanction of local authorities before being resorted to.

A word of caution likewise is needed for the reason that summer and fall roosts of starlings may be inhabited also by certain species protected by State or Federal law. When robins, purple martins, or other desirable native species congregate with the more abundant starlings, extreme care should be taken not to encanger them. Usually these species arrive at roosts as separate groups and often occupy certain trees, which should not be subjected to gunrire.

Shooting has been resorted to most frequently at tree roosts in suburban sections or in residential parts of cities, but it has also been employed on more or less open plazas about public buildings. Particularly effective work of this kind has been done in discouraging starlings from roosting on the State capitol building at Harrisburg, Pa.

Success in shooting as a frightening measure depends much on the procedure followed and the will to keep at it until the birds leave. Desultory firing, two or three times a week, will not bring satisfactory results. There are times when one or two nights of shooting will cause the birds to move; at other times repetition for five or six or even more successive nights is needed. Above all, <u>firing should begin when the first birds arrive early in</u> the evening and be kept up until after dark. It is not necessary to kill many

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as benefits are derived from the frightening effects of the gunfire, coupled with the misfortune to comrades that are visible to other members of the flock. At tree roosts the endeavor should be to prevent incoming birds from alighting in their favorite trees and to keep the whole assemblage on the move.

Starlings are quick to learn the deadly effect of gunfire and will respond promptly to shooting at a roost. On the other hand if local conditions prevent the use of shot, the cartridges may be cut, the shot removed, and then discharged as blanks. Though not so effective as the unmodified shells, blanks can be used to some effect when conditions warrant.

In country where starlings are numerous and where late in summer there are several tree roosts within a radius of 20 miles, the usual effect of eradicating one roost is to cause its members to join some nearby assemblage. If their presence is still objectionable the process will have to be repeated with the hope that they will eventually select a site not disturbing to people.

## Miscellaneous Procedures

In places where gunfire is prohibited or impracticable, the discharge of Roman candles among roosting birds has brought satisfactory results. Such tactics are useful mainly at tree roosts and cannot be employed about buildings where they would create a fire hazard. As with gunfire, shooting with Roman candles should be started early in the evening and kept up on successive nights until the birds move out.

An ingeniously constructed noise-producing apparatus, known as a flash gun, has proved helpful in deterring starlings from roosting in places of limited size, as at entrances or beneath the porticoes of buildings. The flash gun, suspended on a flexible spring, explodes periodically a mixture of acetylene gas and air. This causes the gun to bob up and down as well as rotate. A pilot light, backed with bright metal, aids in frightening the birds. Such flash guns have sold at about \$35 apiece.2/

The city fire hose has been drafted into the battle against starlings in some of the large cities with varied success. There is no question but that the birds can be dislodged at least temporarily by deluges of water, but, since persistence is needed to effect lasting benefits, one often finds the starlings outlasting the fire fighters, who usually have more important calls for their services.

Noise-producing activities, including the ringing of bells or the rattling of pebbles in cans suspended in treetops and operated by means of strings, have been used with only moderate success at long-established roosts.

2/ A list of dealers in pyrotechnic supplies and flash guns may be obtained from the Biological Survey, U. S. Department of Agriculture.

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A frightening procedure that is in no way objectionable to residents who might somplain of noise-producing activities is available in a simple arrangement of ropes for shaking the treetops while the birds are gathering in the evening or after they have assembled for the night. The scheme works best in such trees as elms or soft maples, which have a number of nearly parallel upper brancnes. These are joined with short sections of rope about midway of their length, and from the middle points of these connecting ropes others are tied that lead to the ground. Under some conditions several of these "lead" ropes may be joined so that a pull on a single rope will shake the whole treetop (pl. 1,  $\underline{C}$ ). Such an arrangement is particularly heloful when starlings attempt to adopt as their nightly abode a few trees in a private dooryard.

Another perfectly silent frightening procedure that has been used in Washington to dislodge starlings from trees and buildings involves the use of hydrogen-filled toy balloons, raised and lowered by strings in the hands of workers patrolling the streets. This inoffensive method has worked to advantage in the vicinity of hotels, where the more noisy frightening measures would be objectionable.

Despite the fact that the installation of lights in roosting trees and about building ledges has been resorted to, these are of little effect when used without other measures of alarm. This is particularly true at roosts in business sections where starlings often spend the nights in the glare of thou sands of lights. In Washington they have been seen actually sitting on light bulbs. Aggregations of lights, of course, materially raise the temperature, a condition that a starling might even relish on a cold winter night. An attempt to frighten starlings from a public building by training powerful searchlights upon it failed to move the birds.

A frightening measure that has served admirably in keeping starlings from occupying the ledges and ornamental capitals of one of the newer public buildings in Washington was the simple expedient of shooting pebbles with a slingshot. The merit of this procedure, however, rested as much on the persistence with which the building was patrolled by the two men assigned to the task as on the method itself. Although this building was populated by thousands of starling during the winter of 1934-35, during the following year, when it was patrolled, it remained wholly free of all birds except a few persistent pigeons. Daily, from about 3:30 p. m. until dark the building was continually being circled by the men, who fired a pebble or two whenever starlings threatened to alight. With this vigilance on the part of two members of the janitorial force an expensive job of cleaning the sides and colonnades of the building was avoided.

Equally effective results were obtained a few years earlier at another public building by the additional help of men who patrolled the roof and frightened birds away from the eaves by lashing them with "cat-o-nine-tail" whips made of long strands of wire. An air rifle shooting "EB" shot might well be substituted in places where more accurate aim is called for or where large pebbles might break the windows. Such a procedure, promptly applied, discouraged a group of starlings in Washington attempting to avail themselves of the south portico of the White House during the winter of 1935-36.

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#### REDUCTION OF NUMBERS

The merits of an extensive program of starling destruction as a means of reducing the nuisance of objectionably located roosts everywhere have yet to be demonstrated. In the present state of our knowledge and experience the benefits accruing from attempts at wholesale destruction appear to be restricted to the more or less immediate vicinity of the roosts attacked. Whether such a program would be economically sound can be demonstrated only by experimental attempts in a well-defined migration route. It is with the purpose of supplying information to those who wish to undertake control operations at favorable spots where local benefits might accrue that the following suggestions are presented:

# Shooting

The use of the shotgun as a means of killing starlings, in distinction from its employment as a frightening measure, is worthy of consideration under conditions where it is practicable and seems called for. Emphasis is placed on the caution given on page 6 regarding the safeguarding of species that may be roosting with starlings and are protected by Federal or State law. From the very nature of things, however, shooting to kill cannot be resorted to at roosts in the business sections of large cities where the birds roost on the sides or beneath the eaves of buildings or where the oractice may be seriously objected to even when the birds are roosting in trees in thickly settled residential areas. This state of affairs materially interferes with any widesoread or concerted attempt to reduce the number of starlings in some sections of the East, where during late fall and throughout the winter a high percentage of the starling population roosts regularly in such environments.

On the other hand during late summer and early fall starlings do establish roosts in groves in rural sections where the obstacles mentioned are not encountered. Hicks (2) demonstrated in Ohio that shooting may be carried out consistently and with marked advantage throughout much of the fall and winter. It would appear that in this area it is possible to attack a higher percentage of the total starling population by gunfire than in the East, where many of the aggregations are in large cities. In the latter area, particularly in and about the cities of Philadelphia, Wilmington, Baltimore, and Washington, shooting that would be effective and persistent enough to make a material reduction in the starling population, would be difficult and dangerous, as well as objectionable to many residents, or actually contrary to law. In downtown Baltimore, however, the police have resorted at times to shooting, largely as a frightening measure, and the birds killed were turned over to the needy for food. A similar procedure was followed in Wilmington, Del., where the police ropea off certain residential streets and shot birds, which were later used for food.

Shooting with intent to kill the birds is most effective and economical after the leaves have fallen from the trees. Not only do leaves obstruct and deflect the shot, but they also obscure from the shooter the concentrations at which to aim. Furthermore, starlings congregate in more compact masses when the trees are bare and temperatures are low, and, as a result, more birds may then be felled by a single discharge. Shooting at roosts is most effective the first evening, but may be repeated at intervals of a week or more. Shooting on successive nights will have the effect of scattering the birds and thus of reducing the number killed. Unless large and dense concentrations can be attacked, the cost per bird killed, in terms of labor and ammunition, mounts rapidly. Under what appeared to be very favorable conditions, Hicks in Ohio was able to kill, in 14 well-spaced attempts, more than 4,000 birds at an ammunition cost of \$1.34 a thousand (2).

In such activities the use of double-barreled 12-gage guns with shells loaded with no. 7 1/2 or no. 8 shot have been found effective, and the whole procedure can be made more decisive by the employment of a number of men who shoot in unison on prearranged signals. In marked distinction from the shooting done to frighten starlings from roosts, efforts made to kill large numbers should not be started early in the evening but well after dark, when the birds are settled for the night.

So far as alleviating the nuisance of large roosts in metropolitan sections is concerned, it appears questionable whether beneficial results will be obtained by shooting at distant rural roosts, as many of the birds might never join the urban aggregations. From what is known of the pronounced homing instincts of roosting starlings it is conceivable that extensive roosts in rural sections may be eliminated without materially affecting the number of individuals that comprise the population of objectionable city roosts. Furthermore, in areas in the Middle Atlantic States, where the large urban roosts more or less immune to attack by gunfire constitute a high percentage of the total starling population, the possibility of making an effective reduction in the total number by attacking merely the rural roosts becomes doubtful. There is also the possibility that continued attack on rural roosts may lead to the scattered remaining birds joining the ranks of those roosting in the cities, where they are more or less immune to attack, thus aggravating the starling nuisance in metropolitan sections.

## Trapping

When the ground is covered with snow and at other times when food is scarce, starlings may be trapped to advantage. This method is of value to the individual who desires to reduce the size of objectionable flocks that daily consume food put out to attract other species. It also may have utility in a larger program, where under favorable conditions, a number of traps may be operated simultaneously by volunteer or paid workers with the hope of reducing the starling population over a greater area.

Starlings are to a large degree ground feeders, and for this reason traps that favor that habit will work to best advantage. The simple ashsifter type of trap, 3 or 4 feet square, propped on a 1-foot stick that is jerked out by means of a pull-cord, will do very well to capture a small flock that is accustomed to feed in a definite area. The funnel type of selfoperating trap, such as is used extensively in the trapping of English sparrows, also will do well if built with a sufficiently large opening at the apex of the funnel.3/

<u>Australian crow trap</u>.--More ambitious programs of starling control, however, call for traps large enough to capture 100 to 200 birds without undue crowding. To this end a modification of the "Australian crow trap," used in this country for capturing crows, white-necked ravens, and magpies, may be employed. The Australian crow trap is simple in principle, the birds entering it between the slats of a ladderlike opening extending down the center of a V-shaped top (pl. 1, <u>D</u>). Once on the inside they endeavor to make their escape by going to the outer walls rather than to the openings in the middle of the inward-sloping roof.

There is no set rule with respect to the dimensions of such a starling trap, except that it is highly desirable to have it tall enough to permit the operator to capture and remove the imprisoned birds without discomfort. A trap 10 feet square and 6 feet high at the outer corners, with the slatted entrance across the middle and  $4 \frac{1}{2}$  feet from the ground, will be satisfactory. The sides of the ladderlike opening should be 18 inches apart and the slats spaced at 4-inch intervals. Two wires should be stretched lengthwise of the ladder so as to divide it laterally, making the size of each of the apertures through which the birds enter about 4 by 6 inches. In addition, one or two pieces of stiff wire about 8 inches long may be attached to each of the slats, so that their ends, hanging downward, will tend to obstruct attempts of the birds to fly upward through the openings. At the ends of the ladder the space up to the first slat should be covered with wire screen or a board, to prevent the birds from clambering up the end wall of the cage and escaping at this opening. A number of perches should be installed lengthwise of the trap and at a height at least equal to that of the ladder, so that birds flying from one side to the other will tend to pass by the openings rather than fly up through them. A door should be built in one corner to permit access to the interior for the removal of the captured birds.

The materials for the trap frame can usually be picked up at little or no cost. The wire poultry netting used should be of 1-inch mesh. At the expense of some extra material and labor a "knock-down" or movable trap may be constructed that can be readily shifted from one place to another. Such a trap has each of the four sides, the two parts of the top, and the "ladder" constructed as separate units--the whole being fastened together with screws.

<u>Operation of trap</u>.--The trap should be placed in a locality well populated with starlings and to which they come regularly to feed. The vicinity of city dumping grounds, poultry yards, stables, and pastures where livestock is being fed will be found advantageous. Elsewhere some prebaiting will have to be done to accustom the birds to feeding in the area.

3/ Description of both traps will be found in Leaflet 61, English Sparrow Control, which may be had without charge on request addressed to Office of Information, U. S. Department of Agriculture, Washington, D. C. Table scraps, overripe fruit, stale bread, and most any kind of unobjectionable garbage will serve as suitable bait. Grain also may be used, although as a rule it is less attractive to starlings than the miscellaneous and inexpensive baits suggested. The bait should be placed not only beneath the top openings but also next to the outer walls of the trap. A few crusts of bread laid on top of the trap, next to the ladder, will lure wary individuals to these openings, where they can see the bait within the trap. After the first birds have been captured, a few ( 3 or 4) should be left in the trap from day to day as decoys.

During the winter of 1935-36 a trap similar to the one described, operated on the ground of the National Soldiers' Home in Washington, D. C., captured more than 1,500 starlings in a period of 2 1/2 months. On each of several particularly cold days catches of more than 100 were made. The birds captured were largely from flocks on their way to or from an enormous roost established a few miles away in the business section of the city. Because of the numbers passing, the results obtained were probably better than would ordinarily be the case.

Most of the birds captured were banded and released, and it is of interest to note that, of 1,269 starlings so tagged, not one returned to the trap for a second visit. Whether these birds merely avoided the trap or whether they shunned the entire vicinity could not be ascertained. It at least reaffirms the conclusion, reached in earlier experimental work, that starlings react quickly when frightened or handled in an unusual manner. It is this reaction on which the success of frightening measures in roost eradication rests.

## Capturing at Enclosed Roosts

During the winter months, particularly in northern sections, starlings often use barn lofts, belfries, ventilators, church towers, and other enclosed places for nightly shelter. Small enclosures may harbor only a few individuals, but in centers of starling abundance individual towers may shelter thousands. To some of these the birds may travel as far as 15 to 20 miles daily from the feeding grounds.

Such concentrations present a convenient means of local control. If the enclosures are readily accessible, the operators may visit them at night and capture many of the birds by hand or with the aid of nets. Often the openings through which the birds enter may be quietly and quickly closed after dark by a netting pulled or dropped across them, and then the birds can be captured at leisure during the night. If blocking the openings leaves the enclosures fairly tight, fumigation (mentioned under the next heading) may be resorted to.

In some cities a number of well-populated towers or other enclosures may lend themselves to this means of reducing the numbers of starlings; in others suitable structures may be scarce or absent. In Washington more than 4,100 starlings were captured in one of the city's church towers during the winter of 1927-28. A second tower yielded nearly 400 during the following winter, but since then the towers have been torn down, and as there are no other readily accessible well-populated enclosures there, that method of starling control could not be continued to advantage.

In other large eastern cities where most of the roosting birds are found even in the coldest weather on ledges or beneath open porticoes, capture by hand is impossible. Failure of this method in some cities, however, should not discourage its employment elsewhere. Hicks  $(\underline{2})$ , for instance, working in southern Ohio over a period of eight winters, captured nearly 40,000 starlings in the course of 90 nightly visitations to towers, cupolas, and other enclosures.

# Gassing

The use of toxic gases as killing agencies during the World War has suggested the possibility of using them in the control of troublesome birds and other animals. Even though there is little to demonstrate its practicability, the idea of suddenly and completely eliminating large flocks or roosting aggregations by a single application of toxic gas is too captivating not to have its advocates. Some experimental work has been devoted to determining the possibilities as well as the hazards in bird control by gassing.

More than a decade ago the Biological Survey conducted a series of such experiments in cooperation with the Chemical Warfare Service of the War Department to ascertain the economy, safety, and utility for this purpose of six toxic gases commonly used in warfare. It was found that when gas clouds of sufficient size or concentration to kill birds quickly were released to the whim of the winds and allowed to drift, they also constituted a hazard to livestock and even human beings. Not only is such gassing hazardous but there is always the possibility of its being ineffective by the birds taking alarm and moving out or by fitful air currents shifting the toxic cloud to one side or another.

However, when starlings roost in lofts, belfries, porticoes, or other wholly or partly enclosed places as in dense vines on the sides of buildings, there is possibility for successful fumigation. Under such conditions experimental tests have been made with hydrocyanic acid gas. During the winter of 1935-36 the liquid form of this fumigant was experimented with on starlings in the vicinity of Washington, D. C., and in that and previous years calcium cyanide dust, which produces hydrocyanic acid gas when released in a humid atmosphere, also was used in similar experiments.

In the tests with the liquid cyanide two methods of application were studied. One involved discharge of the liquid cyanide through an atomizing nozzle- nitrogen, under a pressure of about 200 pounds to the square inch, propelling it in a fine spray, which volatilized rapidly and formed a dense gas cloud. Release of the gas could be controlled and directed chaough valve manipulation, and by use of a bamboo pole to the end of which the spray nozzle and its connecting hose lines were attached, a height of more than 30 feet was reached with the liquid spray, and the gas cloud itself reached even greater heights in a calm atmosphere. Another method involved the use of Hudson-spray nozzles, installed directly on a pipe line of the liquid cyanide, the pressure on which was maintained at about 100 pounds to the square inch. With this equipment volatilization was less rapid and not so complete and, on the whole, the procedure was less effective.

The experiments were first conducted with caged starlings stationed at various distances from the nozzles and under varied atmospheric conditions. Later, the liquid hydrogen cyanide-nitrogen spray was used at night against starlings roosting in tall but partly enclosed porticoes as well as against others roosting in exposed defoliated trees.

Under conditions prevailing during the winter months about the porticoes and tall colonnades of public buildings in Washington it was found that even on relatively calm nights the air movements were sufficient to disperse and dilute the gas clouds to a point where asphyxiation of the birds on ledges 50 to 60 feet above the ground was irregular and uncertain. Under the most favorable conditions the cost of labor and materials was out of all proportion to the results obtained.

Although starlings roosting under porticoes and in other partially sheltered places often remain undisturbed by gassing operations, those in exposed trees readily take alarm when the hissing nozzle of the gas jet is brought within "firing distance." This reaction of the roosting birds constitutes an important obstacle and completely nullified attempts at gassing in trees in Washington, where starlings roost in dense concentrations both before and after the leaves fall.

It was demonstrated earlier and again checked in the winter of 1935-36 that in well-protected porticoes and under ideal atmospheric conditions starlings may be funigated with calcium cyanide dust propelled as a cloud by an electrically driven blower. The cost of materials, equipment, and labor, however, coupled with the element of uncertainty of success, makes even this relatively more successful operation of doubtful utility.

There starlings established objectionable roosts in vines growing on the sides of buildings, success in gassing was achieved with calcium cyanide dust propelled by hand- or power-operated guns, with hose and tubing of sufficient length to reach the birds.<sup>4</sup>/ The hand-operated dusters employed in insect fumigation are useful in cases where the starlings are not roosting too high. After all nearby windows have been tightly closed, a dust cloud may be released near the ground and close to the building. This produces a column of hydrocyanic-acid gas that will slowly rise, passing up the side of the building, and penetrating all the spaces between the overlapping leaves beneath which the birds roost. By using extensions to the tubing higher roosting spots can be reached, but for heights above 50 feet

A list of dealers in calcium cyanide dust and dust guns may be had by addressing the Biological Survey, U. S. Dept. of Agr., Washington, D. C.

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a power-operated machine will be needed. A period of a minute or more may elapse between the time the dust cloud is released and the time the first birds begin to drop. Under the conditions just described, there is little doubt that a liquid cyanide spray also would be effective.

Within enclosures that are reasonably tight and where the birds roost at points so inaccessible as to prevent capture by hand or with nets, as in tall church spires or ventilators, it may be possible to fumigate with liquid cyanide, calcium cyanide dust, or even the gas generated by the action of dilute sulphuric acid on sodium or calcium cyanide, as is done in household insect fumigation.5/

<u>Caution</u>.--It must be remembered in any attempt at fumigation, however, that hydrocyanic acid gas is a most deadly poison: it should not be used except by competent and experienced workers. For this reason its handling must <u>not</u> be entrusted to others who may wish to employ it in the control of birds. If occasions arise where fumigation appears called for, either professional fumigators should be hired or the advice and guidance of experienced workers obtained. Furthermore, in some municipalities, fumigation with hydrocyanic acid gas is permitted only under the strictest regulations: these should be respected at all times.

## Poisoning

Just as the idea of killing large numbers of starlings with lethal gas has caught the fancy of some persons, so have the possibilities of bait poisoning at roosts attracted others. The latter, however, do not realize that starlings do not come to their nightly gatherings for the purpose of feeding. As a matter of fact most of the birds that enter the roost have full stomachs, the result of their afternoon's meals, and in the morning their first impulse is to get started on the flight back to their favorite feeding grounds, which may be as far away as 15 or 20 miles.

Furthermore, throughout late summer and early fall, starlings get most of their food from grasshoppers and wild fruits, items that are certain to serve as strong counter attractions to any poisoned baits that might be exposed. Even late in fall and during fair open days in winter the birds are reluctant to leave the food supply they manage to find in their favorite hayfields, pastures, and barnyards. During periods of severe weather when the ground is covered with snow, city dumps and garbage-disposal grounds become attractive to the resourceful, omnivorous starlings. Even the average backyard then has something in store for them. Under such conditions and at a multitude of localities where aggregations of variable size are accustomed to feed, there is no doubt that starlings could be poisoned. However, with the exception of a relatively few places such as garbage dumps and the like,

Directions for household insect fumigation with hydrocyanic acid gas will be found in Farmers' Bulletin 1670, obtainable at 5 cents a copy from the Superintendent of Documents, Washington, D. C.

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the feeding grounds of starlings are so varied and so numerous that to reach the bulk of the nomadic flocks would call for the distribution of poison at a great number of places. From the very nature of things such an exposure of poisoned bait would constitute a hazard to many other birds feeding under the dearth of the winter food supply.

It is not believed that the fluctuating population of large metropolitan starling roosts can be materially, economically, and safely reduced by poisoning campaigns conducted over the feeding range of the birds, widespread as it is over the surrounding country.

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DEVICES USEFUL IN COMBATING STARLING ROOSTS

A. Screening to protect sheltered ledges of buildings; <u>B</u>, sloping surfaces of wood or concrete to eliminate footholds on narrow ledges; <u>C</u>, ropes for dislodging roosts by shaking treetops; <u>D</u>, baited trap at daytime feeding grounds. The trap is equipped with a slatted-top entrance, inside perches to deter captive birds from perching on the top slats and escaping, and a door of convenient height for the operator. Baits are placed to attract birds to the entrance and thence to other baits exposed on the ground inside. A satisfactory trap may be 10 feet square and 6 feet high at the corners, with openings and perches about  $4\frac{1}{2}$  feet above ground.

