February 1982

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ABSTRACT: In antiquity, sticky materials were widely used for catching small birds for food and sport, but this practice is now illegal in most industrial nations. The most widespread use of sticky materials is in "glueboards" to catch rats and particularly mice. Their popularity has increased with the negative public attitude towards use of pesticide chemicals. Early materials were made from latex and gums of many trees, but current ones also use industrial chemicals like Polyethylenes and polybutenes. They have most of the advantages of traps but have some disadvantages. Their use may be limited by temperature, moisture, dust, vapors, etc. The proper methods of handling, placement, and cleanup of rodent glueboards are discussed.

The La Brea tar pits that ensnared many primitive life forms millions of years ago just for the benefit of modern archaeologists were the first glue traps, if somewhat oversized. More recently Nature fashioned smaller glue traps in the form of plants such as the sundew (Drosera spp.). These exude a sweet-smelling, sticky substance from glands at the tips of numerous hairlike tentacles on the leaf. When a flying insect becomes entangled, the other hairs on the leaf close in on it, producing digestive enzymes that dissolve the softer body portions to furnish nitrogen to the plant. Man has tried to copy nature by using sticky substances, not only flypaper to catch insects, but also to entrap the larger vertebrates.

The most widespread application of these entanglements has been the so-called "bird limes." These sticky substances from natural gums of plants were painted on twigs in areas where the birds were apt to light. They have been used since the time of the ancient Romans and were first mentioned in the literature as early as 1678 (Bateman 1977). "Liming" was the predominant method of trapping birds in Europe from antiquity to the late 19th century when small birds were trapped on a large scale for food and sport (Hogarth 1929). The technique is even mentioned several times in Shakespeare (Armstrong 1975, Brusewitz 1969):

"Birds never lim'd;
No secret bushes fear."

"Thou'dst never fear the net nor lime
The pitfall nor the gin."

Birds are more easily caught than mammals. The adhesive materials can easily gum up flight feathers and the bird's light weight makes it more difficult for it to escape entanglements. The use of glues against mammals was not as effective nor was widespread. Rat glues were used as early as the 18th century when a rat control manual (Holland 1802) suggested putting a strip of bacon on a one-meter board smeared with bird lime. Glues were even used to catch bigger game. The natives of India reportedly spread the juice of the peepul tree (Ficus religiosa) on leaves along jungle trails. Tigers attempting to get the sticky leaves off their paws would become blinded as they rubbed their faces with their paws (Burton 1918). Joseph Gabos pioneered the use of rat glues into this country around 1920.

Mills (1947) conducting a survey of pest control operators at a Purdue University pest control conference found glues were used by only a small portion of respondents and then not too successfully. Recently, in response to negative public attitudes towards toxicants, there has been an increase in the use of these devices in rodent control. Dr. John V. Osmun, at the author's request, conducted a similar poll at the latest conference(personal conversation 1982). The results of these two polls are compared below:

	1947	1982		1947	1982
Don't use glues	29%	5%	Results - Good	18%	71%
Use glues	71%	95%	Results - Fair	28%	22%
			Results - Poor	54%	7%

Bauer (1980) in querying food processors found they preferred the following methods of rat and mouse control:

Mechanical traps	37%	Fumigation	3%
Poison baiting	31%	Ultrasonics	2%
Proofing/Sanitation	20%	Tracking poisons	1%
GLUEBOARDS	6%		

1982. Proceedings Tenth Vertebrate Pest Conference (R.E. Marsh, Ed.), Univ. of California. Davis, Calif.

The materials used in bird and rodent entanglements have been many. Plant resins and gums, sometimes in combination with vegetable oils, have a long history of use. Holly bark (Ilex aquifolium) was used extensively in old European formulas, slippery elm (Ulmus rubra) in America, and various members of the mistletoe family (Loranthaceae), particularly Loranthus europaeus in Europe and Africa. Over the world, especially in tropical areas, bird limes have been made from the sap of members of the mulberry family (Moraceae). This group includes figs (Ficus spp.), mentioned previously, and breadfruit (Artocarpus spp.) (deWit 1967). The author found natives in Haiti used a combination of narrow-leaved breadfruit latex (Artocarpus incisa), charcoal ashes, and castor oil to make bird limes in that area. Reidinger and Libay (1979) tested local formulations from two Arthocarpus spp. in their Philippine Islands studies. Another material sometimes suggested earlier has been lithographic varnish (Hovell 1924). Published formulations, outside of antiquated ones like the following, are very rare:

> "Take the bark of holly, at Midsummer, as much as will fill a middling sized vessel... put soft water to it, place it over the fire and let it boil till the grey and white bark rise from the green, which will occupy twelve or sixteen hours in the boiling: it should boil gently...(separate) all the green bark, and lay it on the ground, in a close place and moist floor, and cover it over with green fermenting weeds, such as docks, thistles, and the like; thus let it lie ten or twelve days, in which time it will rot, and become converted into a slimy tenacious matter. Then put it into a mortar, and pound it till it becomes thick and tough...carry it to a running stream, and wash it till it is completely cleared of any kind of foulness and extraneous matter...put into an earthen pot, and mix with it the fat of fowls, unsalted, as much as will make it run; then add two table spoonsful of strong vinegar, a table spoonful of the best salad oil, and a small quantity of Venice turpentine." (Johnson 1832)

George Hockeynos (1958) in his excellent studies of the chemistry of entanglements reported the best rat glue formula was:

Rosin (pine)	31%	Polyethylenes	5%
Abalyn*	18%	Latex	6%
Mineral oil	40%		

Probably most of the current rat glues are modifications of Hockeynos[1] pioneer work in this country. The U.S. Environmental Protection Agency has decreed sticky bird repellents have to show the active ingredients on the label. But they have not required the registration of rat glues as yet so their ingredients do not have to appear on the label. Registered bird entanglements, which are probably closely related to glueboard formulations, are mostly made of 90% or more polybutenes or polyethylenes plus some oil like hydrogenated castor oil in different combinations. An effective chemical formulation must have strength, tackiness, stretch, and holding power.

Glueboards have much the same advantages of mechanical traps. There are no toxic chemicals to endanger pets or children, though they can create a messy problem when these nontarget individuals blunder onto the boards. The glueboards hold animals so they don't die elsewhere creating a potential odor problem. Like traps, they are approved by the U.S. Department of Agriculture for use in meat and poultry processing plants under the same restrictions as traps. Entanglements are effective against anticoagulant-resistant individuals. Glueboards are easier to operate and maintain than mechanical traps and appear more professional in appearance as they are not readily available to the householder.

Entanglements have several disadvantages, however. They are not effective over a wide temperature range. While they can be used at ambient temperatures as low as -23°C (-10°F) (Anonymous 1981), their ideal operating range lies between 2-49°C (40-120°F). Besides temperature, other physical factors can influence their effectiveness. Dampness creates a film on the surface of the glue so rodents can skate over it. Dust, sand, and grease also coat the glue surfaces, lowering their effectiveness. Care must be taken in storing glueboards to keep them flat, especially in service trucks where temperatures can be extremely high. They must be protected from pesticide and solvent vapors which might be repellent to rodents if picked up by the glue. When placed in the direct sun, they can be baked hard. They are probably more expensive than mechanical traps as they must be discarded when they have caught animals or been exposed for long periods of time. In some situations, rats are able to pull out if only one or two feet are caught (Anonymous 1970).

These entanglement materials can be used in several ways. One of the oldest methods was to warm the lime and spread it on branches, sticks, or straw scattered on the ground in piles near the birds. Another method was to make a "foolscap" from paper cones about 75-100 mm in diameter. A ring of bird lime was smeared around the open end and kernals of corn (or fish for herons) placed in the bottom. These were placed in holes in the ground so when the birds reached in to get the bait, they became "hoodwinked" and could not see to fly (Brusewitz 1969, Gibson 1881). Reidinger and Libay (1979) experimented in Philippine rice fields by spreading bird lime on branches extending 15-20 cm above the rice. The perches retained their stickiness for three days. Birds caught on them emitted distress calls which tended to frighten other birds from depredating on the treated fields for another five days. Entanglements are also applied to ledges to discourage birds from roosting on buildings. When used in this fashion, they should be placed on tape, wooden slats, or over a protective coating of 2-5% silicone (Hayden 1968) to prevent disfigurement of the masonry.

*Commercial name for a rosin produced by Hercules Powder Company.

Rodent glues have been used in the same manner for discouraging squirrels to run along telephone lines, etc. But in most cases they are used on flat bases as in glueboards. Glues come in bulk or as finished boards or trays. The latter may be made in pairs with the sticky surfaces facing each other to be pried apart when ready for use or covered with a peelable plastic.

When making glueboards out of bulk chemical, base materials can be plywood, floor tiles, paper plates, roofing paper squares, or low cardboard boxes, but it is best to use nonabsorbent materials like plastic or foil. Put a few drops of a liquid detergent in a bucket of water. Dip hands and scissors into the solution so they are covered with a thin film of suds. Pull out a handful of glue until it stretches to a thin point. Cut it off with the scissors. Place this material on the flat surface and flatten it out to 2-3 mm (for mice) or 5-6 mm (for rats) thicknesses. A gob can also be put on a flat surface and another board pressed on top of it to coat both surfaces. These must be cut apart with a soapy knife when ready to use. Individual boards or trays can be covered with plastic wrap (Broome 1977). On flat boards, margins of 10-25 mm should be left to catch the glue if it starts to run. However, it is best to put it in low-lipped trays rather than leave an untreated area on the edges, providing the lips are not too high. The boards should be at least 10 cm long for mice and 23 cm for rats. The length depends upon the circumstances. Never place glueboards directly on carpets or other floor surfaces that might be stained by the glue.

As with traps, proper placement is the most important ingredient for success. Glueboards should be placed flush to walls and rodent traffic funneled over them. While they are probably more effective when not fastened down, as these are more difficult to get loose from, they must be fastened down when near open flames to prevent fire hazards. They can be wired, nailed, or stuck down with two-sided carpet tape or a small gob of the entanglement. Like traps they can be placed on vertical or horizontal pipes or wooden rafters used as rodent travelways. Do not put them over uninsulated hot water or steam pipes. They can be placed in trees for roof rats or in attics for squirrels and bats. Outside placements must be under cover and preferably on elevated floors to keep them dry. They are most effective against small infestations of mice as a cleanup or alternative to other methods. When possible, they can be set across avenues of escape and the environment disturbed by restacking supplies or fogging to get the rodents moving rapidly along these routes and stumbling blindly onto the glueboards.

Covers protect them from dust and keep the trapped rodent's struggles from public view. The glue can be spread on the floor of low cardboard cartons in which holes have been cut in facing sides to make a disposable trapping station. Covers can also be made from 30 cm or longer lengths of 30-50 mm diameter (for mice) or 75 mm or over (for rats) PVC pipe. The glue can be spread on heavy paper and pushed inside the pipe, leaving about 50 mm clean on both ends to facilitate handling and removing trapped rodents. As in the case of traps, use large number of these in a single situation. Placing bait (peanut butter, peanuts, pecans, cotton waste, or other attractive materials) in the center of the glueboard is often used, but the best attractant may be another trapped rodent. The author has found a low ramp or other arrangement that forces the animal to jump down putting all four feet in the glue at the same time increases the potential for catching and holding an animal. One manufacturer has produced a mouse glueboard inside a small cardboard carton station with a bit of ramp that might be very effective.

To clean up spills, use warm water and a detergent or a solvent like kerosene, acetone, naptha, etc. To clean up pets who become entangled, the veterinarians suggest using one of the solvents followed by washing with warm soapy water. The pets should not be allowed to lick the treated areas until they have been thoroughly washed as these can be toxic if taken internally. These treatments should not be repeated too frequently. If the pets keep getting in the boards, the boards should not be used in that situation. Humans frequently step on the boards and, lacking the intelligence of some rodents, will attempt to get it off by putting the other foot on the board. In these instances, new foot gear is recommended.

Assistance of the following persons in the preparation of this manuscript and slides is hereby gratefully acknowledged: Stanley Z. Baker, N.H. Battjes, Dr. Richard L. Bruggers, John deGrazio, Terrence Finley, Jon Hockeynos, Charles E. Knote, Drs. John V. Osmun, Harry D. Pratt, and Robert M. Timm.

Following is a list of glueboard materials sources who replied to a recent query. The listing does not constitute an endorsement of any particular product nor does omission from the list infer the product is not acceptable. (D) indicates a distributor only. Trade names are underlined.

ABEPCO Mfg. Co., 1350 W. Collins, Orange, CA 92667 (D) BOARDWALK

Ar Chem Corp., P.O. Box 767, Portsmouth, OH 45662 GB 1102

Available Exterminators, Inc., P.O. Box 137, Brooklyn, NY 11236 (D) ACTIVE RAT BOARDS

J.T. Eaton & Co., 1393 E. Highland Rd., Twinsburg, OH 44087 STICK'EM

Elco Mfg. Co., Ill Third St., Pittsburgh, PA 15215 (D) STICK'EM, TRAP STIK

Gabos Pest Control, 1428 S. Delsea Drive, Fineland, NJ 08360 RAT GLU

Inter-State Oil Co., 87 Shawnee Ave., Kansas City, KS 66119 PREFERRED BRAND BIRD & SQUIRREL REPELLENT

J-B Exterminating Service Co., 2036 E. 79th St., Chicago, IL 60649 RODENT GLUEBOARDS

Pest Control Supplies, 1012 W. Lunt, Schaumburg, IL 60193 (D) GRABBER GLUE BOARDS, STICK'EM, TRAP STIK, VICTOR HOLDFAST

Rhodes Chemical Co., 1129 Merriam Lane, Kansas City, KS 66103 (D) STICK'EM, TRAP STIK, VICTOR HOLDFAST

Sentinel Laboratory, Inc., 1001 S. 9th St., Springfield, IL 62703 SENTINEL GLUE BOARDS

Star Exterminating Co., 2958 Nostrand Ave., Brooklyn, NY 11229 (D) RAT GLU

Stone Chem. Labs., Inc., 467 N. Aberdeen St., Chicago, IL 60522 GOT'CHA

Summitt Chem. Co., 117 W. 24th St., Baltimore, MD 21218 (D) RAT GLU

Sun Pest Control, 2945 McGee Trafficway, Kansas City, MO 64108 PREFERRED BRAND BIRD & SQUIRREL REPELLENT

Superior Chem. Prod. Co., 3942 Frankford Ave., Philadelphia, PA 19124 (D) RAT GLU

The Tanglefoot Co., 314 Straight Ave., SW, Grand Rapids, MI 49502 RAT & MOUSE TANGLEFOOT

Van Waters & Rogers, 2600 Campus Dr., San Mateo, CA 94403 (Headquarters) (D) STICK'EM

Woodstream Corp., Lititz, PA 17543 VICTOR HOLDFAST

York Chemical Co., 118 Fulton Ave., Garden City, NY 11040 (D) RAT GLU

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