THE EQUIPMENT DEVELOPMENT SECTION OF THE TECHNICAL DEVELOPMENT SERVICES

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The Equipment Development Section is concerned with the engineering functions of the Technical Development Services. To carry out these functions the Section is staffed with engineers, an aircraft pilot, machinists, sheet metal workers, mechanics, an electrician, a plumber, and laborers. It is well equipped with offices, drafting rooms, and laboratories; and machine, sheet metal, automotive, electrical, and plumbing shops. The efforts of the Section fall into three general groups as described below.

EQUIPMENT FOR FIELD USE

One of the primary functions of the Section is to design, fabricate, and test equipment needed for field operations in the control of communicable diseases. This function, in fact, is the historical basis for the existence of the Section since the first major job was that of developing the specialized equipment needed for the residual spraying of DDT when that insecticide first came upon the scene in the last years of World War II. The details of the application of DDT to the walls of homes are now so familiar that it is difficult to recall the time when no one was quite sure which equipment and methods were best. Less attention has been given to these problems in recent years, but a number of projects are still under study.

For instance, the search for a completely leakproof shut-off valve has not yet been successful. A number of commercially developed valves have been advertised as leakproof, but tests have shown that they do not completely meet the requirements created by the introduction of the many new, highly toxic poisons into the insect control field.

Cut-off valves designed and fabricated in our own shops have been leakproof; but they have been unable to meet the requirement of simplicity imposed by potential manufacturers or the rugged characteristics required for equipment subjected to continuous hard usage in the field. Nevertheless, the search for a satisfactory valve continues.

The definite advantage of the constant-pressure sprayer, as introduced to the field by the Georgia Communicable Disease Center Activities, has led to efforts to have a satisfactory sprayer of this type manufactured commercially. Although several designs have been submitted to various manufacturers, no manufacturer has been able to place a satisfactory constant-pressure sprayer on the market for a price which most malaria control programs can afford to pay for them in the quantities required.

A recently completed project, also falling in the category of field equipment, is the development of a package-sprayer apparatus designed to be installed in various models of several small airplanes. The need for such equipment is evident in the event of an epidemic or disaster requiring larviciding or insecticiding by airplanes and in an area in which properly equipped airplanes are not available. Unfortunately, the usual spray airplane can not be flown rapidly across country due to its low speed and lack of equipment for night and bad weather flying. The equipment as now designed and approved by CAA for installation in the Piper Cub J-3 and Piper Cruiser (PA-12) airplanes can be flown in transport airplanes or otherwise shipped into the problem area, and once there, can be installed in a few hours in local aircraft without so much as cutting the fabric or drilling a hole. Spray booms are rapidly bolted to wing struts, tanks are placed on the rear seat and the components are

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Package-sprayer designed for use in various models of small airplanes is compact, can be shipped by regular transport, and at point of destination is easily and quickly installed.

connected by rubber hose. Instead of using a wind-driven pump to provide pressure at the nozzle, the entire system is placed under pressure by means of carbon dioxide carried in a cylinder attached to the sprayer tank. One CO_2 cylinder provides the necessary pressure for discharging four to six 18-gallon tanks of solution. Accurate control of the spray is obtained by means of a cut-off valve actuated by a flexible wire control brought to a point in the plane convenient to the pilot's hand.

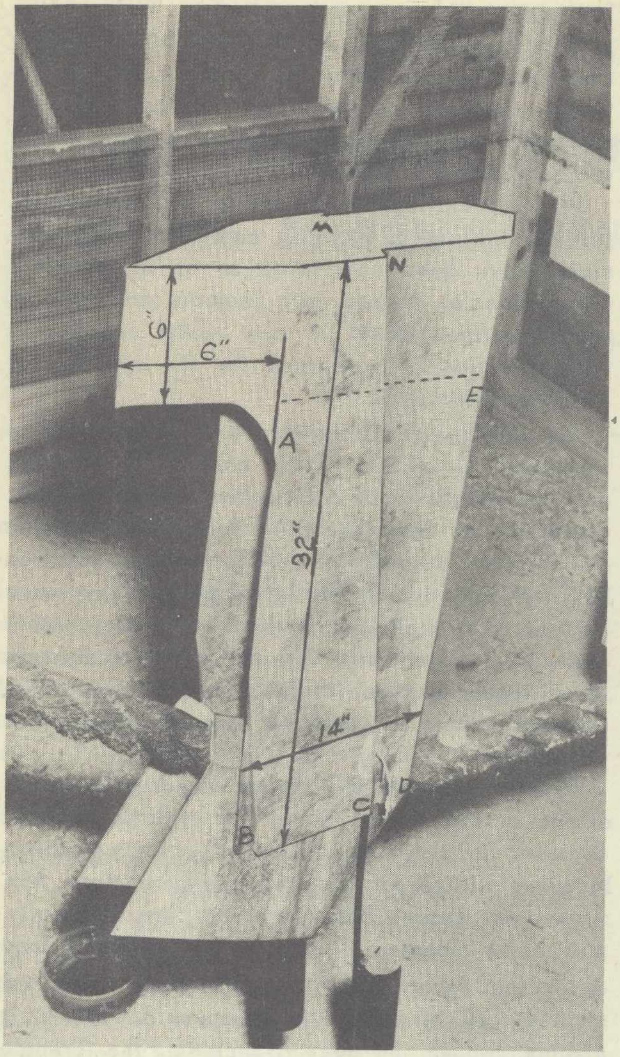
Another solution to this problem which has been investigated in recent months is based on the flow of the solution by gravity from the tanks to double throat Venturi units mounted on the wings. The Venturi tubes create a negative pressure on the lines and break up the solution into small droplets as it is discharged through the Venturi throat into the slip stream. Such a system would have the advantage of simplicity, few parts, and ease of installation. Work on this project has been carried to the point of testing the spray pattern with the Venturi tubes at different positions on the wing, but the work currently is being held in abeyance in favor of projects having a higher priority.

Projects calling not for design and fabrication, but for testing of existing equipment and materials, have been undertaken as an aid to field operations. Among such projects are tests of rubber sprayer hose, of new model commercial sprayers, and of equipment for the spraying of water-wettable DDT.

The ability of different types of rubber hose to withstand the action of the commercial solvents and insecticides with which they are in constant contact is an important cost factor. To determine the potential stability of samples of hose used on DDT spraying equipment, 14 samples of hose were subjected to soaking in xylene for a period of 7 days, after which they were examined for damage. As a result of these tests it has been possible to write more appropriate specifications than previously.

Water-wettable DDT, though used to a minor extent in the United States for malaria control, is used in large quantities in other countries. In some situations the water-wettable form has many advantages, but operations are frequently plagued by clogging of nozzles, with resultant loss of time and labor. Tests have been made on several methods of straining the suspension before it passes through the nozzle, including the Trapido dip-tube strainer, nozzle strainers, and strainers used in filling the spray cans. As a result of these tests, specifications for strainers have been prepared which are being submitted as CDC's recommendation to the World Health Organization Expert Committee on Insecticides.

Not all of the Section's efforts are devoted to facets of the malaria problem; a number of field rodent-control problems have received attention. Tests of the "Tiger Rat Guard," a commercial device designed to be placed on a ship's hawser, were made to determine its efficiency as a rat stopping device. The unit was claimed to have a number of advantages, including ease of placing in position. Tests indicated that rats passed the guard, if not with ease at least in relatively large number. The guard was redesigned and again tested. The new design, although less convenient to place on the hawser, stopped



The manufacturer's model of "Tiger Rat Guard" (shown in place on a 3-inch-diameter ship's hawser) was tested by Technical Development Services and, after modification, was found to be very effective in preventing passage of *Rattus rattus*.

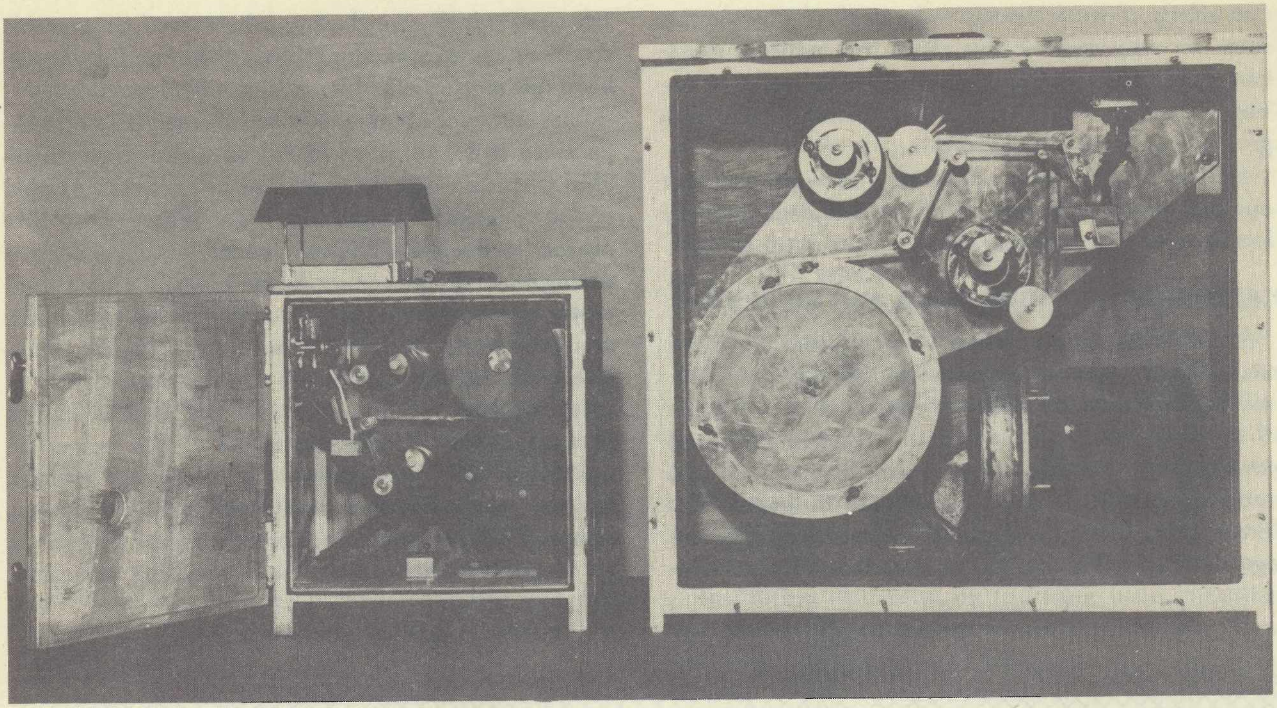
the passage of all but one rat, and this avenue of passage was closed by a simple change. Such devices, apparently effective on casual examination, show flaws only under careful test. Failure thus to test this type of equipment can lead to serious consequences.

Another commercial product submitted to test was a rubber grain-storage bin. The units, small models for the test purposes, were made of rubber-covered fabric which enclosed numerous air cells. The entire unit could be inflated for use. It was believed by the manufacturer that the rats would be unable to attack successfully the rubber walls due to their resiliency. This was found to be true for a period of 2 or 3 months, but the rats finally found a loose edge of rubber and gained access to the grain.

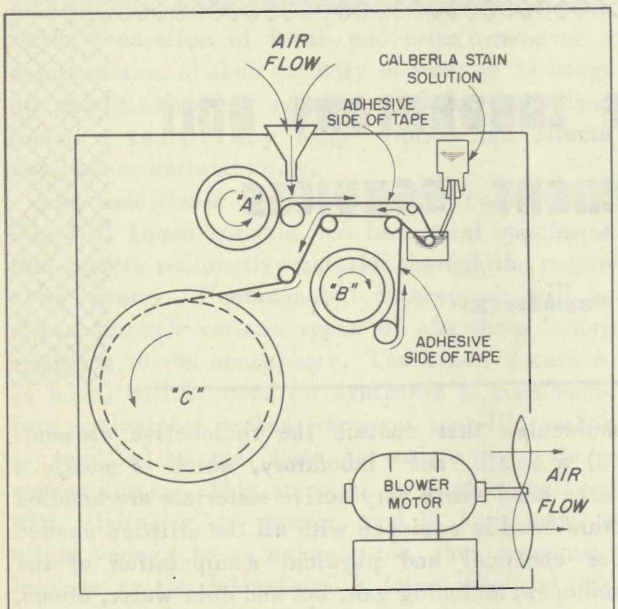
An entry has also been made into the field of air-borne pathogens. For some time it has been desirable to have an air sampling device which would permit the identification and quantification of small particles in the air such as dust, pollen, and spores. A device, based on the use of transparent cellulose tape upon which the particles are impinged, has been developed. The particles are drawn inside the sample box by a fan which creates a negative pressure. After the particles have been impinged on the adhesive side, the tape passes through a staining bath, then joins another piece of tape with the adhesive sides together so that the stained particles are held in a plastic "sandwich." An automatic timer punches three tiny holes in the tape once each hour, thus relating points on the tape to the time of day. The resulting tape is stretched in a special holder which in turn is mounted on the mechanical stage of a microscope. Particles are counted by making sweeps across the tape at various points of interest. At the present time the device is being tested as a ragweed-pollen collection device while plans are being made to use it in connection with surveys of dust and the spores of histoplasmosis. For a special application, a survey of ragweed pollen over a large land area, one of the continuous recording pollen samplers has been mounted in an airplane. The forward speed of the airplane itself is utilized to force large volumes of air through the sampler thus providing a sample of adequate size in relation to the speed of the airplane. There appear to be good prospects for the valuable utilization of this device and further application of the principle of imbedding samples between two pieces of transparent adhesive tape.

EQUIPMENT FOR LABORATORY USE

A second major function of the Section is the development and fabrication of highly specialized equipment for laboratory use by the other sections of the Technical Development Services. One of the most involved problems undertaken to date was the design and construction of equipment for exposing animals to toxic vapors in a test chamber. Specifications for the required apparatus included requirements for the accurate control of the air flow, the amount of the toxic substance, the droplet size, and other factors. An apparatus meeting these requirements was constructed and is in frequent



The pollen sampler as originally designed (above, right) and as modified after testing (above, left). Note that modified collector is approximately half the size of the original model.



Schematic Diagram
ATMOSPHERIC POLLEN & DUST SAMPLER
Continuous Recording Type
(Before Modification)
FEDERAL SECURITY AGENCY PUBLIC HEALTH SERVICE COMMUNICABLE DISEASE CENTER

use for the exposure of animals, from mice to monkeys.

Apparatus strictly for laboratory use is often required, ranging from tongs for the handling of radioactive material to automatic shakers for agitation. In the latter group a mechanical agitator, capable of holding up to 16 500-milligram pear-shaped separatory funnels, was built for use in speeding up milk sample analysis for DDT content determinations. Variations in the speed and length of stroke permit a wide range in controlling the conditions of agitation, while interchangeable racks permit the use of a wide variety of glassware.

Another reciprocating device using the principle of the hydraulic balance was constructed to provide regular oscillations for the activation of a basal metabolism device for small animals.

A considerable amount of miscellaneous equipment for the handling of animals has been built to meet particular needs. The handling of large numbers of animals is, at best, a rather smelly and unsightly process. Every effort has been made to design and construct animal cages, watering and feeding devices, and dropping pans in such a manner that a maximum of sanitation can be accomplished with a minimum of labor. Replenishing the drinking water for rats in the normal style of cages is ordinarily a time-consuming job. This has been obviated in the Technical Development Services animal houses by the installation of water piped to a special valve in each rat cage. Water does not normally flow from these valves, but when the surface of the valve is licked by a rat a drop of water forms, to be replaced by another drop as required by the rats. Not only is labor saved by this piping of the water directly to the cage, but the elimination of spilled water has greatly improved the sanitation.

All animal holding equipment, as well as other special equipment, is constructed almost entirely in the station's own shops.

MAINTENANCE OF BUILDINGS AND EQUIPMENT

In addition to its duties of equipment development the Section is responsible for the provision and maintenance of utilities essential to all parts of the laboratory. These include electric light and power, process and heating steam, compressed air, vacuum, conditioned air, and waste disposal. Unfortunately, these problems are complicated by the age of the facilities and the fact that the installation was not designed as a laboratory. As a result constant maintenance activities are under way to keep the station at top operating efficiency.

The air conditioning of the laboratories for temperature and humidity control is alone a considerable problem, with an installed capacity in excess of 30 tons of refrigeration. To insure that this equipment does not fail as a result of power failure during the not infrequent hurricanes, a diesel generator plant is kept on a standby basis. This unit has a capacity of 42 KVA, sufficient for the absolutely essential requirements of the station.

In addition to maintenance of the physical plant is the job of maintaining much of the scientific apparatus of the station. Innumerable electric motors, scales, balances, ventilators, elevators, lights, bells, signals, cameras, cages, and traps, all require a watchful eye and unending attention.

THE RADIOACTIVE ISOTOPE LABORATORY UNIT AT TECHNICAL DEVELOPMENT SERVICES

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During the past year activities at Technical Development Services have been extended to the field of radioactive isotope tracer technique. This new activity will be particularly useful to the Toxicology Section with its accelerated program on the study of the toxicities of various economic poisons. Although the radioisotope laboratory is a part of the Toxicology Section it may be called on to solve problems for any section of Technical Development Services or other Services of the Communicable Disease Center.

The laboratory consists of six units: (1) housing for biological specimens such as insects, and experimental animals up to the size of dogs and monkeys; (2) a chemistry laboratory where complex compounds can be synthesized from the simpler molecules that contain the radioactive element; (3) a small "hot" laboratory, which is mostly a large hood where very active materials are handled (this hood is equipped with all the utilities needed for chemical and physical manipulation of the isotopes, including gas, hot and cold water, steam, vacuum, air, and electricity); (4) a counting room with Geiger tubes, ionization chambers, and associated electronic equipment (only low levels of activity, contained in samples to be analyzed, are carried to this room); (5) a sample and specimen preparation room where a material whose activity is to be determined can be divided into aliquots, or where insect specimens and small animal tissues may be prepared; and (6) an office.

The walls of the animal and specimen room, the

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