THE DEVELOPMENT OF PUBLIC HEALTH SERVICE QUARANTINE ENTOMOLOGY AND ITS PROGRAM IN SOUTH FLORIDA

JOHN E. PORTER [1]

Guarding against the introduction of diseases from other countries is a responsibility of the Division of Foreign Quarantine of the U. S. Public Health Service. The Service has been charged with this duty since 1798.

Control measures against *Aedes aegypti* mosquitoes became an accepted Public Health procedure on ships with the discovery in 1900 of the relationship of this mosquito with the yellow fever virus. However, it was not until the early days of international air travel that Public Health quarantine entomology as such, had its inception. Even in these early days epidemiologists of the Service foresaw an era in which there would be increased dangers to our country through the possible importation of insects from foreign countries by airplane.

Their realization of this potential threat to our country led to the first reported studies of insects on aircraft. Griffitts (1931) inspected 102 aircraft arriving at Miami, Florida, from Central and South America and the Caribbean area during 1931 and reported the occurrence of 29 mosquitoes on 21 planes. This observation posed a logical question. Can insects survive at the high altitudes and cold temperatures in which planes fly? Subsequent tests by Griffitts (1933) demonstrated the ability of mosquitoes to survive for approximately 80 hours of flying time and at 14,000 feet altitude in these prototypes of the modern plane. Carnahan (1938) reported on insects recovered from aircraft at Miami, Florida, while Welch (1939) was the only worker up to that time to pay any attention to insects other than those of medical importance. Denning *et al.* (1947) and Hughes (1949) have admirably summarized the findings made by Public Health Service inspectors. Since those days much has been said of the accidental transport of insects in aircraft. Observations made today indicate that live insects, including mosquitoes, are frequently found on the modern planes which fly at higher altitudes and often for greater lengths of time than the early planes.

The knowledge that mosquitoes were able to survive at the altitudes these early planes sometimes reached in their international flights was cause for deep concern. It could have been pigeon-holed as just another observation in the gathering of scientific information, but, remembering the not too far removed outbreak of yellow fever in New Orleans, our officials were not anxious to allow foreign mosquitoes access to our shores. The development of heated and pressurized cabins further increased the possibilities of transporting live mosquitoes.

Consequently, studies were commenced to find the best way to prevent these insects from establishing themselves in this country.

The earliest control measures made use of hydrocyanic acid gas fumigations, rotenone dusts and formaldehyde sprays, but none of these were

---

[1] Entomologist, U. S. Quarantine Station, Miami Beach, Florida, Division of Foreign Quarantine, Public Health Service, U. S. Department of Health, Education, and Welfare.

satisfactory or safe. Williams and Dreessen (1935) developed a non-flammable pyrethrum spray for use on aircraft which was the first material applied extensively for the control of insects aboard aircraft.

Control measures devised since the introduction of this spray have pretty well run the ambit of insecticidal knowledge. Early applications of insecticide made use of the plunger-type hand sprayer, followed by the use of a compressed air sprayer. In 1942 Goodhue and Sullivan opened a new approach to insect control with their introduction of a method for dispersing pyrethrum in dichlorodifluoremethane, using this liquified gas as the propellent. This use of an *aerosol* has greatly simplified the problem of in-flight disinsection of aircraft.

Insect control procedures were incorporated in the Public Health Service Foreign Quarantine Regulations in 1941 requiring the disinsection of aircraft arriving in the United States "from any place in South America or tropical Africa, or from any other region where yellow fever may appear." Entomologists and trained inspectors were employed to carry out inspections on aircraft and ships and surveillance around airports and seaports.

The introduction of DDT revolutionized the field of economic entomology and this insecticide was soon made a part of the aerosols used on aircraft. Since its incorporation with pyrethrum in these aerosols little change has occurred.

Many hours of experimentation have gone into efforts to improve the existing formulations to make them more effective toxicants and less irritating to passengers and crew. Unfortunately, to date, there is no ideal aircraft formula.

Until recently two high pressure aerosol formulations, G-382 and G-651, were the only ones acceptable to the Public Health Service for aircraft disinsection. However, in July, 1955, two medium pressure aerosols, G-1029 and G-1152, were approved for this use. The following table indicates the percentage composition by weight of these formulations.

AEROSOL FORMULATIONS AUTHORIZED BY THE PUBLIC HEALTH SERVICE FOR USE IN AIRCRAFT.

Ingredients	Percent by weight composition per formulations			
	G-382	G-651	G-1029	G-1152
Pyrethrum extract, purified (20% pyrethrins)	5.0	6.0	6.0	5.0
DDT (aerosol grade)	3.0	2.0	2.0	3.0
Cyclohexanone	5.0	—	—	5.0
Lubricating oil (SAE 30)	2.0	—	—	2.0
Dichlorodifluoromethane (Freon 12 or Genetron 12)	85.0	84.0	58.8	59.5
Aromatic petroleum derivative solvent:				
(Velsicol AR60 or Socony-Vacuum 544G)	—	8.0	6.0	—
(Velsicol AR50 or Socony-Vacuum 544C)	—	—	2.0	—
Trichlorofluoromethane (Freon -11 or Genetron -11)	—	—	25.2	25.5

Another method of spraying planes, *automatic disinsection*, was developed because of the frequent failure of crew members to properly dis-

charge their spray duties while their planes are airborne. Dr. C. S. White, then of the U. S. Navy, and Mr. D. L. Snow, Public Health Service, in 1945 experimented with the idea of piping an aerosol into all parts of a plane, this material to be released by simply pressing a control button or switch. In 1946, Snow and White conducted tests with the first automatic system at Patuxent River, Maryland. Cdr. John M. Hirst, U. S. Navy, devoted several years to improving this system (U. S. Navy, 1950) and was instrumental in the installation of the system in some Military Air Transport Service planes used during the Korean War. The method is not yet refined enough for use on civilian aircraft.

In the past few years efforts have been directed by the Communicable Disease Center laboratories in Savannah, Georgia, and the Division of Foreign Quarantine, Public Health Service, to the application of residual insecticides and the utilization of insecticidal vapors for insect control on aircraft. Lindane residues of 200 mg. per square foot have given satisfactory insect control of baggage compartments for up to 5 weeks, while lesser deposits in passenger compartments have given control up to 3 weeks. DDT and dieldrin as residuals have not shown much effectiveness.

Lindane and DDVP (dimethyl 2,2-dichlorovinyl phosphate) as vapors have been applied in some experiments. These vapors originate from insecticidally treated glass-wool filters installed in the ventilator systems of planes. Such use of insecticides as these shows promise of being the easiest and most effective method of disinsecting aircraft. Details of the toxic hazards to passengers and crew must be determined before this method may be generally used.

A search is still being made for a formula, as well as dispersing apparatus, which possesses all of the following characteristics:

1. It should be economical.
2. It should be non-irritating and non-toxic to passengers and crew.
3. It should be harmless to aircraft interiors.
4. It should be rapidly effective in its paralyzing and toxic powers on insects.
5. It should be applied automatically.
6. It should be light weight and free of maintenance problems.

Modern concepts of insect control are, however, varied and flexible. We do not depend upon the disinsection of planes and ships as our only expedient. It does not present the perfect barrier to insect introduction as might be supposed. Theoretically, only complete cessation of travel would give us a reasonably perfect barrier. Frequent entomological survey of those areas surrounding airports and seaports, is another method used by our station for the early detection and prompt eradication of any insects which may have unknowingly been introduced into this area. Mosquito light traps prove a useful adjunct to this surveillance program.

Routine inspection is made of airports and seaports and their surrounding areas for removal of conditions attractive to the breeding of *Aedes aegypti*. Our staff institutes control measures when actual breeding of mosquitoes is observed. Education of the public is an accepted principle in most types of control programs. Since airline crews are held responsible for the proper disinsection of planes, it is a practice of this station to

participate in their training programs. Instruction is given on the proper methods and procedures for spraying aircraft. Emphasis is given to two facts. First, it is usually easier to keep an insect out of the country than it is to eradicate it; and second, great dangers to the public are present if cases of yellow fever, plague, typhus, encephalitis or relapsing fever should be introduced. Not only do we stress our concern with insects of medical importance but those of agricultural significance as well. In fact, publicity concerning the recent introduction of the Mediterranian fruit fly, *Ceratitis capitata* Wied., in this area has impressed airline personnel of the necessity for thorough disinsection of all arriving aircraft. The receipt by all Public Health Service quarantine stations of intelligence reports dealing with epidemiological conditions throughout the world enable us to ascertain the degree of danger involved by air or marine traffic from these areas. Often routine insect control measures are intensified as a result of such information.

Thus, to be effective, quarantine control depends upon cooperation among governments and from several different agencies; cooperation of passengers and crew (in accepting in good faith and without complaint the disinsection of aircraft and ships); cooperation of airline and ship personnel and the federal agencies interested in the control procedures indicated by receipt of epidemiological reports; and cooperation among the federal regulatory agencies and state and county control authorities to detect and eliminate the breeding and breeding conditions conducive to the establishment of undesirable insects in this country.

The World Health Organization has exempted certain airports and seaports from the yellow fever endemic zone. They are like islands of safety surrounded by a sea of endemicity because breeding of *Aedes aegypti* is kept below hazardous levels. Some thought it being given to the possibility of making all ports of entry and departure free from insects of public health importance—i.e. sanitary ports. If such a dream could come true—and there is definitely more promise of it now with the great array of scientific and technical knowledge available—our quarantine problems would be greatly reduced.

Literature Cited

Annand, P. N. 1947. Preventive entomology. J. Econ. Ent. 40(4): 461-468.

Carnahan, C. T. 1938. Activities of the U. S. Public Health Service in mosquito control for airplanes. Fla. Anti-Mosquito Assn. Rep. 12: 1-7.

Denning, D. G., J. J. Pratt, Jr., A. E. Staebler and W. W. Wirth. 1947. A tabulation of insects recovered from aircraft entering the United States at Miami, Florida, during the period July 1943 through December 1944. U. S. Dept. Agric., Foreign Plant Quarantine Memo. Number 474.

Goodhue, L. D., and W. N. Sullivan. 1942. The preparation of insecticidal aerosols by the use of liquified gases. E. T. 190. U. S. Dept. Agric. Bur. Pl. Quar 3pp (Processed).

Griffitts, T. H. D., and J. J. Griffitts. 1931. Mosquitoes transported by airplanes; staining method used in determining their importation. Public Health Rep. 46(47): 2775-2782.

Griffitts, T. H. D. 1933. Air traffic in relation to public health. Amer. J. Trop. Med. 13: 283-290.

Hughes, John H. 1949. Aircraft and public health service foreign quarantine entomology. Pub. Health Rep. Suppl. 210.

Magath, T. B., and P. T. Knies. 1945. Modern concepts of international quarantine with special reference to military traffic. Mil. Surg. 96(3): 209-222.

Pimental, D., and J. W. Klock. 1954. Disinsectization of aircraft by residual deposits of insecticides. Amer. J. Trop. Med. and Hyg. 3(1): 191-194.

Quarterman, K. D., and W. N. Sullivan. 1953. Disinsectization of aircraft by lindane vapors from filters in the ventilating system. J. Econ. Ent. 46(4): 715-716.

Snow, D. L. 1945. A preliminary report of the development of equipment for the automatic disinsectization of airplanes. Pan American Sanitary Bureau and U. S. Public Health Service.

U. S. Public Health Service. Title 42, Code of Federal Regulations, Section 11.513(d). (Nov. 1, 1941)

U. S. Public Health Service. Division of Foreign Quarantine, Circular No. 12, July 20, 1955.

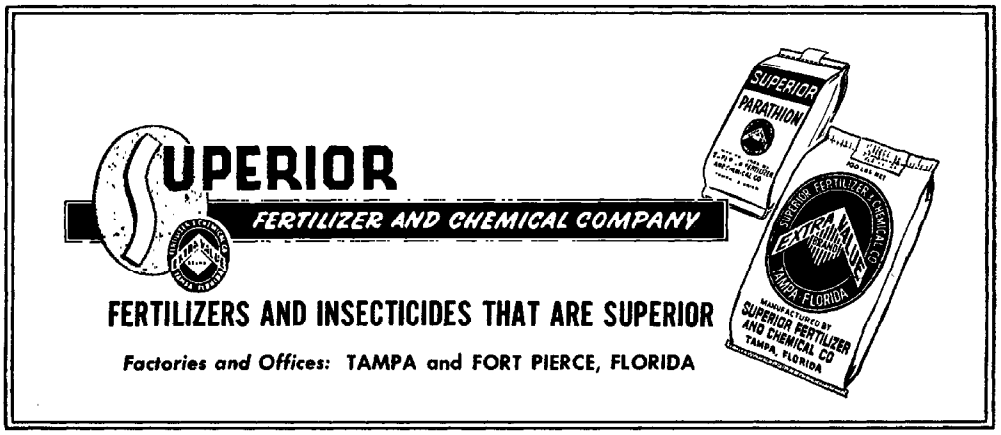
U. S. Department of Health, Education, and Welfare. 1953. Techniques and materials for the disinsectization of aircraft. Bull. World Hlth. Org. 8: 527-533.

U. S. Navy. 1950. Development of equipment for automatic disinsection of aircraft. Rep. Proj. No. TED UNL AR 633001. April 21, 1950.

Welch, E. V. 1939. Insects found on aircraft at Miami, Florida, in 1938. Pub. Health Rep. 54(14): 561-566.

White, C. S. 1947. Development of apparatus for disinsectization of aircraft. U. S. Naval Test Center, Patuxent River, Maryland.

Williams, C. L. 1940. Disinsectization of aircraft. Pub. Health Rep. 55(23): 1005-1010.

Williams, C. L., and W. C. Dreessen. 1935a. The destruction of mosquitoes in airplanes. Pub. Health Rep. 50(20): 663-671.

———. 1935b. A non-flammable pyrethrum spray for use in airplanes. Pub. Health Rep. 50(41): 1401-1404.