The Impact of Jet Transportation on Plant Quarantine*

K. L. MAEHLER
PLANT QUARANTINE DIVISION, AGRIC. RES. SERV. U.S.D.A.
SAN FRANCISCO, CALIFORNIA

(*Submitted for publication December, 1961*)

The speed with which the Tenth Pacific Science Congress convened, with its hundreds of participants from all over the world, is a good illustration of the problems confronting Plant Quarantine today. For such a group to assemble fifty years ago would have required weeks of travel. Today we go by jet and get there in a few hours.

When Orville Wright made his successful 12-second, powered flight on the sand dunes at Kitty Hawk, North Carolina, December 17, 1903, and Wilber Wright flew for 59 seconds on the same day, I doubt if they visualized what would become of their idea. On February 10, 1908, the air service of our country contracted with the Wright brothers for America's first military plane, which would carry at least two men in continuous flight for one hour at a speed of not less than 40 miles an hour. The test flight was made in Virginia, from Fort Meyers to Alexandria and return. The purchase price of that plane was $30,000; a modern jet aircraft flying at speeds of 600 miles an hour and carrying 130 passengers costs about $5,000,000. But it is just another milestone in aviation history. Larger and faster planes, destined to carry more passengers and cargo, are on the drawing boards today.

While air transportation has made spectacular progress, all modes of transportation have improved and more people are traveling each year. The U.S. Immigration Service figures indicate that the number of people entering the United States annually is about the same as our total population.

Modern transportation provided by aircraft, ships, trains, trucks, and passenger cars not only moves man and his products but affords these same facilities to his insect enemies. A fruit basket I examined on an Air France plane arriving at Anchorage, Alaska, had oranges from Spain, peaches from France, grapes grown in hot houses in Holland, and hydroponic strawberries from Japan. This could not have happened a few years ago.

While the jet age is just a tick of eternity, insects have inhabited our earth for over 250 million years. Prior to man's arrival, the migration of insects was primarily by wind, water, natural adult flight or larval movement, or hitch-hiking on animals. (They did not travel half way around the world in a few hours).

* Presented at the TENTH PACIFIC SCIENCE CONGRESS of the Pacific Science Association, held at the University of Hawaii, Honolulu, Hawaii, U.S.A., 21 August to 6 September, 1961, and sponsored by the National Academy of Sciences, B. P. Bishop Museum, and the University of Hawaii.

Insects and diseases spread as their host distribution permitted until they were halted by some geographical barrier—a desert, an ocean or a mountain range. Availability of food and biological and climatic factors affected each species. There was a rise and fall relationship between the species and its environment.

When modern man appeared, changes took place which upset this natural equilibrium. When the Colorado potato beetle relied on scattered stands of cockleburr for sustenance, food was a limiting factor, but when man planted thousands of acres of potatoes, food was no longer limited and with other factors favorable, the Colorado potato beetle population exploded. When ecological factors depress an insect population in one area and man inadvertently transports a potential pest to another area without these controlling factors, he may have a pest problem.

Most species have an extremely high biotic potential and when the lid of environmental resistance is lifted the population trend is explosively upward. Man has seriously interfered with the balance of nature by cutting down mixed forest and replanting with a single plant species; by moving the vegetative cover which harbors birds and other insect enemies; by providing ample of one food plant; by reducing predators and parasites or by transporting species into areas where they formerly did not occur. By doing all of these things, man has created many of his own problems.

Our plant quarantine efforts are immeasurably assisted by natural factors which make it difficult for a species to establish itself in a new area. For a species to gain a beachhead many factors must be synchronized. There are many odds to be overcome for an insect to leave its host in one country, hitchhike via jet aircraft and then successfully find its host in a distant land, at the proper time of the year, in a gravid condition, and before it meets an untimely end. The biological control scientist will tell you that sometimes it requires the liberation of thousands of individuals before a beneficial insect can be established. However, if the insect is moved with its host, and that host is subsequently planted or placed in an area where other host material is available, the odds are increased considerably for a little new community to be established.

Climate is a severely limiting factor. Man may be able to live in the tropics or in the arctic but most insects are more selective. Banana importations from Mexico, Central America, Panama, Colombia, and several islands of the West Indies have been observed since the early history of plant quarantine. Thousands of insects have been found associated with packing and debris in these shipments. The bulk of these insects do not feed on banana but are there incidentally. And yet with the thousands of opportunities for introduction we have no records of these species becoming established in this country. The primary reason seems to be that they are tropical insects and that our more rigorous climate is not conducive to their development.

So regulatory plant quarantine receives a valuable assist from nature in a number of ways. But chance enters the picture. The probability of a species

becoming established in a new area is dependent on its adaptability and the number of times it is introduced. Even if the insect is adapted to the new area, the averages are against all conditions being suitable for its establishment. Nonetheless, it can and does happen. Consider the outbreak of the Japanese beetle in Sacramento, California in the summer of 1961 where over 400 specimens were collected. This beetle has been in New Jersey since 1916 where it was probably introduced as larvae with balled nursery stock from Japan. Forty-five years later it became established in California. In 1960 a total of 536 Japanese beetles were collected from aircraft arriving at west coast airports from the east coast; of this number 448 were alive. Is it not likely that in spite of all our precautions, some of these escaped detection? This could have been the way the Japanese beetle arrived in California, although there are other possibilities. Modern jets flying direct from the eastern United States to the west coast greatly increase the chances of introduction.

On April 6, 1961, Plant Quarantine inspectors at Idlewild Airport, New York, and Anchorage International Airport, Alaska picked up several large European chafers, *Melolontha melolontha*. Investigators in France said that there was an unusually heavy flight of the beetle this year near the airport in Paris. One specimen was found alive at Anchorage, Alaska, in an aircraft which had flown over the polar route, from Paris to Tokyo to Anchorage, a distance of 11,614 miles. This illustrates that jet transportation can provide a quick means of moving an insect from one end of the earth to the other. During the month of April, 38 aircraft carried 120 known specimens of *Melolontha melolontha* into the Eastern United States airports.

New introductions are most often found established along main transportation routes. For many years Guam has been a port of call for ships. Many of the species found there are from the Philippines. Yap, in the Caroline Islands off the beaten track, has not been so populated. I can recall collecting an *Epilachna* along the airport runway at the Agana Airport, Guam on inkberry, a solanaceous plant. It was later determined as *E. philippensis*, a pest of solanaceous plants, and true to its reputation became a serious pest of tomatoes on Guam. About 1948 the grape vines at the Agricultural Farm on Guam were noted to be heavily skeletonized. When daytime observation turned up no evidence of the insect involved we looked at night and found the Chinese rose beetle *Adoretus sinicus* which probably had been introduced from Honolulu or the Philippines.

The Mediterranean fruit fly is supposed to have been introduced into Hawaii from Australia in ship's stores about 1910. The melon fly is believed to have been introduced into Hawaii about 1895 from the Orient in the baggage of Chinese immigrants. Most recently the Oriental fruit fly was found in Hawaii in 1946 and may have been brought back from Saipan, Marianas, with returning military troops. While all of these flies have been in Hawaii a number of years, none of them have been reported trapped in California until recently. In 1956 a single melon fly was caught in a fruitfly trap on the University of California

campus in Los Angeles. In 1960, three specimens of *Dacus dorsalis* were trapped, two in Anaheim and one at Carpinteria, California.

As air traffic from Hawaii to the mainland increases there is danger that any of these three species may be introduced. We have the following records of Oriental fruit fly being found aboard aircraft: 1948–47, 1949–60, 1950–10, 1951–0, 1952–3, 1953–4, 1954–1, 1955–8, 1956–1. These figures represent a total of 134 Oriental fruit flies caught on aircraft during the movement of 119,932 planes which left Hawaii for the mainland. With a drop in fruitfly populations in Hawaii the number we have been catching has diminished, which supports the apparent fact that population level has a direct bearing on the chance of a fly accidentally getting on an aircraft.

I do not wish to alarm you. The jet aircraft is no Pandora's box. Still there is no question that when large numbers of insects are abundant in an airport area there is a good chance for them to inadvertently get on the aircraft, particularly if they are attracted to light and the plane is loading at night. Advocates of applying residual insecticides around airport areas in order to maintain a pest-free airport have a very good point.

There are other ways of meeting the threat. By the use of cards, brochures, and posters, the traveling public is being kept aware of the problems and risks in moving plant material from one country to another. The inspection and disinsectization of aircraft at arrival or treatment at originating airport are good precautionary measures. In combating the Japanese beetle, researchers have devised a new type of aerosol bomb. The original idea for the aerosol was developed by a USDA employee, who used Freon 12 under pressure. The gas vaporized so that a gas pressure head was formed which forced the insecticide and Freon from the bomb at a uniform rate. The newer innovation combines the use of micronized DDT in colloidal form propelled by carbon dioxide. It has been used this past summer for Japanese beetle control on planes on the east coast. If it is more efficient, less objectionable than aerosol using organic solvents, and cheaper than our present method, it undoubtedly will be used more extensively.

Hawaii is a garden paradise with colorful flowers and trees from all over the world brought here mostly by man. Most of the endemic plants and insects are found now only in the mountain forests. Insects in the lowlands, such as the ant *Pheidole megacephala*, the three fruit flies, the three species of mosquitoes and others, have all been introduced by man and his products.

Hawaii is a plant quarantine man's ideal illustration of geographic protection as the Pacific ocean provides an almost perfect barrier which worked, until man built a bridge which insects and plant disease use today—a bridge of commercial transportation.