

## TRAPPING OF AIR-BORNE INSECTS ON SHIPS IN THE PACIFIC, PART 7<sup>1</sup>

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*Abstract* : Nine cruises were made aboard ships in the Pacific during 1965 to supplement data previously reported on air-borne insects. Of the 659 specimens collected, the Orders Homoptera and Diptera accounted for a total of 491.

*Introduction* : A survey of dispersal of insects across oceans must take into consideration all possible means of transportation. While the primary aim of the Museum's ship-trapping program is to give insight into which groups of insects can migrate and/or be transported passively by the wind, several new ideas were tried in 1965 to determine what role the vessel itself plays in the transfer of insects from one land mass to another.

Collecting of airborne insects from ships in the Pacific started in 1957 and reports have been published for all cruises through 1964<sup>1</sup>. During 1965 the following cruises were taken :

USNS Gaffey	San Diego-Honolulu	Jan. 1965	E. P. Holzapfel
USS Hitchiti	Samoa-Honolulu	Feb.-Mar.	G. A. Samuelson
USNS Gaffey	Honolulu-Yokohama- Okinawa-Taiwan	Mar.	B. D. Perkins
USNS Gaffey	Honolulu-San Francisco- Honolulu	Apr.	E. P. Holzapfel
USNS Barrett	Taiwan-Honolulu	May	B. D. Perkins
USNS Gaffey	Honolulu-Yokohama- Okinawa-Manila-Guam- Honolulu	July-Aug.	E. P. Holzapfel
USNS Sultan	Honolulu-Yokohama- Okinawa-South Vietnam- San Francisco	Aug.-Sept.	J. C. Harrell
USNS Gaffey & USNS Barrett	Honolulu-San Francisco- Honolulu	Oct.-Nov.	E. P. Holzapfel

1. Results of a project supported by a grant to Bishop Museum by the Biology Branch, Office of Naval Research (through the Pacific Science Board, National Academy of Science). Previous reports of this series were by Gressitt & Nakata, 1958; Yoshimoto & Gressitt, 1959, 1960, & 1961; Harrell & Yoshimoto, 1964; and Harrell & Holzapfel, 1966.

2. Current 1969 address : c/o Agricultural Attaché, Buenos Aires, Argentina.

Of the 659 identifiable specimens collected on the 9 cruises listed above, 275 were Homoptera, 216 Diptera, 49 Hymenoptera, 44 Thysanoptera and 75 belonged to other orders which included several Arachnoids.

No cruises were taken in the Pacific during 1966 though collecting from ships in the Antarctic area which started in 1959 was terminated at the close of the Antarctic '66 Season and will be published separately.

Recently the program has placed emphasis on the closer analysis of the relative numbers of insects at various distances from land (Holzapfel & Harrell, 1968). Actual collecting at sea was resumed during the second half of 1967 and in the spring of 1968 additional modifications were made to the suction trap. A new automatic device is being engineered and constructed and will be in operation before the end of 1968. Results of current collecting and a description of the new and modified equipment will appear in future reports.

*Methods:* While the standard nylon nets on 75 cm diameter rings suspended from ropes or lines (Yoshimoto & Gressitt 1960) continued to be used on all 9 cruises, several new ideas were experimentally tried during 1965 in an effort to improve collecting efficiency and to determine what role the ship itself plays in the transoceanic transport of insects.

In an attempt to more accurately measure the volume of air screened, a 11.3 cm metal extension was added forward of the 75 cm diameter ring (Holzapfel & Harrell 1968). This extension allowed the mounting of an anemometer which permitted the relative wind direction and speed passing through the nets to be known at all times.

The electric suction trap (Yoshimoto, Gressitt & Mitchell, 1962) was used by Holzapfel on his January, April, and July-August cruises and by Perkins on his March cruise. A commercial black light (Spin-sect) suction trap was also used in the various storage and living compartments of the vessel by Holzapfel during his April and July-August cruises to help determine the relative numbers and kinds of specimens routinely transported by the ship.

While the need for uniformity of both the number and location of the nets aboard the various collecting vessels had been recognized, it was not until March 1965 that Perkins began to record the numbers of insects and the amounts of debris at various levels above the main-deck. A series of 6 nets was rigged vertically from the cross beam (King Post) to the main deck forward of the bridge as has been done on previous cruises (Yoshimoto & Gressitt, 1960). A second series of 4 nets was rigged from a cable above the flying bridge, the highest possible location on the ship. In order to operate in this area, 2 pulleys had to be attached to the longitudinal halyard connecting line and a cable suspended between them and the top deck. This series of nets was raised and lowered with the aid of a hand winch. These 2 series of nets allowed collections to be taken from the highest possible point on the vessel down to within 25 m of the main deck. On his return cruise in April, Perkins flew nets from the main deck upon leaving Taiwan but later suspended them only from the signal halyards.

In addition to the suction and black light traps already mentioned, Holzapfel flew from 2 to 10 nets on his 4 cruises. The desirability to avoid debris and contamination encountered while operating from the main deck caused nets to be flown from the signal

halyards whenever possible. In order to facilitate collecting from the top deck (flying bridge), a semipermanent cable was rigged amid ships of the Gaffey for the July-August cruise. This cable was suspended from the longitudinal halyard connecting lines and was sturdy enough to support 2 series of nets together with their pulleys, ropes and guidelines.

Samuelson was permitted to use only 4 nets aboard the rather small Hitchiti and Harrell flew from 5 to 8 nets aboard the Sultan, including the 2 with experimental metal extensions.

The various collecting devices were normally checked 3 times daily near land and twice farther out at sea. A small aspirator was used to remove specimens and debris from the traps and data was recorded on position, weather and other useful points.

*Results* : Tables 1 through 8 present a summary of the specimens taken from the nets and suction trap. Table 9 combines the use of the black light trap for 2 cruises and from the numbers taken, one can begin to see that the ship does play an important part in the transport of insects.

Perkins used separate vials when collecting material from the nets and suction trap in order to determine any difference in collecting efficiency as to relative location aboard the vessel. The vials were labeled A., B., C., and D. as outlined below and as they appear on Table 10.

Vial A : Material from the lower 3 nets of the series of 6 flown from the main deck of both the USNS Gaffey and the USNS Barrett.

Vial B : Material from upper 3 nets of the series of 6 flown from the main deck of both the USNS Gaffey and the USNS Barrett.

Vial C : Material from 4 nets on cable above the flying bridge on the USNS Gaffey.

Vial D : Material taken from the suction trap on the USNS Gaffey.

The usefulness of knowing the source of specimens found great distances from land is self evident. While trajectories have been attempted (Holzapfel & Harrell 1968), accuracy can be approached only when one is fortunate enough to collect species of limited distribution. It is hoped that a separate report will eventually be possible which will trace the route taken by such specimens from their land source to the ships far out to sea. Weather and other pertinent data as well as the specimens are being kept on all cruises in preparation for such a publication.

*Discussion* : As the ship trapping program continued to evolve in 1965, several new ideas were tried with varying degrees of success. Early in the year Perkins made a record of trash taken from the nets. The results of this survey is reported in Table 10 and points out the desirability of flying the nets from the highest possible point on the vessel. Gressitt & Wise were the first to suspend nets above the top deck (flying bridge) in 1961. They used existing halyards which are normally used only briefly to fly signal flags when the ship enters or departs a port. From this early experience, they found that sturdier halyards would be required to support the weight and drag exerted by the insect nets. Perkins attempted to correct this deficiency by replacing the rope with a light cable and hand winch but these, too, proved inadequate to support the nets. Stur-

dier pulleys and a much larger cable were semipermanently rigged expressly for insect collecting from the flying bridge of the Gaffey in time for Holzapfel's July cruise.

A preliminary survey to determine shipboard contamination was conducted by Holzapfel who operated a black light (Spin-sect) trap in the various forward compartments of the ship. The results of this survey is presented in Table 9 and several interesting observations were made. During the single July-August cruise a total of 170 specimens were taken in the light trap while 397 were removed from the nets and suction trap. An even more significant result from analysing the collections made on this cruise related to the approach and departure from the Philippines. During the 24-hour period of collecting before docking in Manila, only 1 specimen was removed from the light trap while 149 were taken from the nets and suction trap. Cargo was unloaded at Subic Bay the night previous to departure which allowed insects to descend several decks into the various compartments. During the 24-hour period following departure from Subic Bay, 98 specimens were removed from the light trap while only 91 were taken from the nets and suction device. It might be added that upon leaving Subic, the ship passed through the Sibuyan Sea and out through the San Bernardino Str.; an area which in the past has yielded some of the largest numbers of insects.

One point that has never been adequately discussed in the ship trapping program is the "spillage" of air and in consequence insects from the nets. In the mid 1930's J. A. Freeman used nets to calculate insect densities by placing them up to 300 feet on radio antennas. In his 1945 publication on the results of this work he points out that to analyse the results from this type of collecting is difficult due to the variables such as wind speeds. He also found by experiment that the meshed materials used filtered only 80 % of the air passing them.

C. G. Johnson (1950) concurred with Freeman's findings and stated that the air which passes through any net is only a portion of the amount which would pass through a similar area without the net. He further stated that the higher the wind speed the greater is the proportion which the net allows to pass. With the materials he used, wind speeds of 0.8 MPH allowed only 25.0 % to pass while at 16.7 MPH the percentage increased to 89.2.

Harrell's observations aboard the Sultan in 1965 showed that the anemometer in the new experimental net rings registered only 80 % of the wind speeds recorded by the ship's weather anemometers. Though actual wind velocities were not given for these observations, it was speculated that perhaps up to 10 % of this loss was due to deflection of the wind flow by the various structures on the deck forward of the collecting area.

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## PACIFIC SHIP TRAPPING

Table 1

Ship - Gaffey  
Coll. - HolzapfelJanuary 1965  
San Diego - Honolulu

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
1 N	16. I. 65	Lt. Wind		32°25'N	118°50'W	32°16'N	119°57'W	100km, San Clemente I., Calif.	12	Homoptera	Aphididae
									1	Coleoptera	Coccinellidae
2 N	16. I. 65	Lt. Wind		32°25'N	118°50'W	32°16'N	119°57'W	100km, San Clemente I., Calif.	14	Homoptera	Aphididae
									1	Diptera	Sciaridae
4 N	17. I. 65	050°	10k	32°16'N	119°57'W	31°17'N	125°26'W	160km, San Clemente I., Calif.	10	Homoptera	Aphididae
7 S	18. I. 65	150°	17k	30°42'N	128°40'W	29°28'N	134°36'W	1220km, Point Concep- tion, Calif.		a feather	
8 N	"	"	"	"	"	"	"	1220km, Point Concep- tion, Calif.		a feather	

PACIFIC SHIP TRAPPING

Table 2

Ship - WSS Hitchiti  
Coll. - G.A. Samuelson

Feb. - March 1965  
Samoa - Oahu

No.	Date 1965	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
1	25.II.65	080°	11k	14°16'S	170°40'W	14°06'S	170°32'W	18km, Tutuila I., Samoa Is.	1	Homoptera	Aphididae
									1	Diptera	Sciaridae
2	25.II	100°	12k	14°06'S	170°32'W	12°44'S	170°31'W	31km, Tutuila I., Samoa Is.	1	Diptera	Sarcophagidae
4	4.III	Variable		08°34'S	172°36'W	Passing through Tokelau Is.			2	Diptera	Drosophilidae
									1	Coleoptera	Staphylinidae
12	11.III	085°	5-10k	00°37'S	160°30'W	00°25.5'S	160°03.5'W	65km, Jarvis I.	2	Diptera	Drosophilidae
									1	Lepidoptera	Pyralidae
									1	Araneida	
									2	Insect fragments. ant. & leg	
14	12.III	095°	8-12k	00°59'N	158°52'W	01°59'N	157°34'W	At Christmas I.	1	Hymenoptera	Formicidae
15	15.III	110°	10k	At anchor at Christmas Island					2	Hymenoptera	Formicidae
									1	Insect fragment	
16	15.III	115°	10k	01°59'N	157°34'W	03°30'N	159°34'W	54 km, Fanning I.	1	Thysanoptera	
									1	insect fragment-pronotum	
17	16.III	350°	10k	03°30'N	159°34'W	04°58'N	161°30'W	63 km, Wash. I.	1	Hymenoptera	Pteromalidae
18	16.III	110°	10k	04°58'N	161°30'W	05°46'N	162°00'W	40 km, Palmyra I.	1	Hymenoptera	Pteromalidae
19	19.III	090°	10k	At anchor-Palmyra Island					1	Diptera	Drosophilidae
20	20.III	065°	15-23k						1	insect fragment-leg	
		070°	6-13k	10°56'N	160°40'W	11°36'N	160°31'W	600 km, Palmyra I.			

## PACIFIC SHIP TRAPPING

Table 3

USNS Gaffey  
D. PerkinsMar. 1965  
Hon.-Yokohama-Naha-Taiwan

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
1	10.III	290°	08k	Honolulu		021°38'N	160°33'E	off Oahu+Kauai I., Hawn. Is.	1	Thysanoptera	Thripidae
									1	Psocoptera	exuvium of immature
									1	Homoptera	Aphididae
									1	Hemiptera	Piesmidae
									1	Coleoptera	Nitidulidae
									1	Diptera	damaged
									1	Hymenoptera	Braconidae ( <i>Chelonus</i> )
									1	"	Encyrtidae
9	13.III	220°	20k	025°35'N	176°39'W	025°52'N	174°47'W	120 km, Lisianski I., Hawn. Is.	1	Neuroptera	Hemerobiidae
13	21.III	275°	07k	031°25'N	134°04'E	030°30'N	132°30'E	240 km, Kyushu, Japan	1	Diptera	Chloropidae
16	24.III	178°	0	025°41'N	125°08'W	8km from Taiwan	Keelung,		1	Lepidoptera	Oenophilidae
									7	Diptera	Chironomidae
									4	"	Drosophilidae

## PACIFIC SHIP TRAPPING

Table 4

USNS Gaffey  
E. Holzapfel(1) Honolulu - San Francisco  
(2) San Francisco - Honolulu  
April 1965

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
(1) <i>Honolulu - San Francisco</i> NEGATIVE RESULTS											
(2) <i>San Francisco - Honolulu</i> POSITIVE RESULTS (see below)											
3A	22.IV	060°	05k	033°45'N	131°10'W	031°17'N	136°27'W	1400 km, Point Con- ception, Calif.	1	Homoptera	Aphididae
3D	"	"	"	"	"	"	"		1	white feather	
5B	22.IV	125°	10k	031°17'N	136°27'W	029°49'N	140°25'W	1700 km Pt. Concep- tion Calif.	1	white feather	
5D	"	"	"	"	"	"	"				
11c	24.IV	150°	03k	026°12'N	147°00' W	024°09'N	151°19'W	1450 km, Maui I., Hawaii	1	white feather	

## PACIFIC SHIP TRAPPING

Table 5

USNS Barrett  
D. Perkins22 April-1 May 1965  
Taiwan-Honolulu

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
1	22.IV	110°	12k	26km Keelung,		25°53'N	126°40'E	70 km, Miyako I., Ryukyu Is.	1	Diptera	Chironomidae
									1	"	Dolichopodi- dae
									1	Hymenoptera	Formicidae (head only)
2	22.IV	100°	10k	025°53'N	126°40'E	025°58'N	128°18'E	80 km. Okinawa, Ryukyu Is.	14	Homoptera	Aphididae
									1	Lepidoptera	microlep. (damaged)
30	1.V	070°	10k	021°30'N	160°15'W	021°17'N	158°47'W	600 km, Marcus I.	2	Diptera	Agromyzidae
									5	Thysanoptera	Thripidae



# PACIFIC SHIP TRAPPING

Table 6

Ship - USNS Gaffey  
Coll. - Holzapfel

July-Aug. 1965  
Hon.-Japan-Manila-Guam-Hon.

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
S 2	23. VII	060°	16k	021°27.5'N	160°21'W	022°67'N	165°12'W	48 km, Niihau I., Hawn. Is.	1	Psocoptera	
N 8	24. VII	085°	18k	023°56'N	168°25'W	025°13'N	173°07'W	80 km, Lisianski I., Hawn. Is.	1	feather	
N11	24. VII	083°	12k	025°39'N	174°28'W	026°15'N	176°26'W	50 km, Lisianski I., Hawn. Is.	1	feather	
S30	30. VII	225°	18k	034°13'N	150°28'E	034°36'N	144°46'E	250 km, off Japan Coast	1	feather	
S35	31. VII	242°	18k	034°29'N	142°16'E	In Tokyo Bay			1	Homoptera	Delphacidae
									1	Diptera	Cerato- pogonidae
S36	1. VIII	160°	06k	Depart Tokyo Bay		034°36'N	139°05'E	Departing Tokyo Bay	1	Homoptera	Aphididae
									2	Coleoptera	Staphylinidae
									1	Diptera	Cerato- pogonidae
S37	1. VIII	154°	03k	034°36'N	139°05'E	033°02'N	138°25'E	14 km off Japan Coast	1	Homoptera	Aphididae
									1	Diptera	Ephydriidae
									1	"	Sciaridae
									1	"	fragment
N38	1. VIII	154°	03k	034°36'N	139°05'E	033°02'N	138°25'E	14 km off Japan Coast	7	Homoptera	Aphididae
									7	"	Delphacidae
									1	Diptera	Tachinidae
									1	insect fragments	
									1	Araneida	Argiopidae

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Table 6 (continuation)

No.	Date 1965	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
S40	2. VIII	173°	5k	033°02'N	138°25'E	031°30'N	134°15'E	135km, Hachijo I., Japan	6	Homoptera	Aphididae
									10	"	Delphacidae
									1	Diptera	Ephydriidae
N41	"	"	"	"	"	"	"	"	3	Homoptera	Aphididae
									95	"	Delphacidae
									1	Coleoptera	Scolytidae
S42	"	100°	15k	031°30'N	134°15'E	029°43'N	131°04'E	40km, Tanegashima, Japan	1	Coleoptera	Coccinellidae
									1	Diptera	Cerato- pogonidae
N43	"	"	"	"	"	"	"	"	3	Homoptera	Delphacidae
N45	3. VIII	090°	19k	029°43'N	131°04'E	027°21'N	128°02'E	60km, Amami-Oshima Ryuku Is.	1	Homoptera	Aphididae
N47	"	100°	18k	027°21'N	128°02'E	028°26'N	126°13'E	27km, Okinawa, Ryukyu Is.	1	Diptera	Phoridae
									1	"	damaged (Nematocera)
S50	7. VIII	235°	09k	021°28'N	123°16'E	020°02'N	121°41'E	32km, Bataan Is.	1	Araneida	Argiopidae
N51	"	"	"	"	"	"	"		1	Homoptera	Delphacidae
N53	"	225°	07k	020°02'N	121°41'E	019°20'N	121°00'E	30km, Babuyan Is, Philippines	1	Homoptera	Delphacidae (damaged)
S55	8. VIII	067°	06k	019°20'N	121°00'E	015°06'N	119°51'E	3km, Coast of Luzon	1	Homoptera	Aphididae
									3	Diptera	Cerato- pogonidae
									3	"	Chironomidae

Table 6 (continuation)

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
N56	8.VIII	067°	06k	019°20'N	121°00'E	015°06'N	119°51'E	3km, Coast of Luzon	32	Thysanoptera	
"									6	Homoptera	Aphididae
"									3	"	Delphacidae
"									1	Hemiptera	Corixidae
"									1	Diptera	Cecidomyiidae
"									26	"	Cerato- pogonidae
"									18	"	Chironomidae
"									1	"	Chloropidae
"									1	"	Drosophilidae
"									1	"	Phoridae
"									4	"	Psychodidae
"									1	"	Tipulidae
"									39	"	fragment
"									2	Coleoptera	Staphylinidae
"									1	"	Euglenidae
"									1	Araneida	Argiopidae
<i>The Philippines (Philippines-Hawaii)</i>											
N3	20°VIII	300°	08k	013°30'N	121°05'E	013°14'N	121°42'E	5km, Mindoro, Philip. Is.	2	Thysanoptera	
									2	Homoptera	Aphididae
									1	Diptera	Cecidomyiidae
									4	"	Cerato- pogonidae
									1	"	Chironomidae
									9	"	damaged

Table 6 (continuation)

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc	Lat.	Long.	Lat.	Long.				
S 5	21.VIII	090°	03k	013°14'N	121°42'N	012°52'	125°37'E	10km, Samar, Philip Is.	1	Homoptera	Aphididae
									1	"	Cicadellidae
									1	"	Delphacidae
									1	Diptera	Agromyzidae
									2	"	Cerato- pogonidae
									1	"	Chironomidae
									1	"	Phoridae
									1	Araneida	Argiopidae
N6	"	"	"	"	"	"	"	"	2	Thysanoptera	
									12	Homoptera	Aphididae
									8	"	Cicadellidae
									6	"	Delphacidae
									1	Hemiptera	Anthocoreidae
									1	"	Miridae
									1	"	Reduviidae
									2	Diptera	Chironomidae
									10	"	Sciaridae
									2	"	Tipulidae
									11	"	damaged
									2	Hymenoptera	
N7A	21.VIII	Lt.	Airs	012°52'N	125°37'E	012°55'N	127°04'E	35km, Samar, Philip. Is.	2	Araneida	Argiopidae
									3	"	Linyphiidae
									1	Homoptera	Aphididae

Table 6, (continuation)

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
N 9A	21. VIII	060°	04k	012°55'N	127°04'E	012°58'N	129°06'E	171km, Samar, Philip. Is.	1	Diptera	Sciaridae
N17B	23. VIII	350°	06k	013°23'N	141°21'E	013°23'N	142°41'E	200km, Guam, Mariana Is.	1	Lepidoptera	micro
N22	25. VIII	075°	02k	013°41'N	144°53'E	014°58'N	148°11'E	27km, Rota I., Mariana Is.	1	Araneida	Theridiidae
28	26. VIII	195°	05k	015°44'N	152°17'E	016°37'N	156°21'E	700km, Saipan, Mariana Is.	1	fragment (leg)	
32	"	Found on bridge							1	Coleoptera	Curclionidae
48	30. VIII	072°	10k	021°21'N	169°24'W	021°24'N	165°00'W	285km, Wake I.	1	Diptera	fragment

PACIFIC SHIP TRAPPING

Table 7

USNS Sultan  
Coll.- Harrell

Aug. - Sept. 1965  
Honolulu - Viet Nam - San Francisco

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
1	10.VIII	110°	14k	20°20'N	159°10'W	21°32'N	160°33'W	6km to Kula Rock	1	Coleoptera	Bruchidae
									1	"	Mycetophagidae
									1	"	Nitidulidae
									34	Hymenoptera	Agaontidae
									1	"	Formicidae
									3	Insect Fragments	
19	18.VIII	015°	16k	34°30'N	145°18'E	5km Coast of Japan			5	Homoptera	Aphididae
									3	"	Delphacidae
									1	Diptera	Cecidomyiidae
									3	"	Cerato- pogonidae
									1	"	Chironomidae
									1	Coleoptera	Staphylinidae
									1	Hymenoptera	Chalcidoidea
20	20.VII	160°	25k	5km Yokohama Bay		33°34'N	139°00'E	15km, Coast of Japan	1	Homoptera	Aphididae
									1	Diptera	Agromyzidae
									1	Hymenoptera	Chalcidoidea
24	25.VIII	180°	7k	25°44'N	125°15'E	Keelung, Taiwan			1	Homoptera	Aphididae
									1	"	Delphacidae
									1	Hemiptera	Lygaeidae
									8	Diptera	Chironomidae
									1	Araneida	

Table 7 (continuation)

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
25	25.VIII	150°	12k	Keelung Harbor, Taiwan					1	Hemiptera	Lygaeidae
									1	Diptera	Cerato- pogonidae
									6	"	Chironomidae
									1	"	Ephydriidae
									2	abdominal fragments	
26	26.VIII	340°	06k	Keelung Harbor, Taiwan		22°18'N	121°15'E	28km, Hsa I.	1	Hemiptera	Coreidae
									1	Diptera	Psychodidae
									1	"	damaged
27	26.VIII	060°	11k	22°18'N	121°15'E	21°09'N	120°06'E	28km, Hsa I.	1	Diptera	Cerato- pogonidae
									1	wing fragment	
30	27.VIII	110°	12k	18°32'N	113°52'E	18°06'N	112°37'E	118km, Paracel Is.	4	Homoptera	Delphacidae
									1	Araneida	
31	27.VIII	100°	12k	18°06'N	112°37'E	17°28'N	111°20'E	80km, Paracel Is.	1	Homoptera	Delphacidae
									1	Araneida	
32	28.VIII	110°	10k	17°28'N	111°20'E	DaNang, South Vietnam			1	Homoptera	Aphididae
									1	"	Delphacidae
									4	Araneida	

Table 7 (continuation)

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
32b	28.VIII	070°	07k	DaNang Harbor, South Vietnam					1	Homoptera	Aleyrodidae
									5	"	Aphididae
									3	"	Delphacidae
									1	Hemiptera	Veliidae
									1	Diptera	Cecidomyiidae
									2	"	Cerato- pogonidae
									2	"	Chironomidae
									1	"	Chloropidae
									3	"	Ephydriidae
									2	Hymenoptera	Agaontidae
									2	"	Mymaridae
									2	"	Trichogram- matidae
									1	Araneida	
33	28.VIII	090°	08k	DaNang, S. Vietnam		16°26'N	108°57'E	64km, Coast of Vietnam	1	Thysanoptera	
									2	Homoptera	Aphididae
									4	"	Delphacidae
									1	Hemiptera	Lygaeidae
									1	Diptera	Chironomidae
									1	"	damaged
									2	Araneida	
									3	insect fragments	
34	29.VIII	023°	09k	16°26'N	108°57'E	18°11'N	113°40'E	144km, Hainan I.	5	Homoptera	Delphacidae



Table 7 (continuation)

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
43	1.IX	018°	09k	030°24'N	135°38'E	032°15'N	138°50'E	48 km, Kagoshima, Japan	10	Homoptera	Delphacidae
47	6.IX	340°	10k	040°26'N	175°57'E	041°32'N	178°38'E	825 km., Kure I., Hawn. Is.	1	wing fragment	
<i>Insects Found Aboard Ship</i>											
5	12.VIII	080°	15k	023°25'N	169°11'W	025°35'N	174°15'W	In dining room	1	Coleoptera	Scarabaeidae

## PACIFIC SHIP TRAPPING

Table 8

USNS Gaffey — Oct. 1965 Honolulu-San Francisco  
 USNS Barrett — Nov. 1965 San Francisco-Honolulu  
 E. Holzapfel

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
Gaffey Cruise — Honolulu - San Francisco — Oct. 1965											
1	18.X	070°	10k	Departing Oahu, Hawaii		023°47'N	154°14'W	Off Hawaiian Is.  150km, San Francisco, Calif.	1	Araneida	
9	22.X	060°	18k	036°10'N	127°48'W	037°30'N	123°26'W		3	Homoptera	Aphididae
	22.X	On deck of ship - near islands off San Francisco							2	Lepidoptera	Geometridae
Barrett Cruise — San Francisco - Honolulu — Nov. 1965											
3	18.XI	060°	10k	029°08'N	135°09'W	028°18'N	137°05'W	1600km to Hawaiian Is.	2	Araneida	

# PACIFIC SHIP TRAPPING

Table 9

## Total Light Trap Collection

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
Table 4. USNS Gaffey — E. Holzapfel — Hon. - San Francisco - Hon. April 1965											
	8-9.IV			026°30'N	149°24'W	028°46'N	145°14'W	In dry stores	1	Lepidoptera	Gelechiidae
	20.IV			Departing San Francisco near chill reefer for fresh vegetables					1	Diptera	Sciaridae ♀ gravid
	22.IV										
Table 6. USNS Gaffey — E. Holzapfel — Hawaii - Manila - Hawaii July - August 1965											
1	23.VII			021°27.5'N	160°21'W	022°67'N	165°12'W	48km, Niihau I., Hawn. Is.	1	Diptera	Anthomyiidae
3	"			022°67'N	165°12'W	023°56'N	168°25'W	54km, French Frigate Sh., Hawn. Is.	4	Diptera	Muscidae
									1	Diptera	Drosophilidae
6	24.VII			023°56'N	168°25'W	025°13'N	173°07'W	80km, Lisianski I.	2	Diptera	Muscidae
9	24.VII			025°13'N	173°07'W	026°15'N	176°26'W	50km, Lisianski I., Hawn. Is.	1	Diptera	Muscidae
									2	Diptera	Phoridae
12	25.VII			026°15'N	176°26'W	027°51'N	178°42'E	36km, Lisianski I., Hawn. Is.	1	Diptera	Drosophilidae
									1	Diptera	Muscidae
									1	Diptera	Phoridae
15	"			027°51'N	178°42'E	028°54'N	175°54'E	60km, Midway I., Hawn. Is.	1	Diptera	Phoridae
20	28.VII			031°22'N	166°46'E	032°23'N	161°48'E	1050km, Marcus I., Hawn. Is.	2	Diptera	Drosophilidae
26	29.VII			033°41'N	153°50'E	034°13'N	150°28'E	970km, Japan Coast	1	Diptera	Muscidae
29	30.VII			034°13'N	150°28'E	034°36'N	144°46'E	250km, Japan Coast	1	Diptera	Anthomyiidae
31	"			034°36'N	144°46'E	034°29'N	142°16'E	135km, Japan Coast	2	Lepidoptera	Pyrilidae

Table 9 (continuation)

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
44	3. VIII			029°43'N	131°04'E	027°21.5'N	128°02.5'E	60km, Amami Oshima, Ryukyu Is.	1	Diptera	Phoridae
									2	Lepidoptera	micro
48	6. VIII			Naha, Okinawa		025°40'N	127°24'E	Leaving Okinawa	1	Diptera	Phoridae
54	8. VIII			019°20'N	121°00'E	015°06.5'N	119°51.5'E	3km, Philippine Coast	1	Hemiptera	Miridae
<i>Manila - Hawaii</i>											
1	20. VIII			013°30.5'N	121°05'E	013°14'N	121°42'E	5km, Mindoro Philip. Is.	3	Homoptera	Delphacidae
									4	Diptera	Cecidomyiidae
									20	"	Cerato- pogonidae
									13	"	Chironomidae
									2	"	Drosophilidae
									2	"	Ephydriidae
									4	"	Phoridae
									1	"	Psychodidae
									1	"	Tipulidae
									1	Hymenoptera	Braconidae
4	21. VIII			013°14'N	121°42'E	012°52'N	125°37'N	10km, Samar, Philip. Is.	1	Thysanoptera	
									1	Homoptera	Cicadellidae
									1	Diptera	Calliphoridae
									28	"	Cerato- pogonidae
									10	"	Chironomidae
									5	"	Tipulidae
									1	Lepidoptera	micro.

Table 9 (continuation)

No.	Date	Wind		Starting		Ending		Approx. Dist. Nearest Land	No. Spec.	Order	Family
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
8	21. VIII			012°52'N	125°37'E	012°58'N	129°06'E	35km, Samar, Philip Is.	1	Diptera	Borboridae
12	22. VIII			013°05'N	133°44'E	013°14'N	137°00'E	750km, Guam Mariana Is.	1	Lepidoptera	micro.
19	23. VIII			Moored-Apra Harbor, Guam					1	Diptera	Cerato- pogonidae
20	24. VIII			Apra Harbor, Guam		013°45'N	145°02'E	Guam	1	Diptera	Anthomyiidae
									2	"	Borboridae
									2	"	Cerato- pogonidae
									11	"	Chloropidae
						013°45'N	145°02'E	At Guam	2	Diptera	Muscidae
									5	"	Phoridae
									9	"	Sciaridae
									1	Hymenoptera	micro
23	25. VIII			014°58'N	148°11'E	015°44'N	152°17'E	215km, Saipan, Mariana Is.	1	Diptera	Tipulidae
26	26. VIII			015°44'N	152°17'E	016°37'N	156°21'E	700km, Saipan, Mariana Is.	1	Lepidoptera	Noctuidae
29	"			016°37'N	156°21'E	017°21'N	159°31'E	720km, Wake I.	1	Hymenoptera	Formicidae
33	27. VIII			017°21'N	159°31'E	018°14'N	164°03'E	270km, Wake I.	1	Diptera	Tipulidae
39	27. VIII			019°47'N	172°07'E	020°09'N	175°20'E	540km, Wake I.	2	Diptera	Cerato- pogonidae
									1	"	Chloropidae
41	28. VIII			020°09'N	175°20'E	020°35'N	179°33'E	860km, Lisianski I., Hawn. Is.	1	Diptera	Borboridae
									1	"	Chloropidae
									1	"	Phoridae

Table 10. Amount and Type of Trash and Number of Insects Caught in Insect Trap in Different Locations Aboard Ship

Sample and/or Vial Numbers		TYPE OF TRAP AND LOCATION															
		A*				B				C				D			
		L	De	T	P**	L	De	T	P	L	De	T	P	L	De	T	P
DISTRIBUTION OF TRASH	1.						+++										++
	2.	++	++			++	++	++		+	+	+			+		
	3.	++				++							++		+	+	
	4.	+	+			++	++						+				
	5.	+	+			++		++					+		+		
	6.	+	+	+		++	++	++		Rigging inoperative after Sample #4.					+		
	7.	++	++	++		++		++							+		
	8.		+	+		++		++							+		
	9.		+	++			++	++							+		
	10.		+	+			++								+		
	11.		++			+		+							+		++
	12.		+			++	++	+							+		
	13.																
	14.	++	+	+		++		+									
	15.		+			++											
	16.						+										
	17.	++	++			++	++		++								
	18.	++	++	+		++	++	+									
	19.	++	+			++		+									
	20.	+				++											
	21.		+				+										
	22.	Debris only, amount negligible 21-45															
	23.																
SUMMATION OF TRASH	1-4	5	3	0	0	7	6	2	0	1	1	1	3	1	3	0	3
	1-12	13	13	8	0	18	15	18	0					1	11	0	5
	1-20	23	20	10	0	34	21	20	2								
	21-45	Equal amounts of debris only collected in A and B nets; amount almost negligible.															
SUMMATION OF INSECTS		Number of Insects Caught at Different Locations															
	1-4	2				0				5				1			
	5-20	17				8								0			
	1-12	2				0								2			
	21-45	5				0											

\* Each letter represents a vial label as to location of the trap; see text for detail

\*\* L=lint, De=debris, T=tobacco, P=paint chips.

\*\*\* +'s indicate amounts of trash: +=very little, ++=some, +++=much and ++++=very much.

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