

TRAPPING OF AIR-BORNE INSECTS ON SHIPS ON THE PACIFIC, PART 9¹

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Abstract: Two cruises were made aboard ships in the Pacific for the purpose of collecting air-borne insects during 1969-70. Over 3300 specimens were collected, the majority of which belong to the orders Diptera, Homoptera and Hymenoptera.

In an effort to document the transoceanic movements of insects by air transport as part of a zoogeography and evolution study, the Entomology Department of the Bishop Museum began a program of collecting from ships in the summer of 1957 (Gressitt & Nakata 1958). The study was continued to early 1970. Previous papers in this series were Yoshimoto & Gressitt 1960, 1961, Harrell & Yoshimoto 1964, Harrell & Holzapfel 1966, Holzapfel & Perkins 1969 and Guilmette et al. 1970. The present paper covers the last phase of the study, from May 1969 to February 1970.

During 1969-1970 E. P. Holzapfel was permitted to operate insect collecting equipment aboard the Scripps Oceanographic Research Vessel *Argo*, whose primary mission was to conduct seismic surveys at a number of sites for the Scan Expedition in the Pacific. Two major cruises were taken. One departed Honolulu on 10 May 1969 and returned on 26 July 1969 with ports of call at Yokohama, Japan and Apra Harbor in Guam. The second cruise departed Papeete, Tahiti, on 18 October 1969 and arrived in San Diego, California on 19 February 1970, with ports of call at Pitcairn Island, Balboa (Panama Canal Zone) and Acapulco, Mexico. Another technician, H. B. Clagg, volunteered to collect insect specimens while on a tour of duty aboard the U. S. C. G. C. *Gresham*. Sampling began off Honolulu in April 1969, continued while on weather site Ocean Station Victor (Lat. 34°00'N, Long. 164°00'E) for 3 weeks, was interrupted by a 3-week port call to Yokosuka, Japan, in May and was resumed for another 3 weeks at Ocean Station Victor from late May to early June. In September, Clagg resumed collecting while en route to, and while at, Ocean Station November (Lat. 30°00'N, Long. 140°00'W) for a 3-week period.

MATERIALS AND METHODS

TRAPS

Nylon nets on 75 cm diam. metal rings suspended from ropes (Yoshimoto & Gressitt 1960) and modified cables (Guilmette et al. 1970) were used on both the *Argo* and *Gresham*. On the *Argo*, a series of nets was rigged from each of the yardarms of the mainmast and,

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weather permitting, screening done with a total of 10 nets. The outboard signal halyards of the foremast yardarms were used to rig a series of 8 nets for screening on the *Gresham*. Some smoke contamination of the nets by the stack exhaust was noted occasionally.

An electric suction trap (Yoshimoto et al. 1962) was modified (Guilmette et al. 1970) and was in continuous use aboard the *Argo*, although the black light was secured at night, as its light interfered with navigation.

A Moving Net Insect Sampler (MNIS) (Guilmette et al. 1970) was modified by replacing the original 115 CFM blower with a stronger 250 CFM (15 cm diam.) unit. This stronger unit increased the volume of air screened as well as secured the specimens to the gauze until they could be laminated by the mylar. USP Type 1 surgical gauze was used along with a 1-mil mylar. When loaded with a 9m (30 ft) roll of gauze and mylar, the sampler operated continuously for 2 weeks. A 24-hr mark was made each day as an aid to screening later in the laboratory.

The MNIS was in continuous operation on the *Argo*; however, mechanical problems developed while in port, causing the blower to become inactive. This resulted in a reduction of efficiency in July between Guam and Hawaii. A loss of sampling occurred on the fall cruise due to a malfunction of the advance mechanism.

Determination of shipboard insect contamination was made with a Spinsect black light trap on the *Argo* during the 1969-1970 sample periods. Insects were also recovered from the decks and stored food.

Normally collections were made from all sampling devices at 0600 hr, 1200 hr and 1800 hr while near land. The 1200 hr collection was eliminated in mid-ocean. A small aspirator was used to remove specimens and debris from nets and the suction trap. Collection data were recorded each time a sample was taken.

RESULTS AND DISCUSSION

During 1969-1970, a total of 1356 identifiable specimens was collected at sea. Homoptera was the prevalent order with 503 specimens, followed by Diptera with 335. Acari accounted for 223 of the total collected. Of the total specimens collected at sea, 798 were from the aerial nets, 242 from the Spinsect light trap, 241 from the MNIS, 49 from the suction trap and 26 were taken from the ship's deck. The Spinsect black light trap collected 498 specimens while the *Argo* was in port (TABLE 12). A total of 2267 specimens were collected during 1969-1970 on the *Argo* (TABLE 1-8 & 10). No concentrated effort was made to collect during ports of call; however, the MNIS was operated on 5 occasions while in port (TABLE 11). Of special interest are the results of the MNIS when started at the pier and operated while departing, at sea and entering ports. An indication of the capabilities of this device in areas of high insect densities is given in TABLE 11 as compared to results from areas with low insect densities (TABLE 3 & 7).

All insects collected aboard the *Gresham* are shown in TABLE 9.

Of the 1114 specimens taken from the nets, suction trap and MNIS while at sea, 499 were Homoptera, 223 Acari, 133 Diptera, 90 Araneida, 56 Hymenoptera, 20 Coleoptera, 21

Lepidoptera, 12 Thysanoptera, 11 Psocoptera, 10 Hemiptera, 1 Orthoptera, 1 Isoptera and 1 Strepsiptera. Of special interest is the recovery of 219 Acari (family Acaridae) from the MNIS while only 3 were taken from the nets and 1 from the suction trap.

During the periods 13.IV-3.V.1969 and 24.V-14.VI.1969, the U. S. C. G. C. *Gresham* (WHEC-387) was stationed on Ocean Station Victor. During these periods, a set of 8 trap nets was used continuously to sample the air for insects. These results are shown in TABLE 13. During this same time span, the *Argo* was transiting the area 450 to 600 km to the S and SW of Ocean Station Victor. Results of trap nets and MNIS for this collection period are shown in TABLE 14.

Four weather fronts were associated with the capture of specimens during the period 28.V-3.VI.1969. These included 3 cold fronts and a warm front associated with the 3rd cold front. The first 2 cold fronts were associated with rapidly moving cyclones which traveled from Japan to the area just N of Ocean Station Victor in 2 days. The position of the *Argo* 450 km SW of Ocean Station Victor resulted in both the *Argo* and the *Gresham* being passed by the first 2 cold fronts on the same days (27 and 29.V.1969). The capture of specimens on 28 and 30.V was closely related in distance from, and time after, passage of the frontal systems by both the *Argo* and *Gresham*. On 31.V.1969 another cyclone began a slower 3-day passage across the North Pacific to the area N of Ocean Station Victor. The *Argo*, then 670 km SW of Ocean Station Victor, passed through the slow-moving warm front associated with the cyclonic disturbance. One Acari was captured on that day. On 1.VI.1969 another Acari was captured. Negative results were recorded at Ocean Station Victor where the warm front was just passing. On 2.VI.1969 the *Argo* captured a microlepidopteran in the trap nets shortly after passage of the cold front. A massive gale center was developed from the cyclone and the cold front moved rapidly eastward, passing Ocean Station Victor on the same day; negative results were obtained with traps. On the day following passage of the cold front, 3.VI.1969, an aphid was captured in the trap nets on the *Argo* and a microlepidopteran on the *Gresham*.

In 8 of the 10 sample periods at Ocean Station Victor, the specimens were captured in moderate (12-20 knots) SW to NW winds on the day after passage of a frontal system. These fronts were associated with storm systems which had passed in the vicinity of Japan only 2-3 days prior to capture of specimens.

The major storm track in this area of the Pacific at the time was along a line crossing Okinawa to the SW, traveling NE along the southern coastline of Japan in the area of Tokyo Bay and heading ENE into the North Pacific, to pass some 550 km N of Ocean Station Victor. Occasionally a continental low system would come out of the Sino-Soviet area, cross the Sea of Japan and the N 1/2 of Honshu, then curve to the NE and pass 1400-2200 km N of Ocean Station Victor. These continental systems, while less frequent, usually developed into more severe disturbances than the more common oceanic low systems approaching from the SW Pacific.

While the 1000 mb (surface) winds varied considerably with passing pressure systems, the upper level streamlines remained quite stable, showing only minor fluctuations with the

TABLE 1. Results of suction trap and net trap sampling on the R/V *Argo*, May–July 1969, traveling Hawaii–Japan–Guam–Hawaii.

No.*	DATE 1969	WIND		STARTING		ENDING		APPROX. DIST NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
1S	11.V	040°	04kn	019°38.9' N	160°13.1' W	019°05.1' N	160°57.3' W	231 km S Niihau, Hawaiian Is	Psocoptera	1 Pseudocaeciliidae
3S	12.V	080°	10	018°27.0' N	161°57.0' W	016°38.6' N	164°45.5' W	556 km SW of Hawaiian Is	Coleoptera	1 Anthribidae
5N	13.V	063°	10	016°31.0' N	164°45.0' W	016°07.4' N	164°19.5' W	578 km E of Johnston Atoll	Isoptera	1 Kalotermitidae
13N	15.V	070°	20	017°56.0' N	167°16.0' W	019°17.2' N	168°59.7' W	241 km NE of Johnston Atoll	Lepidoptera	1 Geometridae
40N	2.VI	032°	09	032°26.5' N	157°21.0' E	032°02.0' N	156°17.5' E	926 km NNE of Marcus I	Lepidoptera	1 Microlepidoptera
43N	3.VI	135°	10	032°02.0' N	156°17.5' E	033°12.6' N	152°59.6' E	926 km N of Marcus I	Homoptera	1 Aphididae
50N	8.VI	009°	08	032°46.5' N	153°29.0' E	034°39.8' N	142°39.5' E	222 km SE of Inubo Saki	Diptera	2 no ID
52N	9.VI	—	—	034°48.0' N	141°47.0' E			20 km Nojima Saki, Japan	Diptera	2 Ceratopogonidae 7 Chironomidae
60N	16.VI	140°	12	034°00.0' N	139°16.0' E	032°00.0' N	138°45.0' E	28 km W of Miyake Jima	Diptera	1 Muscidae 1 Sciaridae 3 Sphaeroceridae 2 Aphididae
61S	16.VI	140°	12	034°00.0' N	139°16.0' E	032°00.0' N	138°45.0' E	28 km W of Miyake Jima	Homoptera Coleoptera	1 Coccinellidae
62N	16.VI	137°	12	032°00.0' N	138°45.0' E	030°09.2' N	140°00.0' E	28 km W of Tori Shima	Homoptera	1 Aphididae
65N	18.VI	230°	16	028°59.5' N	141°39.8' E	027°04.4' N	141°53.4' E	19 km S of Muko Shima Retto	Homoptera	1 Aphididae
66S	18.VI	217°	12	028°59.5' N	141°39.8' E	027°52.0' N	141°07.0' E	19 km S of Muko Shima Retto	Diptera	1 Phoridae
67S	18.VI	225°	14	027°52.0' N	141°07.0' E	026°11.0' N	142°07.0' E	46 km E of Nishina Shima	Acari Coleoptera	1 Uropodidae 1 Scolytidae
75N	22.VI	100°	19	018°31.6' N	141°46.0' E	018°11.3' N	141°20.0' E	444 km W of Marianas Is	Diptera	1 Sphaeroceridae
79N	24.VI	075°	20	017°59.0' N	141°05.0' E	017°49.0' N	142°22.2' E	389 km W of Marianas Is	Hymenoptera	1 no ID
83N	26.VI	075°	10	017°49.1' N	144°46.5' E	017°33.0' N	144°33.0' E	111 km W of Marianas Is	Hymenoptera	1 Agaontidae
84S	26.VI	075°	10	017°49.1' N	144°46.5' E	017°33.0' N	144°33.0' E	111 km W of Marianas Is	Diptera Hymenoptera	1 Sphaeroceridae 1 Agaontidae
103S	7.VII	081°	13	013°38.0' N	145°37.0' E	011°44.0' N	147°33.3' E	65 km E of Guam	Coleoptera	1 Scolytidae
115S	15.VII	094°	20	009°21.0' N	165°40.9' E	009°38.2' N	168°41.9' E	9 km N of Kwajalein Atoll	Diptera	1 Muscidae

118S	18.VII	051°	18	009°39.9' N	179°36.5' E	009°20.0' N	179°58.0' E	945 km ENE of Majuro Atoll	Diptera	1 no ID
119S	18.VII	075°	22	009°20.0' N	179°58.0' E	009°24.8' N	179°49.9' E	945 km ENE of Majuro Atoll	Psocoptera	1 no ID
127N	25.VII	068°	11	015°31.0' N	169°30.0' W	020°00.0' N	160°43.0' W	111 km SE of Johnston I	Psocoptera	1 no ID
128N	25.VII	070°	17	020°00.0' N	160°43.0' W	020°29.0' N	159°38.0' W	167 km S of Kauai	Hemiptera	1 Lygaeidae

*Sequential sample taken from the devices. S = suction trap; N = nets.

TABLE 2. Results from MNIS on the R/V *Argo*, May–July 1969.

TIME ± 3 hr	DATE 1969	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
0300	17.V	080°	10kn	—	—	019°15.0' N	169°06.0' W	278 km N of Johnston Atoll	Acari	6 Acaridae
1500	17.V	065°	22	019°34.5' N	170°06.0' W	020°14.5' N	171°03.0' W	407 km NW of Johnston Atoll	Acari	3 Acaridae
2100	17.V	—	—	020°14.5' N	171°03.0' W	—	—	407 km NW of Johnston Atoll	Acari	7 Acaridae
0300	18.V	065°	15	—	—	021°29.5' N	173°26.0' W	527 km S of Laysan and Lisianski I	Acari	9 Acaridae
1500	18.V	093°	16	022°01.2' N	174°23.9' W	022°37.5' N	175°30.0' W	407 km SW of Lisianski I	Acari	5 Acaridae
2100	18.V	090°	09	022°37.5' N	175°30.0' W	—	—	407 km SW of Lisianski I	Acari	3 Acaridae
0900	19.V	300°	04	023°50.0' N	177°29.2' W	024°12.0' N	178°10.9' W	453 km S of Midway Is	Acari	3 Acaridae
1500	19.V	300°	04	024°12.0' N	178°10.9' W	024°12.4' N	178°52.8' W	472 km S of Kure I	Acari	5 Acaridae
2100	19.V	calm		024°12.4' N	178°52.8' W	—	—	472 km S of Kure I	Acari	5 Acaridae
1500	20.V	303°	07	024°18.2' N	178°18.1' W	024°16.0' N	178°51.0' W	472 km S of Kure I	Acari	3 Acaridae
2100	20.V	calm		024°16.0' N	178°51.0' W	—	—	472 km S of Kure I	Acari	2 Acaridae
1500	21.V	060°	14	024°09.1' N	178°38.0' W	024°08.4' N	178°31.3' W	472 km S of Kure I	Acari	2 Acaridae
1500	25.V	231°	10	028°54.5' N	169°00.7' E	028°57.0' N	169°48.0' E	1093 km NNE of Wake I	Acari	1 Acaridae
1500	28.V	270°	12	032°23.5' N	158°13.0' E	032°20.8' N	156°56.8' E	926 km NNE of Marcus I	Acari	11 Acaridae
2100	30.V	310°	10	032°15.2' N	159°15.8' E	—	—	1056 km NNE of Marcus I	Acari	1 Acaridae

TABLE 2 (continued).

TIME ± 3 hr	DATE 1969	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
1500	31.V	171°	12 kn	031°56.2' N	157°07.8' E	031°43.5' N	156°33.5' E	880 km NNE of Marcus I	Acari	1 Acaridae
0900	1.VI	217°	18	032°28.0' N	158°18.0' E	032°56.6' N	157°48.8' E	1056 km NNE of Marcus I	Acari	1 Acaridae
0900	4.VI	130°	15	033°11.0' N	153°14.0' E	033°20.0' N	152°58.3' E	1000 km NNW of Marcus I	Acari	3 Acaridae
2100	6.VI	198°	20	033°45.0' N	151°09.5' E	—	—	1083 km E of Hachijo Jima	Acari	2 Acaridae
0900	7.VI	207°	31	034°06.1' N	148°43.2' E	034°16.3' N	147°29.9' E	639 km ESE of Inubo Saki	Acari	2 Acaridae
2100	7.VI	202°	18	034°21.5' N	146°16.8' E	—	—	527 km ESE of Inubo Saki	Acari	11 Acaridae
0300	8.VI	—	—	—	—	034°21.7' N	144°02.4' E	333 km ESE of Inubo Saki	Acari	7 Acaridae
1500	15.VI	136°	15	034°57.5' N	139°37.0' E	034°00.0' N	139°16.0' E	37 km SW of Miyake Jima	Homoptera Acari	1 Aphididae 3 Acaridae
2100	16.VI	152°	13	030°09.2' N	140°00.0' E	—	—	37 km SW of Tori Shima	Acari	2 Acaridae
0900	18.VI	223°	14	027°04.4' N	141°53.4' E	027°52.0' N	141°07.0' E	74 km NNE of Nishino Shima	Acari	3 Acaridae
2100	22.VI	100°	16	018°11.3' N	141°20.0' E	—	—	474 km W of Mariana Is	Acari	2 Acaridae
0300	25.VI	090°	15	—	—	017°47.0' N	143°44.0' E	222 km W of Pagan I	Acari	2 Acaridae
0900	26.VI	099°	09	017°39.5' N	144°52.6' E	017°33.0' N	144°19.3' E	167 km W of Mariana Is	Acari	8 Acaridae
1500	26.VI	094°	08	017°33.0' N	144°19.3' E	017°33.0' N	144°33.0' E	167 km W of Mariana Is	Acari	5 Acaridae
0300	27.VI	097°	09	—	—	017°24.0' N	144°40.0' E	167 km W of Mariana Is	Acari	26 Acaridae
2100	28.VI	070°	17	016°45.5' N	146°35.5' E	—	—	56 km E of Mariana Is	Acari	2 Acaridae
1500	9.VII	156°	17	—	—	009°31.5' N	151°24.0' E	69 km N of Namonuito Atoll	Acari	1 Acaridae
2100	15.VII	070°	21	009°42.5' N	169°48.2' E	—	—	28 km NW of Wotje Atoll	Acari	2 Acaridae
1500	17.VII	064°	20	009°32.9' N	176°43.5' E	009°34.0' N	177°40.0' E	713 km NE of Majuro Atoll	Acari	5 Acaridae
0900	18.VII	077°	17	009°39.9' N	179°36.5' E	009°29.0' N	179°47.2' E	834 km NE of Majuro Atoll	Acari	2 Acaridae

TABLE 3. Results from the Spinsect light trap aboard the R/V *Argo*, May-July 1969.

No.*	DATE 1969	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
42L	3.VI	230°	06 kn	032°06.7' N	156°04.5' E	033°02.7' N	154°07.8' E	945 km N of Marcus I	Diptera	2 Chloropidae 2 Sphaeroceridae
48L	6.VI	198°	20	033°17.7' N	153°44.2' E	033°45.0' N	151°09.5' E	1000 km N of Marcus I	Lepidoptera Psocoptera Diptera	1 Microlepidoptera 1 Liposcelidae 1 Chloropidae
53L	9.VI			034°48.0' N	141°47.0' E	Mouth of Tokyo Bay		10 km off Nojima Saki, Japan	Diptera	1 Chloropidae
59L	16.VI	140°	12	034°00.0' N	139°16.0' E	032°00.0' N	138°45.0' E	28 km W of Miyake Jima	Diptera	1 Chironomidae 1 Muscidae
76L	23.VI	117°	14	018°11.3' N	141°20.0' E	018°20.0' N	141°15.0' E	472 km W of Mariana Is	Coleoptera	1 Tenebrionidae
82L	26.VI	085°	12	017°49.1' N	144°46.5' E	017°39.5' N	144°52.6' E	111 km W of Alamagan I	Coleoptera	1 Anobiidae
87L	28.VI	064°	14	017°10.6' N	144°50.7' E	017°01.0' N	145°37.4' E	40 km NW of Surigan I	Coleoptera	2 Anobiidae
101L	6.VII	040°	15	013°25.0' N	145°40.0' E	013°38.0' N	145°37.0' E	56 km E of Guam	Diptera	1 Sphaeroceridae
104L	7.VII	071°	16	013°37.0' N	145°37.0' E	011°08.0' N	148°28.5' E	56 km E of Guam	Diptera	1 Tephritidae
110L	11.VII	180°	03	009°58.0' N	151°30.0' E	009°06.9' N	152°55.1' E	67 km NE of Hall Is	Diptera	1 Sphaeroceridae
125L**	25.VII	068°	11	018°49.6' N	162°51.2' W	020°00.0' N	160°43.0' W	195 km SSW of Niihau	Diptera	2 Chloropidae
126L***	25.VII	068°	11	018°49.6' N	162°51.2' W	020°00.0' N	160°43.0' W	195 km SSW of Niihau	Coleoptera	2 Anobiidae

*See footnote of Table 1; L = light trap.

**From carpenter's shop.

***From hatch cover area.

TABLE 4. Miscellaneous collections made on board the R/V *Argo* from the deck, May-July 1969.

No.*	DATE		LAT.	LONG.	APPROX. DIST. NEAREST LAND	ORDER	FAMILY
69D	19.VI	Caught on deck	025°00.0' N	142°15.0' E	102 km E of Volcano Is	Coleoptera	1 Coccinellidae
85D	27.VI		017°33.0' N	144°33.0' E	158 km W of Alamagan I	Diptera	1 Muscidae
102D	7.VII		011°44.0' N	147°33.0' E	352 km SE of Guam	Coleoptera	1 Cleridae
129D	26.VII	Found dead on bulkhead			51 km SW of Barbers Pt, Oahu, Hawaii	Isoptera	1 Kalotermitidae

*See footnote of Table 1. D = deck.

TABLE 5. Results of suction trap and net sampling on the R/V *Argo*, October 1969–February 1970, traveling Tahiti–Panama–Mexico–San Diego.

No.*	DATE	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
2S	1969 20.X	090°	12kn	014°27.8'S	144°18.0'W	012°10.0'S	141°01.0'W	56 km E of King George Is	Coleoptera	1 Scolytidae
8S	23.X	110°	14	006°25.0'S	136°00.7'W	006°28.3'S	136°13.9'W	472 km NE of Huahine I, Marquesas Is	Coleoptera	1 Anthribidae
19S	29.X	160°	09	012°14.7'S	134°20.0'W	016°25.4'S	132°59.1'W	612 km NE of Reao Is, Tuamotu Arch.	Diptera	1 Sphaeroceridae
29S	4.XI	095°	25	012°27.3'S	135°32.3'W	023°16.9'S	135°05.7'W	9 km S of Mangareva, Tuamotu Arch.	Diptera	No ID, wing fragments
35S	6.XI	215°	05	027°54.8'S	138°44.1'W	029°04.2'S	140°12.3'W	348 km SE of Islots de Bass	Hemiptera	1 Miridae
40S	9.XI	100°	15	023°34.3'S	141°08.3'W	024°52.8'S	143°29.1'W	222 km SSW of Tematangi I, Tuamotu Arch.	Diptera	No ID, fragments
45S	12.XI	120°	18	020°15.9'S	147°38.5'W	018°36.1'S	148°31.2'W	111 km SE of Tahiti, Society Is	Coleoptera	1 Tenebrionidae
48N	18.XI	075°	07	017°14.0'S	149°20.0'W	014°28.5'S	146°32.0'W	19 km E of Rangiroa Atoll & Ane Atoll, Tuamotu Arch.	Homoptera	1 Aphididae
81N	12.XII	140°	10	002°56.0'N	099°15.8'W	003°44.6'N	099°34.3'W	963 km NW of Galapagos Is	Arachnida	1
86N	15.XII	120°	10	004°01.8'N	096°21.5'W	004°10.0'N	095°38.5'W	527 km W of Galapagos Is	Arachnida Lepidoptera	1 No ID, wing fragments
91N	18.XII	130°	04	004°10.0'N	095°38.5'W	006°14.3'N	084°50.5'W	19 km N of Cocos Is	Arachnida Homoptera	9 19 Aphididae 12 Delphacidae
92N	18.XII	light airs		006°14.3'N	084°50.5'W	006°28.0'N	083°50.0'W	204 km SW of Panama Coast	Arachnida	3
93N	19.XII	300°	08	006°28.0'N	083°50.0'W	006°56.4'N	081°00.0'W	32 km S of Pt Marieto, Panama	Arachnida Homoptera	1 17 Aphididae 4 Delphacidae
95N	19.XII	light airs		006°56.4'N	081°00.0'W	007°01.8'N	080°08.0'W	32 km S of Pt Marieto, Panama	Diptera Homoptera Hymenoptera	4 Cecidomyiidae 3 Aphididae 1 Delphacidae 1 Pteromalidae

98N	20.XII	320°	18	007°01.8' N	080°08.0' W	008°18.5' N	079°26.5' W	19 km E of Pt Marieto, Panama	Arachnida Coleoptera Diptera Hemiptera Homoptera Hymenoptera	12 Aranea 1 Scolytidae 5 Tenebrionidae 21, no ID 2 Miridae 10 Aphididae 1 Cicadellidae 8 Delphacidae 1 Formicidae 2 Ichneumonidae
99S	20.XII	320°	18	007°01.8' N	080°08.0' W	008°18.5' N	079°26.5' W	19 km E of Pt Marieto, Panama	Arachnida Diptera Homoptera	1 1 Syrphidae 1 Aphididae
111S	31.XII	180°	06	007°39.0' N	079°50.4' W	005°35.6' N	083°06.9' W	Balboa Harbor	Coleoptera Diptera Homoptera	1 Coccinellidae 1 Simuliidae 2 Cicadellidae 1 Delphacidae
112N	31.XII (1800)	180°	06	005°42.0' N	082°56.4' W	005°35.6' N	083°06.9' W	241 km SW of Isla Coiba	Arachnida Homoptera	1 spiderling 2 Aphididae 1 Delphacidae
114N	1970 1.I (1200)	170°	13	005°35.6' N	083°06.9' W	004°07.9' N	084°50.2' W	278 km SE of Cocos I	Arachnida Homoptera Hymenoptera	23 spiderlings 4 Delphacidae 1 no ID, fragments
115N	1.I (1800)	210°	08	04°07.9' N	084°50.2' W	03°59.0' N	085°39.0' W	222 km SE of Cocos I	Arachnida	4
118N	2.I (1800)	205°	08	03°59.0' N	085°39.0' W	03°21.5' N	085°52.5' W	231 km SE of Cocos I	Lepidoptera Arachnida	1 Geometridae 3
120N	3.I (1200)	185°	12	03°21.5' N	080°52.5' W	02°02.5' N	086°00.0' W	333 km SSE of Cocos I	Arachnida	3
123S	3.I (1800)	190°	10	03°59.0' N	085°39.0' W	01°30.0' N	086°10.0' W	222 km SSE of Cocos I	Coleoptera	1 Bruchidae
124N	4.I (1200)	170°	10	02°02.5' N	086°00.0' W	00°39.7' N	086°08.3' W	389 km ENE of Galapagos Is	Arachnida	4
129N	6.I (1800)	170°	10	00°39.7' N	086°08.3' W	01°35.9' S	086°33.5' W	333 km E of Galapagos Is	Lepidoptera Homoptera Arachnida	1 Geometridae 1 Agalliidae 7
130N	7.I (1800)	155°	10	01°35.9' S	086°33.5' W	04°58.2' S	088°10.8' W	333 km SE of Galapagos Is	Arachnida	1
133N	8.I (1800)	125°	15	04°58.2' S	088°00.8' W	08°00.0' S	089°11.0' W	575 km SSE of Galapagos Is	Arachnida Psocoptera	1 1 Liposcelidae
135S	8.I (1800)	125°	15	00°36.2' N	086°06.0' W	08°00.0' S	089°11.0' W	333 km E of Galapagos Is	Psocoptera	1 Liposcelidae
147S	14.I (1800)	130°	16	07°28.0' S	102°38.0' W	06°50.0' S	105°54.5' W	1519 km SW of Galapagos Is.	Diptera (Nematocera) Psocoptera	1 Liposcelidae

TABLE 5 (continued).

No.*	DATE	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
164S	24.I	060°	13 kn	08°06.9' N	113°55.7' W	10°13.2' N	110°29.0' W	1204 km to NE	fragments	? no ID
167N	27.I	025°	12	12°03.2' N	108°01.3' W	12°22.5' N	102°23.7' W	278 km to NE	Homoptera	1 Delphacidae
169S	27.I	330°	08	14°11.3' N	104°19.8' W	16°34.0' N	100°20.0' W	74 km to NE	fragment (? wing)	
170N	28.I			16°34.0' N	100°20.0' W			19 km from Acapulco	Homoptera	1 Aphididae
173N	1.II	250°	12			16°52.5' N	101°07.5' W	19 km off Acapulco	Hemiptera Hymenoptera Homoptera Thysanoptera	1 Miridae 1 Chalcidoidea 2 Aphididae 2 ?
176N	2.II	340°	14	16°52.5' N	101°07.5' W	16°40.5' W	103°53.0' W	222 km NE to Mexico	Hemiptera Homoptera	1 3 Aphididae
177N	2.II	335°	10	16°40.5' N	103°53.0' W	15°56.4' N	106°11.0' W	389 km NE to Mexico	Homoptera	3 Aphididae
182N	4.II	light airs		14°53.2' N	109°13.0' W	17°01.0' N	106°58.0' W	315 km NE to Mexico	Homoptera	1 Aphididae
184S	4.II	light airs		14°53.2' N	109°13.0' W	17°01.0' N	106°58.0' W	315 Km NE to Mexico	Diptera	2 Sphaeroceridae 1 Drosophilidae
186N	5.II	095°	08	18°21.5' N	105°14.6' W	Off Manzanillo, Mexico		22 km off Manzanillo	Homoptera Diptera	1 2 Chironomidae
188S	5.II	095°	08	18°21.5' N	105°14.6' W	Off Manzanillo, Mexico		22 km off Manzanillo	Diptera	1 Otitidae 6 Phoridae
190S	6.II	015°	12	18°37.5' N	104°07.8' W	16°55.9' N	107°03.0' W	389 km NE to Mexico	Hymenoptera Diptera	1 Pteromalidae 2 Otitidae 1 Culicidae
191S	7.II	050°	12	16°55.9' N	107°03.0' W	16°25.0' N	109°35.0' W	556 km NE to Mexico	Hymenoptera Coleoptera	1 Anthribidae
195S	9.II	055°	22	15°53.8' N	111°46.2' W	14°54.6' N	111°12.5' W	834 km NE to Mexico	Diptera	1 Sphaeroceridae
196N	10.II	080°	6	14°54.6' N	111°12.5' W	15°55.0' N	107°55.0' W	500 km NE to Mexico	Homoptera	1 fragment
197N	11.II	300°	10	15°55.0' N	107°55.0' W	16°57.0' N	104°19.8' W	167 km NE to Mexico	Lepidoptera	1 wing fragment
199N	12.II	304°	15	16°57.0' N	104°19.8' W	17°29.8' N	102°29.6' W	74 km NE to Mexico	Lepidoptera	3 no ID
200N	12.II	325°	17	17°29.8' N	102°29.6' W	17°40.0' N	105°16.0' W	167 km NE to Mexico	Diptera Homoptera Lepidoptera	2 3 Aphididae 1 1 fragment 1 unident.

201N	13.II	340°	14	17°40.0'N	105°16.0'W	17°42.1'N	107°19.6'W	296 km NE to Mexico	Hymenoptera	1 Chalcidoidea, no ID fragment
205N	14.II	320°	13	17°40.1'N	108°52.7'W	19°50.5'N	107°06.3'W	296 km ENE to Mexico	Homoptera	1 Aphididae 2 Aleyrodidae 1 larva 2 fragments
207N	15.II	150°	4	19°50.5'N	107°06.3'W	20°37.0'N	105°21.0'W	19 km E to Mexico	Arachnida Diptera	2 Cecidomyiidae 16 Aphididae
208N	15.II	000°	9	20°37.0'N	105°21.0'W	20°40.0'N	106°29.0'W	111 km E to Mexico	Diptera	3 Phoridae 5 Chromonidae 3 Ceratopogonidae 2 Cecidomyiidae 6 no ID possible 5 Pteromalidae 5 Braconidae 4 Mymaridae 1 Ichneumonidae 1 Torymidae 2 Agaonidae 8 Chalcidoidea (fragmented)
									Hymenoptera	27 unident. (fragmented)
									Homoptera	19 Aphididae 1 Psyllidae 1 Cicadellidae 3 Miridae 6
									Hemiptera Arachnida Coleoptera Psocoptera Thysanoptera	1 no ID possible 3 Pseudocacchiidae 8 Thripidae 1 unident. ? fragments
209S	15.II	000°	9	20°37.0'N	105°21.0'W	20°40.0'N	106°29.9'W	111 km E to Mexico	Diptera	1 Chloropidae 1 Cecidomyiidae
210N	16.II	290°	14	20°50.0'N	106°29.0'W	23°15.0'N	110°53.0'W	56 km NE to Baja Peninsula, Mexico	Homoptera	28 Cicadellidae 13 Aphididae 205 Aleyrodidae 1 Platygastridae 1 Braconidae 1 Mymaridae 2 Encyrtidae 2 Cecidomyiidae
212S	16.II	290°	14	20°40.0'N	106°29.0'W	23°15.0'N	110°53.0'W	56 km NE to Baja Peninsula, Mexico	Diptera Thysanoptera Hymenoptera Diptera	1 Phoridae 1, not found 1 Pteromalidae 1 Phoridae

TABLE 5 (continued).

No.*	DATE	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
213N	17.II	322°	8kn	23°15.0' N	110°53.0' W	24°54.9' N	112°48.8' W	74 km E to Baja Peninsula, Mexico	Lepidoptera Diptera Homoptera	1 Noctuidae 2 Ctenuchidae 1 Chironomidae 8 Cicadellidae 10 Aphididae ? fragments
214N	17.II	330°	13	24°54.9' N	112°48.8' W	26°05.7' N	113°47.8' W	74 km N to Baja Peninsula, Mexico	Lepidoptera	1, wings missing, no ID
215S	17.II	320°	22	23°15.0' N	110°53.0' W	26°59.0' N	114°35.0' W	19 km E to Baja Peninsula, Mexico	Unidentified	1 fragment, no ID
216N	18.II	340°	28	26°05.7' N	113°47.8' W	31°00.0' N	116°31.5' W	28 km E to Baja Peninsula, Mexico	Psocoptera Thysanoptera Coleoptera Diptera Hymenoptera Homoptera Acarina	1 1 Thripidae 1 Coccinellidae 1 no ID 4 Pteromalidae 2 no ID 5 unident, no ID 3 oribatids ? fragments ? fragments, no ID
217N	19.II					Off Pt Loma		San Diego		? fragments, no ID

*See footnote of Table 1. S = suction trap ; N = nets.

TABLE 6. Results from the MNIS aboard the R/V *Argo*, October 1969–February 1970.

TIME	DATE	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
	1969									
12–										
1800	18.XII	light	airs	05°59.0' N	086°06.0' W	06°14.3' N	084°50.5' W	107 km ENE of Cocos Is	Acarina	2
1800	18.XII	130°	04kn	—	—	06°14.3' N	084°50.5' W	248 km ENE of Cocos Is	Acarina	3
0000	19.XII	light	airs	—	—	06°28.0' N	083°50.0' W	198 km SW of Gulfo Dulce	Acarina Lepidoptera	44 1 Sphingidae
0600	19.XII	light	airs	—	—	06°43.0' N	082°45.0' W	135 km SW of Isla Coiba, Panama	Acarina	3

1200	19.XII	light airs	—	—	06°46.0'N	082°05.0'W	74 km SW of Isla Coiba, Panama	Diptera	2
1800	19.XII	300°	08	—	07°00.0'N	080°53.0'W	26 km S of Punta Manato, Panama	Diptera	1 Syrphidae
0000	20.XII	light airs	—	—	07°15.0'N	080°00.0'W	30 km SSE of Punta Mala, Panama	Diptera	2, sample not found
1200	20.XII	320°	18	—	08°19.0'N	079°25.0'W	28 km S of Balboa, Panama	Hymenoptera	2 Formicidae
1800	20.XII	300°	15	—	08°42.0'N	079°45.0'W	Anchored outside Balboa Harbor	Hymenoptera Strepsiptera Diptera	3 Formicidae 1 2
0000	31.XII	000°	08	—	07°14.0'N	079°50.0'W	30 km SSE of Punta Mala, Panama	Lepidoptera Diptera	5 Sphingidae 1 Amathusidae 2 Syrphidae
0000	12.I	150°	14	—	08°54.0'S	095°48.0'W	1003 km SW of Galapagos Is	Acarina	1
12-1800	19.I	115°	13	05°05.0'S	03°15.0'S	113°53.0'W	2501 km W of Galapagos Is 1547 km SSW of Clipperton	Hymenoptera	1 Trichogrammatidae
1800	20.I	115°	14	—	01°10.0'N	113°56.0'W	2501 km W of Galapagos Is 1140 km SSW of Clipperton	Acarina	1
1800	21.I	130°	18	—	02°05.0'N	113°54.0'W	2500 km W of Galapagos Is 1028 km SW of Clipperton	Acarina	1
23.I	23.I	100°	17	06°00.0'N	07°45.0'N	113°55.0'W	556 km SW of Clipperton	Acarina	1
25.I	25.I	045°	15	10°15.0'N	112°00.0'N	107°45.0'W	65 km NW of Clipperton	Acarina	1

times and dates approximate due to trap malfunctions

TABLE 7. Results from the Spinsect light trap aboard the R/V *Argo*, October 1969–February 1970.

No.*	DATE	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
	1969									
3L	20.X	090°	12kn	14°27.8'S	144°18.0'W	12°10.0'S	141°01.0'W	56 km E of King George Is	Diptera	1 Muscidae
5L	21.X	090°	14	12°10.0'S	141°01.0'W	10°59.0'S	139°23.3'W	102 km SW of Fatuhiva Is	Diptera	2 Sphaeroceridae
9L	23.X	100°	16	06°25.0'S	136°00.7'W	06°15.5'S	136°38.3'W	472 km NE of Huahuna Is	Diptera	4 Sphaeroceridae
12L	25.X	070°	16	06°34.0'S	136°06.1'W	10°25.2'S	135°51.8'W	392 km NE of Fatuhiva Is	Diptera Coleoptera	3 Sphaeroceridae 1 Tenebrionidae
20L	29.X	160°	09	12°14.7'S	134°20.0'W	16°25.4'S	132°59.1'W	612 km NE of Reao Is	Diptera	8 Sphaeroceridae
24L	31.X	200°	08	20°16.2'S	131°38.5'W	22°20.0'S	130°36.0'W	139 km N of Oeno Is	Diptera	3 Sphaeroceridae
27L	2.XI								Diptera	4 Chloropidae 4 Sphaeroceridae
28L	3.XI	105°	25	Near Pitcairn Island		24°27.3'S	135°32.3'W	65 km off Pitcairn I	Diptera	6 Chloropidae
31L	5.XI	315°	10	24°05.7'S	135°51.9'W	27°54.8'S	138°44.1'W	139 km SW of Mangareva Is	Diptera	4 Chloropidae 1 Sphaeroceridae
34L	6.XI	215°	05	27°54.8'S	138°44.1'W	29°04.2'S	140°12.3'W	342 km SE of Islots de Bass	Diptera	4 Chloropidae
36L	7.XI	210°	09	29°04.2'S	140°12.3'W	27°54.2'S	140°36.3'W	278 km E of Islots de Bass	Diptera	1 Sphaeroceridae
38L	9.XI	100°	15	23°34.3'S	141°08.3'W	24°52.8'S	143°29.1'W	213 km SW of Tematangi Is	Diptera	1 Sphaeroceridae 3 Chloropidae
49L	18.XI	075°	07	17°14.0'S	149°20.0'W	14°28.5'S	146°32.0'W	19 km E of Rangiroa Atoll	Diptera	2
55L	22.XI	105°	14	05°16.1'S	138°29.5'W	02°25.1'S	135°46.6'W	389 km NE of Eiao Is	Hymenoptera Diptera Coleoptera	1 Braconidae 1 Sphaeroceridae 1 Tenebrionidae
59L	24.XI	135°	10	00°23.0'N	133°21.0'W	00°26.9'N	133°18.8'W	1222 km NE of Marquesas Is	Hymenoptera	3 Pteromalidae
61L	25.XI	120°	21	00°26.9'N	133°18.8'W	02°31.5'N	132°01.5'W	" "	Hymenoptera	1 Pteromalidae
64L	27.XI	140°	12	03°12.1'N	130°19.6'W	02°46.9'N	130°06.5'W	1667 km NE of Marquesas Is	Diptera	4 Sphaeroceridae
67L	28.XI	120°	11	02°46.9'N	130°06.5'W	02°26.8'N	129°39.6'W	" "	Diptera Hymenoptera	1 Sphaeroceridae 1 Eulophidae
69L	29.XI	160°	14	02°26.8'N	129°39.6'W	02°25.7'N	126°22.6'W	" "	Diptera	3
71L	1.XII	130°	16	02°25.3'N	122°53.7'W	02°40.5'N	121°42.5'W	1723 km SW of Clipperton	Coleoptera	1 Tenebrionidae

73L	3.XII	175°	16	03°10.8' N	119°49.6' W	03°26.5' N	116°07.7' W	1139 km SW of Clipperton	Diptera Lepidoptera (microlepidoptera)	1 Sphaeroceridae 1
76L	6.XII	180°	14	02°56.0' N	108°09.8' W	02°30.4' N	107°30.6' W	815 km SSE of Clipperton	Coleoptera	1
84L	13.XII	130°	11	03°44.6' N	099°34.3' W	04°01.8' N	096°21.5' W	583 km NW of Galapagos Is	Coleoptera	1 Tenebrionidae
87L	15.XII	120°	10	04°12.5' N	095°33.7' W	04°10.0' N	095°38.5' W	481 km NW of Galapagos Is	Diptera	1
88L	16.XII	070°	10	04°10.0' N	095°38.5' W	05°00.0' N	091°53.0' W	407 km N of Galapagos Is	Diptera	1 wing fragment, no ID
89L	17.XII	light airs		05°00.0' N	091°53.0' W	05°26.0' N	088°01.0' W	120 km W of Cocos Is	Coleoptera Diptera	1 Tenebrionidae 1 Sphaeroceridae
97L	19.XII	light airs		06°28.0' N	083°50.0' W	07°01.8' N	080°08.0' W	22 km S of Punta Manato, Panama	Diptera	1 Sphaeroceridae
107L	31.XII	307°	06	07°29.0' N	079°50.4' W	06°18.4' N	081°59.5' W	28 km E of Punta Manato, Panama	Diptera Coleoptera Hymenoptera Orthoptera Homoptera	15 Sphaeroceridae, Sciariidae 1 Tenebrionidae 2 Elasmidae 1 Gryllidae 1 Cicadellidae
	1970									
116L	1.I	210°	08	04°40.4' N	084°08.4' W	03°59.0' N	085°39.0' W	222 km SE of Cocos Is	Hymenoptera	1 Braconidae
119L	2.I	205°	08	03°59.0' N	085°39.0' W	03°21.5' N	085°52.5' W	231 km SE of Cocos Is	Diptera Hymenoptera	3 Sphaeroceridae 1 Pteromalidae
122L	3.I	190°	10	03°21.5' N	085°52.5' W	01°30.0' N	086°10.0' W	416 km NE of Galapagos Is	Diptera	5 Sphaeroceridae
125L	4.I	180°	12	01°30.0' N	086°10.0' W	00°26.2' N	086°06.0' W	370 km NE of Galapagos Is	Diptera	6 Sphaeroceridae
128L	5.I	170°	15	00°36.2' N	086°06.0' W	00°56.0' N	086°12.5' W	371 km NE of Galapagos Is	Diptera	3 Sphaeroceridae
131L	7.I	155°	10	01°35.9' S	086°33.5' W	04°58.2' S	088°10.8' W	333 km SE of Galapagos Is	Diptera	3 Sphaeroceridae
134L	8.I	125°	15	04°58.2' S	088°00.8' W	08°00.0' S	089°11.0' W	575 km SSE of Galapagos Is	Diptera	5 Sphaeroceridae
136L	9.I	140°	15	08°00.0' S	089°11.0' W	10°03.2' S	090°15.0' W	723 km SSE of Galapagos Is	Diptera	8 Sphaeroceridae 2 Culicidae
138L	10.I	140°	13	10°03.0' S	090°15.0' W	09°13.8' S	093°56.6' W	945 km S of Galapagos Is	Diptera	2 Sphaeroceridae
140L	11.I	150°	14	09°32.6' S	092°32.6' W	08°49.8' S	095°58.2' W	963 km SW of Galapagos Is	Diptera	2 Sphaeroceridae

TABLE 7 (continued).

No.*	DATE	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
	1970									
143L	12.I	120°	15 kn	08°49.8'S	095°58.2' W	08°08.2' S	099°11.7' W	1000 km SW of Galapagos Is	Diptera	2 Sphaeroceridae
144L	13.I	140°	16	08°08.2'S	099°11.7' W	07°28.0' S	102°38.0' W	1278 km SW of Galapagos Is	Diptera	4 Sphaeroceridae
146L	14.I	130°	16	07°28.0'S	102°38.0' W	06°50.0' S	105°54.5' W	1519 km SW of Galapagos Is	Diptera	6 Sphaeroceridae
148L	15.I	120°	09	06°50.0'S	105°54.5' W	06°18.9' S	108°13.0' W	1704 km WSW of Galapagos Is	Diptera	7 Sphaeroceridae
149L	16.I	130°	12	06°18.9'S	108°13.0' W	05°37.5' S	111°28.8' W	1945 km WSW of Galapagos Is	Diptera	3 Sphaeroceridae
150L	17.I	120°	13	05°37.5'S	111°28.8' W	04°39.7' S	114°04.9' W	2240 km WSW of Galapagos Is	Diptera	4 Sphaeroceridae
152L	18.I	130°	15	04°39.7'S	114°04.9' W	02°08.9' S	113°57.5' W	2556 km NE to Acapulco, Mexico	Diptera Psocoptera	8 Sphaeroceridae 1 Caeciliidae
155L	19.I	125°	13	02°08.9'S	113°57.5' W	01°00.0' N	114°00.0' W	2222 km NE to Mexico	Diptera	2 Sphaeroceridae
157L	20.I	120°	13	01°00.0' N	114°00.0' W	01°29.7' N	113°48.6' W	2130 km NE to Mexico	Diptera	1 Sphaeroceridae
158L	21.I	130°	13	01°29.7' N	113°48.6' W	03°01.0' N	114°00.0' W	2000 km NE to Mexico	Diptera	3 Sphaeroceridae
159L	22.I	105°	11	03°01.0' N	114°00.0' W	06°13.1' N	113°58.7' W	1760 km NE to Mexico	Diptera	1 Sphaeroceridae
162L	23.I	100°	17	06°13.1' N	113°58.7' W	08°06.9' N	113°55.7' W	1556 km NE to Mexico	Diptera Coleoptera	1 Sphaeroceridae 1 Tenebrionidae
163L	24.I	060°	13	08°06.9' N	113°55.7' W	10°13.2' N	110°29.0' W	1204 km NE to Mexico	Diptera	2 Sphaeroceridae
166L	25.I	045°	12	10°13.2' N	110°29.0' W	12°03.2' N	108°01.3' W	852 km NE to Mexico	Coleoptera	2 Tenebrionidae
171L	28.I			16°34.0' N	100°20.0' W	19 km off Acapulco, Mexico			Homoptera Psocoptera	5 Aphididae 1 Pseudocaeciliidae
174L	1.II	250°	12	19 km off Acapulco		16°52.5' N	101°07.5' W	19 km E to Acapulco Mexico	Lepidoptera	1 Noctuidae
178L	2.II	335°	10	16°52.5' N	101°07.5' W	15°56.4' N	106°11.0' W	389 km NE to Mexico	Diptera Coleoptera Unident.	1 Drosophilidae 1 Chironomidae 2 Anobiidae 1
183L	4.II	light airs		14°53.2' N	109°13.0' W	17°01.0' N	106°58.0' W	315 km NE to Mexico	Diptera	1 Sphaeroceridae
194L	9.II	055°	22	15°53.8' N	111°46.2' W	14°54.6' N	111°12.5' W	834 km NE to Mexico	Diptera	1 Sphaeroceridae

198L	11.II	300°	10	15°55.0'N	107°55.0'W	16°57.0'N	104°19.8'W	167 km NE to Mexico	Diptera	2 Sphaeroceridae
202L	13.II	340°	14	17°40.0'N	105°16.0'W	17°42.1'N	107°19.6'W	296 km NE to Mexico	Coleoptera Diptera	1 Tenebrionidae 1 Sphaeroceridae
211L	16.II	290°	14	20°40.0'N	106°29.0'W	23°15.0'N	110°53.0'W	56 km NE to Mexico	Diptera	2 Ephydriidae 1 Chironomidae 1 Agromyzidae 1 Cecidomyiidae

*See footnote of Table 1. L = light trap.

TABLE 8. Miscellaneous collections made on the R/V *Argo* from deck-and food, September 1969-February 1970.

NO.*	DATE	WIND		LAT.	LONG.	APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.					
15F	27.X							
17D	28.X	light airs		12°25.0'S	134°09.0'W	575 km NE of Pukapuka I	Coleoptera	1 Dermestidae
21D	30.X	200°	10kn	19°14.3'S	132°00.0'W	444 km NE of Marutea Atoll	Diptera	1 Chloropidae
54D	22.XI	135°	22	03°13.2'S	136°32.5'W	695 km NE of Marquesas Is	Coleoptera	1 Carabidae
58D	24.Xf	125°	10	00°30.2'N	133°22.9'W	1259 km NE of Marquesas Is	Orthoptera	1 Blattidae
60D	25.XI	130°	15	02°33.9'N	132°49.0'W	1444 km NE of Marquesas Is	Psocoptera	1 Liposcelidae
75D	6.XII	180°	14	02°30.4'N	107°30.6'W	1741 km W of Galapagos Is	Coleoptera	7 Silvanidae
78F	8.XII	108°	12	02°26.8'N	106°56.1'W	1667 km W of Galapagos Is	Coleoptera	Tenebrionidae Tenebrionidae
80D	8.XII	175°	14	02°28.3'N	106°07.9'W	1584 km W of Galapagos Is	Orthoptera	? Blaberidae
96D	19.XII	light airs		07°01.8'N	080°08.0'W	56 km SE of Punta Manato, Panama	Lepidoptera	1 Sphingidae
105D	30.XII	060°	08	07°39.0'N	079°50.4'W	37 km E of Punta Manato, Panama	Lepidoptera	1 Sphingidae (dry)
108D	31.XII	307°	06	06°18.4'N	081°59.5'W	111 km S of Isla Caiba	Lepidoptera	2 Sphingidae (dry)

TABLE 8 (continued).

No.*	DATE	WIND		LAT.	LONG.	APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.					
	1970							
113D	1.I	220°	09 kn	04°40.4' N	084°08.4' W	333 km SE of Cocos Is	Lepidoptera	1 Sphingidae (dry)
121D	3.I	185°	12	02°02.5' N	086°00.0' W	416 km SSE of Cocos Is	Lepidoptera	1 Sphingidae (dry)
127D	5.I	180°	14	01°32.8' N	086°04.8' W	444 km SSE of Cocos Is	Orthoptera	1 Tettigoniidae
132D	8.I	120°	15	06°53.4' S	088°47.7' W	612 km SSE of Galapagos Is	Diptera Hymenoptera	1 fragment, no ID 1 Formicidae

*See footnote of Table 1. F = food ; d = deck.

TABLE 9. Results of all collections made from the U.S.C.G.C. *Gresham*.

No.*	DATE 1969	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
May-June 1969, traveling Hawaii-Ocean Station Victor-Japan-Ocean Station Victor										
1N	3.V.	340°	20kn	34°00' N	164°00' E	34°00' N	164°00' E	1444 km NE of Marcus Is.	Homoptera	1 Aphididae (alive on capture)
2N	28.V.	255°	15						Homoptera	1 Aphididae
3N	30.V.	330°	17						Homoptera	1 Aphididae
4N	3.VI.	300°	19						Lepidoptera	1 Microlepidoptera
September 1969, traveling San Francisco-Ocean Station November										
5D	4.IX.	NNW	20-30	37°28.3' N	123°22.2' W	37°42' N	125°49' W		Diptera	2 Drosophilidae
6D	4.IX.			Caught in Ward Room					Neuroptera	1 Chrysopidae
70S**	15.IX.	calm		30°00' N	140°00' W	30°00' N	140°00' W	1963 km NE San Francisco, Calif.	Hemiptera	11 Gerridae
90S	16.IX.	calm							Hemiptera	7 Gerridae
80S	26.IX.	calm		29°45' N	136°30' W	29°45' N	136°30' W	1852 km NE San Francisco, Calif.	Hemiptera	7 Gerridae

*See footnote of Table 1. N = net ; D = deck ; OS = ocean surface.

**Samples 7, 8 and 9 were recovered from the ocean's surface by netting.

TABLE 10. In-port collections—Yokohama, Apra, Honolulu, Papeete, Balboa, Acapulco—on board the R/V *Argo*, 1969.

No.*	DATE 1969	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY	
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
56S	15.VI			Sample while at pier, Yokohama, Japan						Homoptera	1 Aphididae
									Diptera	1 Chironomidae	
57S	15.VI	145°	16kn	Yokohama, Japan		34°57.5'N	139°37.0'E	In Tokyo Wan	Homoptera	1 Aphididae	
58N	15.VI	128°	14	34°57.5'N	139°37.0'E	34°00.0'N	139°16.0'E	In Tokyo Wan	Homoptera	29 Aphididae	
									Neuroptera	1 Delphacidae	
									Diptera	1 Hemerobiidae	
										1 Chironomidae	
										1 Chloropidae	
95S	4.VII			Sample while at pier, Apra Harbor, Guam						Hemiptera	1 Plataspidae
									Coleoptera	1 Coccinellidae	
										1 Curculionidae	
131S				20°29.0'N	159°38.0'W	In Honolulu Harbor, Hawaii			Psocoptera	1	
									Araneida	1	
1S	19.X	110°	11	At breakwater Papeete, Tahiti		14°27.8'S	144°18.0'W	0.1 km, Papeete, Tahiti	Psocoptera	1	
46S	17.XI	120°	16	At pier, Papeete, Tahiti		17°14.0'S	149°20.0'W	At pier, Papeete, Tahiti	Coleoptera	1	
100N	20.XII	320°	18	Off Panama						Diptera	2
									Hymenoptera	2	
									Homoptera	1	
									Hemiptera	1	
101S	20.XII			At river, Balboa, Panama						Coleoptera	1
									Hymenoptera	1	
									Diptera	3	
									Araneida	1	
104S	30.XII	060°	08	Departing Panama		07°39.0'N	079°50.4'W	In Balboa, Panama	Homoptera	1 Delphacidae	
									Diptera	1 Sphaeroceridae	
106N	31.XII	307°	06	Off Panama		06°18.4'N	081°59.5'W	Off Balboa, Panama	Coleoptera	25	
									Diptera	79	
									Hymenoptera	24	
									Lepidoptera	3	
									Homoptera	61	
									Hemiptera	11	
									Orthoptera	1	
									Psocoptera	2	
									Araneida	1	

*See footnote of Table 1. S = suction trap; n = nets.

TABLE 11. Results of in-port collections. Moving Net Insect Sampler (MNIS).

TIME	DATE		ORDER	FAMILY
2100 ?	9.VI to 15.VI.1969	Trap left operating while in port, Yokohama, Japan	Homoptera Diptera Neuroptera Hymenoptera Acarina	6 Aphididae 3 Tipulidae 40 1 1 2
2100 1700	20.XII. to 30.XII.1969	Trap left operating while in port, Balboa, Panama	Homoptera Hemiptera Coleoptera Strepsiptera Lepidoptera Diptera Acarina Hymenoptera	3 Cicadellidae 5 Delphacidae 2 Psyllidae 1 Miridae 1 Cydnidae 4 Tenebrionidae 4 Stylopidae 2 frag., no ID 5 Pyralidae 2 Geometridae 3 Microlepidoptera 50 frag., no ID 5 Culicidae 66 Chironomidae 97 Ceratopogonidae 6 Dolichopodidae 15 Phoridae 24 Sphaeroceridae 1 Empididae 1 Sarcophagidae 2 Psychidae 3 Simuliidae 3 Drosophilidae 30 Tipulidae 3 Chloropidae 1 Sciaridae 7 3 frag., no ID 1 Chalcoidea 3 Apidae 1 Scelionidae 4 Cynipidae 1 Sphecidae 8 Ichneumonidae
	28.I to 1.II.1970	Trap left operating while in port, Acapulco, Mexico	Homoptera	2 Aleyrodidae 101 Psyllidae 7 Cicadellidae 3 Delphacidae

Diptera	18 Chironomidae
	4 Ceratopogonidae
	4 Tipulidae
	1 Cecidomyiidae
	43
Hemiptera	1 Veliidae
	1 Corixidae
Hymenoptera	4 Agaontidae
	1 Braconidae
	5 Formicidae
	7
Strepsiptera	2 Stylopidae
Lepidoptera	1 Geometridae
	4 Pyralidae
	8
Coleoptera	1 Coccinellidae
	1
Thysanoptera	3

TABLE 12. Results of in-port collections. Light trap (L).

No.*	DATE	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.			
47L	17.XI.1969	120°	16kn	Papeete Harbor, Tahiti		17°14.0S	149°20.0'W	At pier, Papeete for 4 days	Diptera	4 Culicidae 5 Sphaeroceridae 14 Chloropidae 9 Phoridae 5 Milichiidae 2 Therevidae 1 Lauxaniidae
									Coleoptera	1 Scolytidae 1 Staphylinidae 3 Tenebrionidae
									Hymenoptera	3 Pteromalidae
									Lepidoptera	1 Pyralidae 1 Noctuidae 13 Microlepidop.
									Isoptera	1 Termopsidae
									Hemiptera	2 Miridae 1 Anthocoridae
									Homoptera	2 Delphacidae
									Thysanoptera	23 Cicadellidae 6 Thripidae

TABLE 12 (continued).

No.*	DATE	WIND		STARTING		ENDING		APPROX. DIST. NEAREST LAND	ORDER	FAMILY	
		Dir.	Veloc.	Lat.	Long.	Lat.	Long.				
55L	15.VI.1969			Sample while at pier, Yokohama, Japan						Diptera	2 Phoridae 11 Chironomidae 1 Sciaridae 2 Psychodidae 1 Cecidomyiidae 8 Scatopsidae 1 Lonchaeidae 16 Sphaeroceridae 30 Chloropidae 1 Ceratopogonidae
									Coleoptera	1 Tenebrionidae	
									Hymenoptera	2 Formicidae	
									Lepidoptera	1 Microlepidop.	
									Homoptera	15 Aphididae 3 Cicadellidae	
									Psocoptera	1	
									Thysanoptera	1	
96L	1.VII.1969			Sample while at pier, Apra Harbor, Guam						Diptera	2 Chironomidae
									Coleoptera	1 Tenebrionidae 1 Staphylinidae	
									Hymenoptera	6 Formicidae	
									Hemiptera	1 Miridae	
									Thysanoptera	2 Thripidae	
97L	4.VII.1969			Sample while at pier, Apra Harbor, Guam						Diptera (adults)	1 Sphaeroceridae 2 Chloropidae 5 frag. 75 Chironomidae 5 Phoridae 2 Sarcophagidae 3 Muscidae 3 Anthomyiidae 2 Heleomyzidae 5 Drosophilidae
									Diptera	23 (larvae)	
									Coleoptera	3 Staphylinidae	
									Hymenoptera	4 Formicidae	
									Hemiptera	11 Anthocoridae	
									Isoptera	1 Rhinotermitidae	
									Acarina	1	
99L	5.VII.1969	085°	20	Apra Harbor, Guam		13°25.0' N	145°40.0' E	In Apra Harbor, Guam	Diptera	1 Syrphidae 1 Phoridae 1 Ephydriidae	
									Coleoptera	1 Elateridae	

102L	30.XII.1969			Sample while at pier, Balboa, P.C.Z.			Diptera	1 Sphaeroceridae 4 Phoridae
103L	30.XII.1969			Departing Panama	07°39.0' N 079°50.4' W	In Balboa, P.C.Z.	Diptera	1 Phoridae 1 Ceratopogonidae 1 Cicadellidae
172L	1.II.1970	275°	10	Sample while at pier, Acapulco Harbor, Mexico from 0945 28.I.1970 to 1200 1.II.1970			Homoptera Diptera Coleoptera Lepidoptera Hemiptera Homoptera Hymenoptera Thysanoptera Fragments Diptera	30 1 Dytiscidae 4 1 2 1 11 65 ? 2 Sphaeroceridae
187L	5.II.1970	283°	12	Manzanillo, Mexico	18°37.5' N 104°07.8' W	At pier in Manzanillo, Mexico	Diptera	2 Sphaeroceridae

*See footnote of Table 1. L = light trap.

TABLE 13. All collections from nets aboard the *Gresham*, showing the relation of each to the prevailing weather pattern.

DATE	SPECIMENS	RELATION TO CURRENT WEATHER
3.V.1969	2 Homoptera	1 day after cold front passage
28.V.1969	1 Homoptera	1 day after cold front passage
30.V.1969	1 Homoptera	1 day after cold front passage
3.VI.1969	1 Lepidoptera	1 day after cold front passage

TABLE 14. Collections from nets and MNIS aboard the *Argo* for the period 28 May–3 June 1969, showing the relation of each to the prevailing weather pattern.

DATE	SPECIMENS	RELATION TO CURRENT WEATHER	TRAP
28.V.1969	11 Acarina	1 day after cold front passage	MNIS
30.V.1969	1 Acarina	1 day after cold front passage	MNIS
31.V.1969	1 Acarina	day of warm front passage	MNIS
1.VI.1969	1 Acarina	1 day after warm front passage	MNIS
2.VI.1969	1 Lepidoptera	day of cold front passage	net
3.VI.1969	1 Homoptera	1 day after cold front passage	net

TABLE 15. A comparison of at-sea and in-port collections from the MNIS aboard the R/V *Argo*, both cruises.

ORDER	AT-SEA COLLECTIONS					IN-PORT COLLECTIONS					Total at sea and in port	
	Suction trap	Trap nets	MNIS	Light trap	Misc. (deck, food, etc.)	Total by order	Suction trap	Trap nets	MNIS	Light trap		Total by order
Orthoptera				1	3	4		1			1	5
Isoptera		1			1	2				2	2	4
Psocoptera	4	7		2	1	14	2	2		1	5	19
Thysanoptera		12				12			3	74	77	89
Hemiptera	1	8			25	34	1	12	9	17	39	73
Homoptera	4	487	1	7		499	3	91	128	45	267	766
Neuroptera					1	1		1	1		2	3
Coleoptera	10	12		19	11	52	4	25	6	19	54	106
Strepsiptera			1			1			4		4	5
Lepidoptera		13	7	3	6	29		3	21	17	41	70
Diptera	27	82	9	206	5	329	5	83	452	298	838	1167
Hymenoptera	4	47	6	10	1	68	1	26	32	26	85	153
Araneida	1	76				77	2	1			3	80
Acarina	1	11	219			231			9	1	10	241
Trap totals	52	756	243	248	54	1353	18	245	665	500	1428	2781

passing of the most severe low pressure disturbances. Generally speaking, the 700 mb, 500 mb and 250 mb streamlines passing over the area of Ocean Station Victor originated to the WSW along an arc running from the Bonin Islands, through Okinawa and up through Kyushu and southern Honshu in Japan. A study of the streamline patterns correlated with the surface storm systems and associated insect captures in the Ocean Station Victor area showed that the overall incidence of origin of the streamlines was as follows: 250 mb from southern Honshu and Kyushu, Japan; 500 mb from Kyushu and Okinawa; 700 mb from between Okinawa and the Bonin Islands.

It would appear that the specimens captured were quite possibly picked up as storm or frontal systems moved across the area of Japan, carried out to sea by the fronts and finally captured in the traps of the *Argo* and *Gresham*. Questions of how the insects were initially trapped in the storm, altitudes at which the insects are transported, importance of precipitation as a factor causing drop-out of insects from the storm system, and level at which active flight by the insect ceases in response to low temperatures cannot be answered by the present data. Recovery of specimens from 8 of 10 samples on the day following passage of a front may be caused by the downslope of cold air sometimes occurring along the backside of a cold front.

The 1969-1970 trapping season gave the MNIS its first wide-ranging, long duration test. Despite a few minor difficulties with the advancement mechanism and the fan motor, the MNIS produced satisfactory results. One mechanical improvement which has been suggested is an automatic marking device for placing time marks on the gauze, thus eliminating the necessity of hand marking by a technician several times daily.

The variety and number of specimens trapped by the MNIS is ample proof of its effectiveness as an insect trap (TABLE 15). One striking result was the number of Acari recovered by the MNIS. Of 241 specimens taken while at sea, 219 were Acari, and on the Western Pacific cruise (V-VI.1969) 186 Acari and 1 Aphididae were collected. These numbers are possibly indicative of shipboard contamination. The large number of Acari recovered, when compared with only 1 in the suction trap and 3 in the nets, indicates a superiority of the MNIS in capture of minute specimens.

Statistical analysis of the collections made in the program have not proven satisfactory (Guilmette et al. 1970). Inconsistency of sample numbers at various distances from land over the 12 years of the program, as well as individual years, make it difficult to use many of the normal distribution formulas.

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