Entomological Activities on Polio Investigations Fly Control Projects

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In July 1948, the Communicable Disease Center established investigative programs in five States to study the possible relationship between flies and the transmission of poliomyelitis. The projects are located at Phoenix, Ariz.; Topeka, Kans.; Muskegon, Mich.; Charleston, W. Va.; and Troy, N. Y. During the 5-year tenure of these programs, detailed epidemiological studies and operational fly control activities will be carried on at each city. The epidemiologic studies have been broadened to include other disease problems. All municipalities bear a significant portion of the operating cost of their respective programs.

The participating cities fall within the same population range (75,000–100,000), but differ widely in their relation to topography, area, prevalent species of flies, extent and magnitude of the fly breeding season, climate, sanitary conditions, racial composition, and other factors. These variations, while augmenting the difficulties of establishing uniform control practices in the five communities, also afford an excellent opportunity for conducting fly control operations and epidemiological investigations under a gamut of environmental conditions.

In the city, the responsibility for securing and maintaining effective fly control is vested in an operations team composed of an engineer and an entomologist. To obtain fly control, principal emphasis is placed upon the elimination of fly breeding foci through the improvement of the current municipal practices employed in the collection, storage, and disposal of refuse. Supplementing this phase is a generalized chemical control program involving the use of exterior space sprays, residual sprays, and larvicides. Guiding these sanitary and insecticidal control activities are entomological surveys which, as an integral part of the operations program, serve to determine the need for, as well as the effectiveness of, the various suppressive measures.

For operational purposes, each city is subdivided into five to nine sections, based upon the criteria of fly densities, sanitation levels, and socio-economic conditions. The block composition of these sections fluctuates, some containing 60 to 100 blocks (business areas) while others include 200 to 400 blocks (residential areas). Operations are formulated on a weekly cycle, the over-all treatment and inspection of each section being scheduled for a definite time-period each week. Adjustments of this schedule are made whenever weather conditions disrupt the normal operating routine.

As a necessary adjunct to the evaluation studies in the treated cities, similar but less extensive activities are conducted in nearby untreated communities, to obtain a measurement of the normal trends in an uncontrolled fly population. Inspection of comparable sections in both cities is accomplished on the same day to minimize the effect of daily variations in weather conditions.

At each project the entomologist, assisted by a corps of six to nine biological aides, carries on the following activities:

(a) Weekly grill surveys to determine fly densities in the treated and untreated cities. The data from these surveys guide the control operations and measure their effectiveness.

(b) Periodic trap collections of adult flies to ascertain the species composition of the fly population and to provide flies for virological analysis.

(c) Special grill surveys to explore the feasibility of a stratified random sampling method in evaluating fly densities (Charleston, W. Va., and Topeka, Kans.).

(d) Special grill surveys to study the residual effectiveness of the new insecticide dieldrin (497) (Phoenix, Ariz.).

(e) Investigations on the biology and ecology of the prevalent domestic flies.

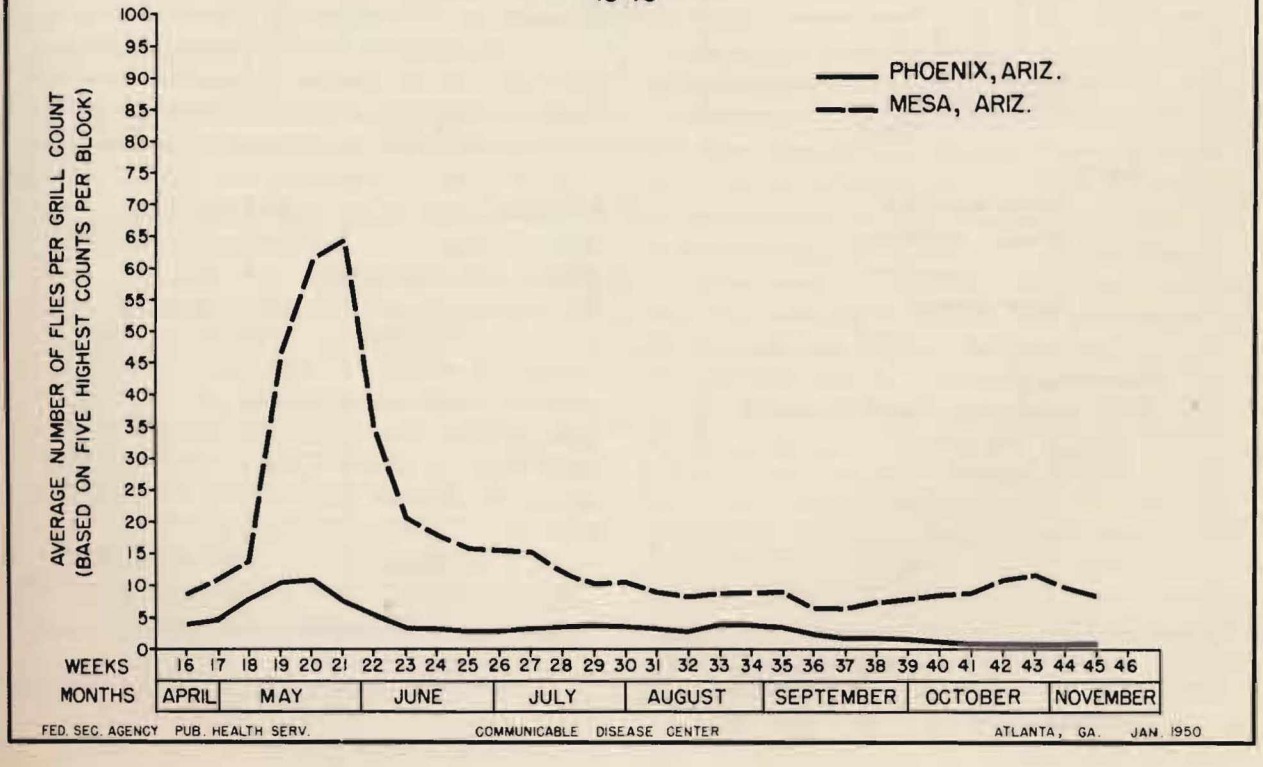
Weekly grill surveys are the chief means of measuring the fly densities in these municipalities. Such surveys entail the inspection of individual blocks, with the degree of block coverage in any given section being contingent upon the fly potentialities and/or the fly densities of that area. Because the principal fly control problems occur in sections composed of business or low-class residential blocks, these receive much greater coverage than do the high-class residential areas. In each block, an effort is made to locate and make grill counts on all major attractants (for example, garbage, animal excrement, and other refuse), with the five highest grill readings being recorded and averaged to serve as the block rating. By combining block ratings, sectional averages are derived and compared with averages for similar sections in the untreated check town (figure 1). In turn, a city index can be computed; however, the value of a city-wide index is debatable because the preponderance of low density blocks evolving from the better-class residential areas frequently tends to obscure the true control status of smaller sections where the higher fly densities prevail.

In guiding the control operations, pretreatment grill surveys are made to determine the need for treatment and to provide data to aid in the selection and placement of the control measure. A post-treatment coverage then serves as a check upon the effectiveness of the measures employed. In sections of intensive fly breeding where the levels of fly prevalence consistently are such as to require routine treatment, pretreatment inspections frequently are discontinued. While the grill surveys provide the bulk of the data upon which control operations are based, these data require interpretation in regard to prevailing weather conditions, larval findings, and other pertinent factors before plans for effective fly abatement can be formulated.

Fly-trap collections are made at the rate of 40 to 60 per week at each of the five cities. Each trap is operated for a period of 24 hours, using a bait composed of a mixture of fish or meat, and

FIGURE I

THE AVERAGE NUMBER OF FLIES PER GRILL COUNT IN THE TREATED BUSINESS SECTION OF PHOENIX, ARIZ., AS COMPARED WITH THE UNTREATED BUSINESS SECTION OF MESA, ARIZ., BASED ON A 3-WEEK MOVING AVERAGE 1949



rotten vegetables and fruit. The flies collected are inactivated and killed by placing the trap in a cardboard drum containing dry ice. Samples obtained for qualitative studies of the fly population are dried, stored in containers with naphthalene flakes to prevent insect damage, and identified during the winter (table 1). Specimens for virological study are stored in freezer plants at subzero temperatures to preserve the polio virus until the samples are analyzed.

The collection of flies for virological examination is part of a cooperative study being conducted by the National Foundation for Infantile Paralysis, the Yale University School of Preventive Medicine, and the Communicable Disease Center to determine the occurrence and spread of polio virus in a city during pre-epidemic, epidemic, and postepidemic periods of an outbreak of this disease. Concurrent with the collection of flies, sewage samples are being taken for similar analysis, and possible correlation, between the dispersion patterns of polio virus in these two extrahuman sources.

In the special grill surveys, the sampling design consists of a stratified random sample of blocks for each weekly survey, in contrast to the operational technique whereby the areas of high fly densities receive the more intensive surveillance. Although random in its distribution, the stratified random sampling method is based on statistical principles which require larger weekly samples from those sections in which the blocks exhibit a greater degree of variance in the fly potential and sanitary standard.

To evaluate the residual effectiveness of the

TABLE 1
Species of Flies Recovered from Fly Traps Operated for 24-Hour Periods from September 1 to November 5, 1948, in Residential and Business Sections of Topeka, Kans.

Species	Number of Specimens*	Percent
Calliphoridae:		
Callitroga macellaria	690	0.5
Cynomyopsis cadaverina	1,343	0.9
Phaenicia caeruleviridis	2,371	1.6
P. pallescens	36,331	24.5
P. sericata	18,314	12.4
Phormia regina	6,717	4.5
Minor species	272	0.2
Total	66,038	44.6
Muscidae:		
Musca domestica	65,837	44.4
Muscina stabulans	1,149	0.8
Ophyra leucostoma	2,105	1.4
Minor species	2,626	1.7
Total	71,717	48.3
Sarcophagidae:		
Sarcophage haemorrhoidalis	617	0.4
S. latisetosa	489	0.3
S. rapax	755	0.5
S. ventricosa	3,903	2.6
Minor species	3,607	2.4
Total	9,371	6.2
Minor families:	1,320	0.9
Grand Total	148,446	100.0

*Total number of collections — 64

promising new insecticide dieldrin (497) under field conditions, tests involving treatment of approximately 330 blocks were initiated at the Phoenix project in August 1949. To date the results have been promising, but are as yet inconclusive.

Investigations on the overwintering habits of flies were begun during the winter of 1949–50. Future plans include expanding these investigations and initiating others on the developmental cycles, breeding habitats, and the daily activities of the prevalent domestic flies in each of the cities.

Virus Encephalitis in the Missouri River Basin

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The arthropod-borne virus encephalitides include the well recognized entities of Eastern, Western, and Venezuelan equine encephalomyelitis and St. Louis, Japanese B, and Russian Far East encephalitis. Other new viruses, the importance of which is still not clearly defined, are constantly being discovered in various parts of the world, among them being those of West Nile, Semlike Forest, Bwamba Forest, Bunyamwera Ilheus, and California.

Although widespread infections of equines involving the central nervous system have occurred repeatedly in many parts of the United States since the early part of the nineteenth century, the etiology of such epizootics or plagues remained unknown until Meyer, Haring, and Howitt (1) isolated a virus (Western encephalomyelitis strain) from equine brain tissue in 1930. The identification of an Eastern strain as distinct from that of the Western one was made in 1933 by TenBroeck and Merrill (2). The possibility that human disease may be caused by the equine viruses was suggested by Meyer in 1932 (3), but it was not until 1938 that Howitt (4) recovered the Western strain and Webster and Wright (5) the Eastern strain from human cases. In 1933, a sharp epidemic of about three thousand human cases of an unknown encephalitis occurred primarily in the city and county of St. Louis, Mo. It quickly was shown that this outbreak was due to a neurotropic virus which is now identified as the St. Louis strain. In 1945, Hammon *et al.* (6) isolated what may be a new strain from mosquitoes in California. This is known tentatively as the California strain, and serum from a child suffering from encephalitis gave significant serological reactions to it (7). The first clue to the method of spread of these viruses was provided by Kelser in 1932 (8) when he demonstrated that *Aedes aegypti* mosquitoes could transmit an equine encephalomyelitis virus from infected guinea pigs to susceptible ones. Following this lead, the work of other investigators showed that a relatively large number of arthropods can pass the virus to susceptible animals under laboratory conditions. It was not until 1941, however, that Hammon and his associates (9) recovered encephalitis virus from wild mosquitoes. Since 1941 the viruses of Western and Eastern encephalomyelitis, St. Louis encephalitis, and the California strain have been recovered from a wide range of arthropods, many of which have been shown to be capable of passing the virus from one vertebrate to another under laboratory conditions. Furthermore, indications of infection with these strains have been found in birds and mammals, and the serological data would indicate that these infections are rather common occurrences. The results of major contributions with respect to possible vectors and reservoirs are summarized in table 1.

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