If, again, we take as an example a pile with a side of 584 cm., we find $W = 24 n_0 v$ ergs/sec. When the pile is operating at a power of 1 kw., the flux of thermal neutrons at the center is therefore about $n_0v = 4 \times 10^8$ neutrons/cm.^{2} sec.

Description of a Graphite Pile at Argonne Laboratory

The first pile was erected under the West Stands on the campus of the University of Chicago at the end of 1942. After having been operated there for a few months it was moved to the Argonne Laboratory, near Chicago, where it has been used until now for various research purposes.

The lattice of that pile is not the same throughout the structure. Since only a small amount of uranium metal was available at that time, metal has been used in the central portion of the pile and uranium oxide in the outer portion.

The intensity of operation of the pile is recorded by a number of BF_3 ionization chambers connected to amplifiers or to galvanometers.

Since this pile has no cooling devices built into it, the power produced is limited by the necessity of avoiding an excessive temperature rise. The pile could be operated indefinitely at a power of 2 kw. and is often operated for periods of the order of one or two hours up to about 100 kw.

One feature that is often used for neutron research work is the thermal column, a column of graphite having sides of about 5 x 5 feet, which is built on the center of the top of the pile and goes through the top shield. The neutrons that diffuse from the pile into this column are rapidly reduced to thermal energy so that the neutrons inside the column a few feet above the top of the pile are practically pure thermal neutrons.

The pile is also equipped with a number of holes in the shield and removable stringers of graphite that make it possible to explore phenomena inside the pile or to introduce samples for neutron irradiation.

When the pile is operated at 100 kw., the flux of thermal neutrons at the center is about 4×10^{10} neutrons/cm.^{2} sec.

Work With Residual DDT Spray in Puerto Rico:

A Report of the First Year's Work

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IN THE FALL OF 1944, the U. S. Public Health Service, in cooperation with the Insular Health Department and the School of Tropical Medicine, inaugurated a residual DDT spray project to determine whether this new method of malaria control which has been so remarkably successful in other parts of the world might be of practical value in Puerto Rico, where the important vector (*Anopheles albimanus*) is a "wild" mosquito which feeds on humans during twilight or at night and seldom remains inside houses for more than a few hours. The results of the first year's work are presented herein.[1]

Two villages approximately 30 miles apart and rather similar in size, population, racial composition, occupation of inhabitants, house construction, rainfall, general ecology, relation to vector-breeding areas, proximity to ocean, relation to rivers, isolation, and mosquito populations were selected for the experiment. Humacao Playa, on the east coast, was chosen as the test village to be sprayed with DDT, while Loiza Aldea, on the northeast coast, was used as an untreated check village.

In each village *A. albimanus* indices were obtained by animal-bait and light trap collections throughout the year. The only previous, long-range malaria control experiment in Puerto Rico was conducted at Salinas during the period 1930–36 and has been reported by Earle (*1*). His data show that in this small, unscreened native village little reduction in number of malaria cases occurred until the *albimanus* population had been reduced to such a low level that animal-bait traps collected less than one *albimanus* per night. In the villages used in the present experiment, bait and light traps caught from one to several hundred *albimanus* on most nights when traps were operated. It is therefore believed that *albimanus* was present in sufficient numbers to transmit malaria throughout the study period.

Unlike the DDT residual spray work with *A. quadrimaculatus* at Stuttgart, Arkansas, and with *A. pseudo-*

[1] The studies on which this report are based were conducted jointly by personnel of the U. S. Public Health Service District #6, Communicable Disease Center activities; the Bureau of Malaria Control, Puerto Rico Department of Public Health; and the School of Tropical Medicine, San Juan, Puerto Rico. The writers wish to acknowledge the assistance and cooperation of officials of the Communicable Disease Center, Atlanta, Georgia; Carter Memorial Laboratory, Savannah, Georgia; Office of Malaria Investigations, National Institute of Health; and District #6, U. S. Public Health Service. The commissioner, Insular Health Department, and the director of the School of Tropical Medicine also have given valuable advice and assistance. Army officials at Fort Bundy generously provided a number of buildings for experimental use.

punctipennis in Mexico, reported by Stage (*2*), no reduction in numbers of *A. albimanus* was found at either Puerto Rican town. In fact, collections of *A. albimanus* at Humacao Playa were actually larger in October and November 1945 than those made in October and November 1944 from identical bait and light traps in the same locations, even though the village had been treated with residual DDT spraying twice between November 1944 and October 1945.

Normally, in Puerto Rico the peak incidence of *A. albimanus* is reached in the fall and winter months from September through December or January, depending on the distribution of rainfall during this period, which constitutes the "rainy season." In most areas where malaria surveys have been conducted over a period of years it has been found that the greatest number of malaria cases occur during this same period, usually lagging a month or two behind the peak in *albimanus* population. Then there follows a marked reduction in the number of malarial mosquitoes and a gradual decline in number of cases of malaria during the period from January to, or through, April, which constitutes the "dry season." Depending upon the beginning of the "rainy season," malarial mosquito production and number of malaria cases begin increasing in late April or early May and continue at an accelerated rate until the period October to January, when the "dry season" begins again.

TABLE 1

COMPARISON OF MALARIA RATES IN UNTREATED AND TREATED VILLAGES IN PUERTO RICO

Date	Total number of positive films of:				Total films			Positive films (%)
	P. falciparum	*P. vivax*	*P. malariae*	*P.* underterm.	Positive	Negative	All	
(Untreated Village—Loiza Aldea)								
First survey November 1–15, 1944	26	30	1	3	60	1,210	1,270	4.7
Second survey March 19–April 5, 1945	7	6	0	0	13	830	843	1.5
Third survey November 1–15, 1945	13	20	0	0	33	835	868	3.8
(Treated Village—Humacao Playa)								
First survey October 15–31, 1944	47	33	2	3	85	1,384	1,469	5.8
First residual DDT spraying November 1–17, 1944								
Second survey March 5–14, 1945	9	19	1	5	34	1,177	1,211	2.8
Second residual DDT spraying June 15–29, 1945								
Third survey October 15–31, 1945	5	4	1	0	10	1,083	1,093	0.91

During the course of this study, three blood film surveys were made: the first, in October and November 1944; the second, in March and April 1945; and the third, in October and November 1945. The slides were stained within 24 hours of the time of collection, and later sent to the Memphis or Atlanta laboratories of the U. S. Public Health Service for examination by trained technicians. The results are given in Table 1.

It will be seen from examination of Table 1 that the percentage of positive malaria slides from the untreated check village of Loiza Aldea followed approximately the normal cycle for Puerto Rico, with 4.7 per cent positive during the "rainy season" of November 1944, a decrease to 1.5 per cent positive during the "dry season" of March–April 1945, and a marked increase to 3.8 per cent positive during the "rainy season" of November 1945. On the other hand, in the village of Humacao Playa, which was sprayed with DDT twice during the period November 1944 to October 1945, there was a progressive decline in percentage of positive malaria slides: from 5.8 per cent in the "rainy season" of October 1944 to 2.8 per cent in the "dry season" of March 1945; and most significantly of all, to 0.91 per cent during the "rainy season" of October 1945.

It is believed that these data, which show a marked reduction in malaria in the DDT-treated village, indicate that DDT may be an effective weapon against malaria in the areas where the vector mosquito is of the "wild" variety, such as *A. albimanus.* Further experience will be necessary before its effectiveness under other conditions and against species with similar habits can be evaluated.

Details of DDT residual spray procedure will be discussed in a subsequent paper. However, it may be stated that approximately 500 houses with adjacent outbuildings were treated three times during the first year: the first residual spraying in November 1944, with an over-all average of 309 mg. of DDT per square foot, at a cost of $1.31 per house; the second, in June 1945, with an average of 147 mg. per square foot, at a cost of $.98 per house; and the third, in June 1945, with an average of 190 mg. per square foot, at a cost of $.98 per house.

Puerto Rican families average about five persons each. Thus, the per capita cost was between $.20 and $.26 for a single application of DDT in Humacao Playa, or between $.60 and $.80 a year. This is not an exorbitant figure when it is realized that, in addition to reducing malaria, residual DDT spraying may play an important part in preventing the transmission of other insect-borne diseases of the Island, such as filariasis and dengue, and other diseases such as typhoid fever, diarrhea, and dysentery in which flies may play a vector role. Moreover, residual DDT spraying is effective in controlling such common household pests as bedbugs and cockroaches for several weeks or months.

References

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