

Since "Since Silent Spring"

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Last year President LaPlante addressed us on the subject of the necessity for concern for the environment in the use of pesticides and he gave us a very complete and definitive summary of the situation and of its dangers. This year I should like to carry this onward to discuss with you the situation as it now exists, and, since many members have expressed an interest, to describe to you our military insect control program and how it is oriented to the environmental problems of today.

There has recently, been published a book entitled, "Since Silent Spring" by a person named Graham, who has also written articles in the same vein in a number of magazines. His thesis is that there is even *more* cause for alarm now than when "Silent Spring" was written. I am sure that neither the title of his book nor the emotional magazine articles have detracted from his royalties. Unfortunately, his statements are too unfounded to go unchallenged but too numerous to counteract with anything less than another book. His opening statement is that events have amply vindicated the author of the original "Silent Spring" and have proven the validity of the implied facts that many persons read into that book. The facts are, of course, somewhat different. What events *have* vindicated is Miss Carson's alarm at the indifference toward environmental contamination by pesticides which until very recently was so widespread, notably among farmers and householders lulled by soothing ads and unimpressed by the fine print on the labels.

Since "Since Silent Spring" appeared there has also been a rash of alarmed articles in magazines and papers, all quoting the same dubious "facts" and calling for a cessation of all pesticide use as a hazard to the environment. Even the august Smithsonian Magazine has joined this chorus...and been taken to task for it by a number of also august—and annoyed—scientists. They have not, however, reformed.

The facts of pesticides are too well known to all of you for me to rehearse them here, but bear with me a moment. It does little good for us to tell each other that there are, by Audubon Society count, more robins and song birds now than ever before. *We* know that exhaustive tests on persons exposed daily to DDT have failed to prove deleterious effect, let alone the causation of cancer...that, in fact, these studies have also linked DDT with cancer regression and even its failure to occur in the statistically expectable numbers in the test populations.

¹Presidential address presented at the December meeting of the Hawaiian Entomological Society.

If I may be allowed to resuscitate an almost obsolete word, we know that the instant ecologists are extravagating inadmissibly when evidence adduced for one species of bird, for instance, is made to appear to apply to all. Or when materials are tested at so far above any conceivable dosage rate that the horrendous results really have no meaning in normal context. Sugar, salt, aspirin and spice at equivalent concentrations would be equally noxious.

We know that many environmental factors enter into each situation, only one of which is pesticides. We know that the growing snowball of evidence on pesticides is composed in large part of unsupported allegations gathered around a small body of undeniable fact, which is quite legitimately a cause for immediate concern, though hardly best countered by panic. We know that our very test for DDT, so often quoted to prove the presence of that pesticide in the penguins of Antarctica, while capable of detecting one part per billion is also capable of being activated by another naturally-occurring compound, so that "DDT" has been found in the fossil ice of a glacier 50,000 years old. And we know that the very real hazards of pesticide use and of certain food chain climaxes are apt to be buried in this sludge of emotion, that hysteria is very apt to make things worse rather than better.

But the general public does not know all this and has no way to know which is true and which is exaggeration, which is legitimate warning and which is self-serving alarmism. I do not think that we are likely to see truth overtake falsehood in this regard in the very near future. It is not to say that lighting the candle is not of more use than cursing the dark but merely that the candle may get blown out a good many times. I think in our private lives we should keep relighting that candle. But I think we would be unrealistic if we did not foresee difficulty ahead of a major sort, both in the proper use of pesticides and in the proper direction of the required major efforts to undo the effects of pesticide misuse which have occurred. We may very likely have to cope with the diversion of funds from research to fads.

We live in a world in which what is believed to be true *is* true, regardless of the facts. We live in a world in which "Earth Day" speakers are perfectly capable of announcing their love for all mankind in one breath and in the next saying that the prevention of malaria with DDT or the increase of the food supply by pesticides may be bad things because they interfere with the "natural regulation" of the population explosion in underdeveloped countries.

If the use of any pesticide is to be considered suspect and the use of many is to be banned by trigger reactions, what are we left with? According to our colleagues, the future is far from dark. Dr. Knipling's cohorts and their work with chemosterilants and radiosterilization have been well and justly publicized. It is, of course, so far, limited to popula-

tions existing in real or relative "islands". However, a further dimension is being introduced when sex pheromones are added to the chemical or radioactive sterilants, causing males from the natural population to sterilize themselves in large numbers immediately upon emerging, and before mating has taken place. The poor males have also been subjected to overwhelming blankets of sex pheromones so that they lose their way.

It seems pretty sneaky but this is war.

Let me remind you of the further list. Mosquitoes have been found to have not only cytoplasmic incompatibility with other strains of the same species but also to be susceptible to genetic crosses which produce sterile males, males with incompletely developed (rotated) terminalia, sex-linked mutant sterile females, and females which attempt to transform into males or back into pupae. The addition of garlic oils to water has been found to be lethal to certain mosquitoes, while others are entrapped by a mucilaginous mustard seed, each of which is capable of drowning more than five larvae, or some twenty-five million mosquito larvae per pound of seed; at one pound per acre, an overkill in many marshes and irrigated pasturelands of some 400%. Some work has been done to show that mosquito larvae may be drowned by the addition of amines or alcohols to reduce the surface tension and in other experiments strains of successfully competitive mosquitoes have been developed with life cycle periods incompatible with the development periods of the disease they have hitherto transmitted. Sonic attractants are being widely studied.

With other insects, the work of Dr. Carroll M. Williams, of Harvard, with juvenile hormones has been fascinating entomologists for a dozen years, while other hormonal work has indicated the possibility of increasing the male-female ratio of progeny to the extent that the fertilized female population might be reduced below the level required to sustain the species in a closely limited environment.

Obviously, some of these things will be too theoretical to be ever of much use and others will be thought by our instant ecologists to pose as great a threat to the environment as do pesticides. Widespread use of sterilant chemicals or even of the juvenile hormones studied by Dr. Williams can, also obviously, never be even considered. Nevertheless, one thing leads to another in research and although serendipity is a badly battered word, it is still an operative phenomenon.

In welcoming the Pacific Branch of the Entomological Society of America to Hawaii, I mentioned the long-standing interest shown by the entomologists of Hawaii in biological control measures and the introduction of predaceous and parasitic species. The work of Cliff Davis and Noel Krauss, of Fred Bianchi and Dr. Pemberton and many, many others now and in the past has not only benefitted Hawaii but has acted as a demonstration and proving ground for interested observers throughout the world. Our Society was founded by persons whose first meeting was

for the purpose of introducing *Gambusia affinis* into Hawaii as a mosquito control. Pat Nakagawa and his group at the Hawaii State Board of Health mosquito control field laboratory are still in the forefront of this work with the use of the so-called "instant" fish, an experiment which is being watched with interest by many entomologists in other areas. It is safe to say that here in Hawaii, with its delicately balanced and infinitely-to-be-cherished environment, there has been greater interest than in any other part of the world in the use of biological controls, and of breeding source reduction by proper manipulation and management, in place of too often scattershot application of chemicals.

Needless to say, this attitude has influenced our military pest control program very greatly. While the program is uniform throughout the services in a large degree, the practice of aiming solely at the target insect insofar as possible, and of using alternative measures with minimal impact on the environment has been at its very foundation. (Parenthetically, we have occasionally even had to defend ourselves in foreign countries where local authorities wished us to use control measures we deemed inadvisable and where they were critical of the less spectacular treatments we found to be effective and which we thought to be better. These situations ranged from our reluctance to use DDT in a widespread fashion over food crops on Okinawa in 1947 to reluctance to use sumithion for the control of fall web worm along the streets of Japan in 1970. Or to use fog machines indiscriminately in heavily populated villages and cities for the control of the tin-can breeding *Aedes albopictus* and *C. quinquefasciatus* in Vietnam and Hawaii.)

Our military pest control program necessarily is sometimes concerned with "winning the war" despite the consequences, but more generally it is concerned with insect and rodent control in stabilized communities such as our installations in Hawaii with which you are familiar. Our efforts embrace household insects, disease vectors (primarily flies and mosquitoes), termites, storage insects, in food and clothing, insects of trees, shrubs and lawns, marine borers and wood rot, rodents, bats, shrews, dogs, cats, mites, ticks and spiders...and even snakes, pigeons and skunks, where these occur. In our control of insects such as flies and mosquitoes, we turn our advice to inducing the stations to eliminate the breeding sources. We require cat and dog control and when we spray for flies we use small amounts of bait spray rather than large area mists or fogs. I might add that in advising sanitary landfills (and by this I mean well-compacted and covered fills and not lightly covered dumps) we entomologists have tried mightily to persuade the engineers to utilize otherwise sterile areas such as abandoned quarries, and to avoid using wet-land areas which are also used as breeding grounds by waterfowl and aquatic wildlife. Mosquito control, of course, necessarily entails draining some marshy areas and thus eliminating a part of the wildlife ecology, but here too, it has long

been found that wildlife habitats and mosquito control are not incompatible if they are correctly carried out. Fogging and use of persistent pesticides were long ago suspended.

In termite control we stress frequent inspection, proper construction, (which includes the soil poisoning which has been found innocent of contaminating the environment around it), and the use of immediate spot dust treatments into the galleries and mudtubes rather than large scale emergency treatments involving soil injection and fumigation. In the control of stored products insects, also, we stress inspection and small-scale local treatment rather than large fumigation, although the new material, aluminum phosphide, appears to offer as little environmental risk as any fumigant so far known.

In the control of insects attacking vegetation we normally follow a wait-and-see routine, which means that where damage is slight and a parasite or predator is present we do not spray with chemicals. Where damage is impermissible we wait to spray until the insect is found by inspection, rather than following an inflexible calendar-based schedule. And, when we spray, preference is given to those materials with the lowest mammalian toxicity, which are applied only to the small area involved and not to all similar plantings everywhere.

You will see from this that we certainly do not entirely rely on non-chemical methods but on the contrary we do rely on chemicals quite heavily! However, we are by no means persuaded that pesticide use is necessarily bad. On the contrary, we are persuaded that proper and careful use of the proper pesticides is essential to maintaining man's best environment. Nonetheless, we do not use a large number of the materials which are still available to the householder from the shelves of every market. And we do not advise our military householders to use these materials either. Rather, we advise them NOT to use pesticides indiscriminately, NOT to use them without reading the label...and following it...and NOT to use some of them under any circumstances.

The military, through the Armed Forces Pest Control Board, not only funded the research done at Orlando, Florida on the initial uses of DDT but has since then funded the research which has produced the modern and highly effective insect repellents and the wide store of developing knowledge on resistance, incompatibility, and the reduction of pesticide use through the new techniques of microdroplets and ultra low volume. Military-funded research on termites is being carried out on the Mainland to determine the effectiveness of trail-following pheromones and this is being coordinated with work being done here at the University of Hawaii on microbial and helminth parasites and predators of termites. We are cooperating in field research on these pheromones combined with mirex in bait stakes placed about the perimeter of infested buildings. We are also an interested though silent partner in research now being commenced at the University on our increasingly pestiferous fly, *Musca sorbens*.

In other aspects of insect control, the military have been strong proponents of effective spraying of planes against would-be immigrant insects and of the strengthening of quarantine procedures for the same purpose. This is routinely done with great energy on military flights and with somewhat less enthusiasm on the military contract flights by commercial carriers. But it *is* done. The U.S.D.A. is carrying out a black light trap surveillance and what will in all probability be a trap *control* program, against airplane-borne immigrants at Hickam and Barbers Point. Teams of military quarantine inspectors are now operating in relays in Vietnam to assure that insofar as is humanly possible no unwanted invaders are brought back on retrograde cargo. In addition to inspections, all cargo is washed with high-pressure hoses and treated with DDVP strips or diazinon dust and with anti-coagulant rodenticide blocks to ensure the exclusion of live fleas and, it is hoped, any other hitch-hiking arthropod.

To ensure that our men are constantly mindful of the requirements of safety and the proper use of pesticides, the military requires all pest controllers to attend a biennial training course given for a period of usually three days and followed by a far-from-easy written examination. Successful completion of the examination, plus on-the-job demonstration of proficiency, is required for certification and certification is required of anyone handling pesticides unless he is under the immediate supervision of someone else who is so certified. Contractors come under this provision also and their operations are supervised by our certified personnel. In addition, computerized reports are made monthly on all pesticide usage, showing place applied, type of application, rate of application, and pest against which it was directed. This is used not only by the area entomologist to check on the local operations but also is transmitted to Washington, D. C. and given in summary form to the Federal Committee on Pesticides, under whose awful hand we hold *our* dominion over palm and pine.

While as individuals, we military entomologists are deeply interested in the results of laboratory research, as operative applied entomologists we in the Engineer half have no official duties in anything but the most shotgun of field research, and in the medical half, our laboratory research is generally oriented to immediate results and not to basic science. Why, then, are we engaged in coordinated efforts with Universities and Governmental pure research organizations? The reason is simple and, to you, I am sure it is obvious. The line between basic research and applied research is becoming very thin indeed in many areas. And as our colleagues delve further into the genetics and physiology of various insects it becomes apparent that knowledge gained today on mosquitoes may very well be found tomorrow to be applicable generally to other orders. Light traps developed first as population counters in mosquito breeding areas and tobacco storage warehouses have given us insight into photo-

responsiveness of many insects. Work being done now on carbon dioxide and L(+) Lactic acid as attractants for mosquitoes is quickly mirrored by findings of attractiveness to flies and other insects.

We might even envision a day when we will do insect control entirely by means of parasites, predators and the strategic placement of containers of attractants, laced with high potency insecticides of minimal mammalian toxicity, and there will be no insecticides sprayed into the environment at all. Of course, this will leave us entomologists little to do but go into taxonomy and spend our days changing names. And it won't satisfy the environmentalists who insist that man alone of all animal species must do *nothing* to change the environment. But it *will* be nice and easy.