

## Food, Fiber, and the Economics of Entomology<sup>1</sup>

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I am an economic entomologist. I deal with practical, money-oriented problems as a professional worker involving the interaction of insects and man. My career began at much the same moment as a more famous, or now infamous, entity known as dichloro diphenyl trichloroethane, nicknamed DDT.

It is difficult to imagine, now, the excitement generated in our dedicated group by the impact of this easily constructed and manufactured chemical upon our plodding world of research. Previous to DDT we had classified our insect control chemicals as stomach poisons, those which killed insects by ingestion; and contact poisons, those which killed insects upon contact. DDT provided a double whammy by combining these actions in one marvelous, lethal package. We applied this miraculous chemical to our crops; slaughtered insects by the billions, and increased yields by astonishing amounts.

The reaction of the public was electric. We were heroes and assumed the omnipotence of gods. Bear in mind that this was in the year 1944. Victory gardens had sprouted like weeds all over this land. The inexorable tide of organic chemicals spawned by DDT ushered in the organic age of insect control whereby all that was required to create a new superstar was to tinker with the molecular structure of a vast variety of chemical compounds and create new and effective solutions to insect control problems. We were like kids with a magnificent collection of new Christmas toys. As it is with kids everywhere, we may have forgotten, just a little bit, the true spirit of Christmas in the joy of new adventure.

The next ten years saw us happily playing with our toys without much more than a passing thought now and then for the future. We applauded all successful control projects using methods other than chemicals, but insisted that the methods were too uncertain and costly for extended use. We plunged along feeling secure and self-righteous even though we sometimes seemed to create two problems in the wake of solving one problem. We referred to this phenomenon as "job insurance".

We had some nagging doubts when the stupid insects began to develop resistance to the lethal effects of some of our pet chemicals, but we quickly told ourselves that we had more smarts than the bugs and laughed gleefully as we created a plethora of new chemicals to which the insects and mites

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were not resistant, at least for the time being. We entertained a few doubts when our chemists found lethal chemical residues in our soil years after application of these same chemicals, but we brushed that aside with a flurry of analytical activity proving that these chemicals were not absorbed by edible crops in sufficient amounts to harm anyone. We told stories on our rounds assuring folks that they would have to eat two bushels of apples a day to ingest enough DDT to be harmful at the tolerance set by our regulatory agencies. The folks laughed because of the well-known cliché of the apple a day keeping the doctor away.

We felt a true zeal akin to the early missionaries arriving in the brigantine *Thaddeus* on the shores of Hawaii. Why did we feel so self-righteous and smug? Why did we want to spread our superior knowledge and technology throughout the world? Why?

Of inescapable importance is the fact that we must eat food to stay alive. Despite our vast technocracy here in the United States we have not yet found a technique of divorcing our bodies from the animal appetite for food, which we share with virtually all animals. Food is the one major element necessary for survival of an individual human. Food and reproduction are the two essential constants for species survival. When we reproduce, we immediately create a need for more food. Food, then, is the touchstone of human survival.

There was a time in human history when man selected his food on a chance basis. He would discard a rotten part and eat the good part. He was satisfied as a forager. Then he began to band together into permanent cities and towns for protection from his enemies. These cities and towns enlarged as man mastered his environment. At the time of the industrial revolution in the United States at the turn of the century, he had reached the point where he was capable of paying more attention to his creature comforts and foraging for food was a thing of the past. Food for the cities was produced on the farm and, as farm technology increased, each farmer was able to feed more and more of his city brethren.

As city and urban populations, dedicated to the production of automobiles and a vast array of material goods multiplied like a cancerous growth on the land, the farmer was left with the burden of feeding these helpless multitudes.

This, then, solves the phenomenal charisma of DDT and its fellow chemicals. The pressure on the food chain from farmer, to transporter, to wholesaler, to retailer and on to the consumer, was crushing. In addition to producing the plain, raw food, the food had to be concomitantly absolutely perfect. Regulations were promulgated to insure that no insects or insect remains contaminated that food. The money would not pass from the hands of the consumer back through the chain to the farmer unless the product was of the highest quality. These are the economic facts of living today in the United States.

During the past 15 years, disturbing side effects from the use of DDT and some of its relatives have become exposed. The widespread usage which resulted in these side effects would have been impossible in the days of the horse and buggy. The airplane and the tractor are the culprits here. Vast acreages were treated in a matter of hours or days. The plague of locusts which since biblical times has caused the death of hundreds of thousands of human lives from starvation has been controlled by airplane treatments with dieldrin. Thousands upon thousands of human lives have been saved as a result of DDT applications to control insect vectors of decimating diseases. Man has protected millions of acres of forest lands with DDT applications so that he can preserve his source of basic shelter material and bury himself in tons upon tons of paper. This magnificent contribution to the welfare of man, DDT, is now under indictment for the key reason it came into widespread use. It is altogether too persistent in our environment. It has poisoned our wildlife and the fish in our waters and is well on its way, along with a number of its persistent relatives, to being irrevocably banned from our environment. DDT is like a fascinating guest that simply stayed too long.

The same public which originally demanded the use of DDT and other chemicals to increase the production of high quality food and fiber has now risen in righteous wrath at the mounting evidence of environmental pollution. The evidence of widespread environmental pollution is also available for the automobile, yet, at least at this time, most of us will leave this meeting in our automobiles and would become immeasurably irate if we were told that we could not drive home, but would have to walk. Yet the death rate from auto accidents is 50,000 per year, 2 million persons are injured annually, and the estimated cost if motor vehicle accidents this year will exceed \$8 billion.

Society, in the United States, is now at a crossroad of decision. Despite our general high standard of living there are still serious pockets of famine in our land. Half of the rest of the peoples of the world are starving. Dire predictions of the doubling of our world population in a matter of 40 to 60 years as a result of the conquering of human diseases and other factors are periodically raised. The economic entomologist feels the firm pressure from these facts and concludes that he must work on increased food and fiber production to feed, clothe, and house this burgeoning world population. He also recognizes that at the present time, there is no other method of insect control as effective as chemical control for this purpose. This is a sobering fact.

Obversely, a horrendous cry is raised and increasingly restrictive legislation is being promulgated to protect the environments of the world from the world's most active polluter and despoiler—the human species and his multitudinous activities. Since 1492, less than 500 years ago, the human species has simply overrun the world. Society looks around at its

fouled nest and howls "This must stop." We must ban persistent pesticides from our environment along with cars, factories, airplanes and other pollutants. The economic entomologist is sensitive to this pressure also and concludes he must work on insect control measures which do not harm the environment. Since, at the present time, it would be impossible to produce the amount of high quality food consumed by the population of the world today without chemicals, a feeling of hopelessness ensues since, despite the public outcry, the public still hasn't caught up with the fact that instead of spending billions of dollars to explore the moon, those billions of dollars are needed to expand the volume of research necessary to produce an adequate amount of food and fiber, without chemical pollutants.

Simply as an exercise in perspective, let us see if we can find an answer to this dilemma by treating a colony of human beings with the same scientific detachment with which we would explore solutions to problems in a colony of mice or a herd of cattle. Let's go along with the astronauts to the moon and look back on earth from that distance. We might dream up these recommendations:

1. It seems obvious that if the world is bulging at the seams with such a large herd of animals that it is outstripping its food supply, there should be some form of population control instituted.

2. It seems equally obvious that the population is fouling its environment and the industries that produce pollutants will have to go, including those that produce pesticides, paints, and plastics, as well as automobiles and gasoline; in other words, virtually all the toys this population is used to playing with.

3. The population has to be dispersed from huddling together in what they call cities and everyone will have to return to producing their own food. In this way, everyone will have more time to fight insect and other pests.

4. We'll have to recommend instituting a breeding program so that the herd can raise a new breed of individuals with a thick fur covering making clothes and houses unnecessary.

Seriously, though, coming back to earth and our society in which we have to live, which direction can the economic entomologist take and still stay within the parameters of public pressure? If we go in the direction of eliminating chemical control we have to bear in mind that monumental sums of money are necessary to implement these programs to attain the same degree of efficiency now available with chemical poison control methods.

We also have to bear firmly in mind that man's battle with insects is strictly from the point of view of man and not what we can euphemistically call nature. A mosquito is useful in nature as food for birds and insects. To man it is a menace to his well-being and health. A termite in nature is one of many useful organisms in the forest economy which break down

solid matter (namely wood) into organic matter useful to other organisms. To man, a termite is a menace to his costly home.

Precisely what do we do when we "control" insects? One definition is given in a recent magazine cartoon depicting a pest control man kneeling on the kitchen floor with a whip in his hand. A neat array of marching cockroaches with flags flying are distributed around the floor in martial array. The woman of the house is looking on astonished. The pest control man says "We don't kill them, lady, we just control them".

Think about that just a little bit "We just control them." Another way of saying it would be "We just manipulate them." Manipulation of insect populations is basically the only sound, constructive approach to suppression of insect populations. The reason for this is simple. Contrary to the beliefs of religious fanatics, there is a biological force in the world which is just as interested in the survival of the insect as it is in the survival of the human. We have to use our brains and our technology to live *with* insects. We will never, never, annihilate them from the face of the earth without annihilating ourselves as well.

Economic entomologists have known this secret for many years. We have been deficient in not letting the public know about it. When someone calls in and asks about ridding their house of cockroaches, we have said "Use chemicals; it is the simplest and the cheapest method of suppression." Since the public accepted this answer without much question, it was the easy way out and forestalled a lot of detailed and time-consuming conversation.

Now we are going to have to educate the public, and the governments established by the public, that our latent and somewhat dormant concept of insect population management has to be generated and charged with a force of an Apollo mission. To manage insect populations, instead of simply trying to kill off comparative thimblefuls in terms of the total population, we need sophisticated computers and many thousands of additional investigators, computer-feeders, data gatherers, and computer data analyzers to get the job done. The reason for this is that it would be exceptional to find only one species of insect in a given ecosystem. Take an average home for instance. There might be termites, cockroaches, ants, fleas, ticks, pantry pests, bed bugs, carpet beetles, house flies, mosquitoes, and, finally, bird mites crawling all over everyone and driving them wild because they cannot be seen. Each one of these human pests needs to be suppressed, managed, or manipulated in some way. In the case of bird mites, simply removing the bird nest giving rise to the mites will suffice. In the case of fleas, remove the dog or cat and make someone very unhappy. You see, it is not simple.

We are developing along many lines to reduce the need for chemicals in our insect population management programs. These include chemosterilants, sex attractants, use of juvenile and other hormones, irradiation

sterilants, energy waves of various kinds, and biological organisms harmless to man but harmful to insects. We are also looking over all our old methods of control, some of which have been discarded for economic reasons, such as crop rotation, mechanical controls such as screens and fly swatters, cleaning up of food media, and many, many others. The list is almost endless in both categories.

Successful use of all of these manipulation and management techniques as opposed to simply spraying a chemical around in an attempt to kill insects outright, requires a much broader and more sophisticated program than we have seen up to now. It is going to require a much more extensive public education program backed up by much more research than we have seen up to now. It is also going to be much more expensive and, in some cases, may be downright traumatic. As an example, we have available at this moment an effective cockroach control program which does not require the use of a gram of chemicals. This is simply the encouragement in our homes of the emerald cockroach wasp, the ensign cockroach wasp and the wolf spider. These three organisms are perfectly capable of completely cleaning up a population of cockroaches in any home. But, our phobias and hang-ups get in our way. We don't want anything in our homes that creep or crawl. We are afflicted with entomophobia.

Without chemical control we may occasionally find a worm in our salad. Strictly speaking, from a purely scientific point of view, there is absolutely nothing wrong with eating a worm or two along with our salad. From the pure standpoint of edibility and nutrition, a worm is edible. However, our entomophobia makes it impossible for us to consider that worm as food fit for human consumption and we consider a human society which dines on insects as primitive and uneducated and much beneath our consideration. Hence, our dedication as a society in the past, to sanction and foster methods of insect suppression aimed at complete destruction of an insect population which dares to do what comes naturally and feed upon our salad greens. Chemical control has been by far the most effective, the most popular, and the cheapest method of accomplishing this aim.

In conclusion, I submit as an economic entomologist, that I know perfectly well that we have been polluting our environment with pesticides. For that matter, so has everyone else with their products of our advanced civilization. We have also done everything in our power to minimize and eliminate the detrimental effects to man in the use of such pesticides. We also are aware of the many other pollutants in our environment and strongly urge a concerted and intelligent approach, now, to the problems of pollution.

But, we also look around us and see that we are human beings and are vulnerable to human failings. As a society, there are many, many things we are unable to give up that cause pollution. To just single out one, all we need to do is reflect on our gasoline-powered automobiles for a short

time and you can readily see my point.

Economic entomologists are just one of the many thousands of groups charged with the responsibility of feeding the 3 billion people on the face of the earth. We also assist in increasing the population of the earth through reducing and eliminating diseases, providing materials for improved shelter, and providing for recreation and other needs.

The involvement of the economic entomologist with society is intimate and dedicated. We have a job to do and we are going to direct our best efforts toward the basic goal of increased human welfare. We are going to need more cooperation than ever before from allied groups including ecologists, biologist, economists, conservationists, nutritionists and home economists. We need the help from the nutritionists and home economists in case we fail in our objective. If we fail, we'll need information on the nutritional value of insects and other arthropods. If we fail, my wife and I will invite everyone over to our house for grasshopper sandwiches. Thank you.