

AFTERNOON SESSION
November 29, 1966

CHARLES F. WURSTER, called as a witness in behalf of the plaintiffs, being (522)
duly sworn, testified as follows:

THE WITNESS: Charles F. Wurster. * * * Department of
Biological Sciences, State University of New York, Stony Brook, New York

DIRECT EXAMINATION by MR. YANNACONE: (523)

MR. YANNACONE: Your honor, in lieu of listening to two pages worth
of qualifications, I submit that we can take the resume subject to cross-examination.

MR. CORWIN: With some minor reservations about his characterization.
that all of this is qualifications, I have no objection. * * *

(The qualifications of Dr. Wurster were received in
evidence and marked as PLAINTIFF'S EXHIBIT 2) (524)

Q. Will you tell counsel and the Court something about the chemistry
of DDT? * * *

MR. CORWIN: May I inquire on the voir dire, Your Honor, as to
whether he is qualified in this particular field?

THE COURT: Yes. Go ahead.

VOIR DIRE EXAMINATION by MR. CORWIN:

Q. Professor Wurster, are you a doctor or professor or do you have a title?
A. Any of them will do. (525)

Q. Will it be your testimony, sir, that DDT by some explainable
chemical reaction kills living organisms? * * *

Do you understand the chemistry by which this is done?

A. To some extent. No one understands all of the chemistry.

Q. To what extent can you describe the chemical reaction?

A. Well, when we talk about it, I will tell you.

Q. Does it make any difference whether the DDT is in para-para form?

A. Yes, it does.

Q. And are you going to be able to tell us in connection with this case (526)
what kind of DDT has been used by the Suffolk County Mosquito Control Commission?

A. Yes.

Q. Whether it is para-para or ortho-para or meta-para?

A. What reaction takes place?

Q. The chemical reaction that you say has a killing effect on some
living organism.

A. You can't understand the effect unless you know something of the
chemistry of it.

Q. Well, if the effect is death, does it make any difference whether the
chemistry comes about as a result of DDT, attacking through a chain of 25 chemical
reactions, or a direct reaction on a particular chemical?

A. The effect is not only death.

Q. What other effects are we concerned with?

THE COURT: Gentlemen, do you know what we are doing now. (527)
We are having testimony which is the proper subject of your cross-examination.

MR. CORWIN: I don't think this testimony is cross-examination,
Judge. It pertains to qualification.

THE COURT: Maybe it does. I don't know. I can't try your case for you. However, I feel this is a proper subject of cross-examination.

MR. YANNACONE: I will be happy if he did it on direct, Your Honor.

THE COURT: Please don't anybody get happy. Let us just try this case. Now, go ahead, counsel.

DIRECT EXAMINATION (continuing) by MR. YANNACONE

Q. Now, Dr. Wurster, will you please tell the Court and counsel and myself something about the chemistry of DDT? (528)

A. Okay. Well, DDT is a chlorinated hydrocarbon, and so I think the first thing we should do is to get some idea of what these are.

MR. CORWIN: I submit Your Honor, this is not responsive to counsel's question, and we are already getting far afield. He is talking about hydrocarbons generally. Let us stick to DDT.

THE WITNESS: I will get to it.

THE COURT: We have been talking about hydrocarbons for two days now. I asked for a definition myself, and part of it was given to me. Now, I am asking you if DDT has a direct relation to chlorinated hydrocarbon compounds?

MR. YANNACONE: Yes, Your Honor. Will you take this subject to connection?

THE COURT: Of course, I will. Go ahead. (529)

A. . . .Hydrocarbons are obviously those compounds that contain carbon and hydrogen. So chlorinated hydrocarbons are those hydrocarbons that also contain chlorine. Therefore, there are three elements in the molecule.

Now, what is a hydrocarbon?

Well, the world is filled with them. For example, acetylene is a hydrocarbon and so is butane, which is used for heating burners. Methane is a hydrocarbon; gasoline is a mixture of various hydrocarbons, octanes and a great variety of hydrocarbons; diesel fuel, petroleum in general; and naphthalene moth balls, for example, are hydrocarbons. . . . as to what is DDT? . . .

DDT is made from chlorobenzene and ethyl alcohol with chloral as an intermediate. I don't think there is any point in going into the manufacture of it any further.

However, the chlorinated hydrocarbons include many of our most common pesticides. Many of them are highly toxic, and they are chemically very stable. We are now getting to the relevance of this case. The chemistry of the molecule is directly related to its action. (530)

Now, one thing that is important to know is that it is chemically very stable, so that when it gets into the environment, it tends to stay there. It will decompose in the presence of either acid or base, but the environment is closer to neutrality, and so it is not broken down.

Another factor of importance is that it tends to be soluble in organic solvents and insoluble in polar or aqueous solvents. This means then that it will dissolve in hexane or acetone or ethyl alcohol.

THE COURT: I understand, go ahead.

A. And it will stay away from water. So if you have a fish, let us say, swimming through water that has a minute amount in it, the DDT will tend to head for the fish and out of the water. It is essentially a separatory-funnel effect where the fish will extract the DDT from the water.

THE COURT: Like osmosis? (531)

THE WITNESS: Not osmosis, solubility.
Now DDT is a white crystalline solid.

THE COURT: A lot of people think it has a strong odor.

THE WITNESS: That is usually the vehicle that it is sprayed in, which is kerosene. It is sometimes sprayed as an emulsion, and it has water mixed with it or xylene or something like that. It is the solvent that smells; it is not the DDT itself.

DDT is a white crystalline solid, and it has a melting point of 109° centigrade.

* * *

Your Honor, I was going to bring a model of DDT to show what (532) is looked like, but I didn't know that I was going to be on, so I don't have my model.

THE COURT: All right.

THE WITNESS: Now, here is the molecule ethane, (writing on the blackboard) and that is a hydrocarbon.

Okay, now let us make a few substitutions. Let us put a chlorine in place of each of these hydrogens, and we are going to replace two of the hydrogens with what came from the chlorobenzene in the synthesis, and this is a six-membered ring.

Okay. Now, we have the molecule DDT. DDT is actually a misnomer. It stands for dichlorodiphenyltrichloroethane, which is not really chemically accurate. A more accurate name is 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane. The whole thing is a substituted ethane, and the para stands for the fact that this chlorine is in the opposite position from the attachment to this carbon here. (533)

Now, if it were over here, it would be meta, for example, and the commercial product contains some of the meta. So when you buy commercial DDT, you don't buy pure para-para-prime-DDT. You get a mixture. The mixture contains about 77%, I think it is, of this compound. It has about 15% ortho-para-prime-DDT, and it also has about 4% of para-para-prime-DDD, which is commonly known as DDD. It is the same as this, except that there is one hydrogen here in place of this chlorine, so the commercial product is not losing power.

The toxicity of these things vary.

THE COURT: Now, slow up. Please slow up as you go along. Be specific about toxicity.

THE WITNESS: Okay. Of these several isomers, this one on the board is the most toxic to most organisms--the DDT. A good bit is known of its toxicity, and this one is toxic.

Now, this one is not as ubiquitous a compound, and it is less toxic than this. This is the ortho-para derivative, which is something in between 5 and (534) 10 times, I should say, one-fifth and one-tenth as toxic.

So this is the most toxic. Any time you spray DDT, you are putting most of this into the environment. So this is what we should talk about, but it is important to bear in mind the fact that there are these other compounds there, and they have similar solubility and characteristics.

Okay. Now, I think it would be a good idea at this point if I give you just a short quote from the Merck index, which I think is a recognized authority.

Q. Before you make the quote, will you state for the record what the Merck index is and who puts it out?

A. The Merck index is put out by the Merck Company.

THE COURT: This is a pharmaceutical company, Merck Pharmaceutical?

THE WITNESS: That's right. It has in it a vast array of organic (535) compounds, and it tells the physiological and solubility effects of these compounds, a general run down.

Q. Is this book a recognized book in the field of chemistry?

A. Yes. Practically all biochemists have it somewhere on their fingertips, usually on their desks.

Q. Do you recognize it as a scientific work?

A. Yes, I do.

Q. All right. Please continue.

A. I would like to read just one quote from what the Merck index says about DDT: "Human toxicity: Poisoning may occur by ingestion or by absorption through the skin or respiratory tract."

"Acute: Tremors of head and neck muscles, tonic and clonic convulsions, cardiac or respiratory failure, death. Estimated oral fatal dose 500 milligrams per kilogram body weight of the solid material. Solvents such as kerosene increase toxicity. Death occurs in two to twenty-four hours.

(536)

"Chronic: Hepatic damage, central nervous system degeneration, agranulocytosis, dermatitis, weakness, convulsions, coma, death."

Now, I will ask you whether it would be a good idea if I were to say something about the other chlorinated hydrocarbons which are not at issue here?

THE COURT: No, this is the only one we are talking about.

MR. CORWIN: And I would object.

THE WITNESS: Okay. So we will pass that up.

Q. Are you going to use the blackboard any more?

A. For the time being, no.

Q. Please continue.

A. Okay. Now, let us talk a little bit about toxicity. How do we determine toxicity? Probably the most common technique is to establish what is known as an LD₅₀. That is an amount which will kill 50% of the test group. This means that if you had a group; if you would take a number of groups of rats, you would feed the differing groups varying amounts, and then you would simply plot the percent-kill versus the dosage, and you would draw a line. You would probably get a straight line relationship, and where it crosses 50%, that is by definition the LD₅₀.

Q. Stop for a moment, please. Is this the standard method usually (537) employed in measuring the toxic dose of various drugs in pharmaceuticals?

A. This is pretty standard, I think. Of course, you wouldn't determine LD₅₀ for an innocuous compound in general. I don't think anybody---Well, let us stop with that.

Q. The method though is standard method?

A. The method is standard, yes, and it is done with a particular chemical that is proposed to be used as a pesticide. They will establish this with a number of organisms, probably rats, and maybe goldfish, maybe possibly birds, although there seems to be less of that, and, of course, the same thing with insects. They establish this same thing to see how effective it is in killing insects. That takes care of the chemistry at this point. (538)

Q. All right. Now, of your own knowledge, you are familiar with the biological effects of DDT?

A. Well, I am.

THE COURT: What does biological mean?

THE WITNESS: It means its effect on living systems, living organisms of any kind.

THE COURT: All right. Go ahead.

Q. Before we go on, have there been determinations in the regular course of scientific investigation of the relative toxicity of DDT as compared with other common insecticides?

A. Yes.

Q. Do you have a summary of those with you?

A. Yes, I do.

Q. It has been criticized by people in the field, isn't that so?
 A. Yes. Not this. I have never heard anybody criticize this. (546)

Q. Well, the mere fact that you haven't heard anybody criticize it, that doesn't mean that because this particular one hasn't been heard to be criticized by you, that doesn't mean that it is good, does it, or that the protests were used?

THE COURT: Counsel, all this testimony is argumentative. This is a question of cross-examination. You are now merely examining on the voir dire to determine the admissibility.

MR. CORWIN: I will renew my motion, Your Honor, that it should not be introduced as an exhibit.

THE COURT: I grant your motion, but I grant it for a different reason than yours. It is self-serving.

DIRECT EXAMINATION (continuing) by MR. YANNACONE:

* * *

Q. With respect to biological effects, you have a doctor's degree in what, Doctor? (547)

A. Organic chemistry.

Q. And you are a professor of what?

A. Biological sciences.

Q. At what school?

A. State University of New York.

Q. You have background then and training and actual teaching in both the field of chemistry and biology and their combination?

A. Well, primarily biochemistry.

Q. You are familiar with the general literature of both disciplines?

A. I think it is a fair statement to say yes, although to say one is familiar with all of the biology or all of the chemistry is a rather sweeping statement that I wouldn't quite want to make.

THE COURT: And that goes for the law also.

MR. YANNACONE: Most emphatically, Your Honor. (548)

THE WITNESS: Each of the two fields is quite vast.

Q. Have you made a study of the scientific and technical literature which respect to the biological effects of DDT?

A. Yes.

Q. Now, we have had a great deal of testimony about literature so far. * * * Are you familiar with the technical scientific literature generally in the field of chemistry and in the field of biology as they affect and as they refer to the effect of DDT on living organisms?

A. Yes.

Q. Now, will you tell us generally what this body of literature consists of? What is it? * * * When we talk about literature with a Capital L, what is it? (549)

A. Well, when you are a student in high school or in college, you get a good bit of your information from textbooks. Fifty years ago this was probably the prime medium for distribution of information. When you are in a research field, this is no longer the case. Such technical information tends to flow through other channels, those channels being specialized journals.

Now, the volume of these specialized journals has in recent years become extremely voluminous, and so much so, that no one person can possibly keep



Q. And will you tell us where the summary is taken from?

A. The summary came from the Pesticide-Wildlife Studies, Fish and Wildlife Service, circular 167, as published in June of 1963, page 104.

MR. YANNACONE: I would like to have that marked in evidence, Your Honor. I offer it in evidence. (539)

THE COURT: Show it to counsel.

MR. YANNACONE: I have a copy.

MR. CORWIN: What page is that?

THE WITNESS: Page 104.

THE COURT: Any objection, Mr. Corwin?

MR. CORWIN: To its being introduced, yes.

THE COURT: All right. Sustained. Mark it for identification.

(The document was marked as
PLAINTIFF'S EXHIBIT 3, for identification)

Q. Will you tell the Court what that exhibit is?

A. It is a list of commonly used pesticides and their toxicities in rats, bobwhite, pheasants, mallards and bluegill fish, so it is somewhat of a cross-section. In each of those cases DDT is taken as 1. and the others are given relative to it. You wouldn't consider this necessarily the last word in that, I am sure, there can be variations from one set of tables to another. This is a common sort of a table. You can find lots of them, and I showed this one, because it was handy, and it was reasonably authoritative. But I don't think anybody would argue very strenuously over a few decimal points. That's not the point. (540)

MR. YANNACONE: Now I would like to offer it into evidence.

MR. CORWIN: I still object on the ground that there is no proper foundation for it, and I should like further at this point once again to inquire of the witness with respect to his personal knowledge of some aspects of this thing. May I inquire, sir?

THE COURT: On the voir dire, go ahead.

VOIR DIRE EXAMINATION by MR. CORWIN:

Q. May I inquire whether or not it is your testimony that DDT is equally toxic in every form and in every form that it is applied, every form of it chemically, and every form in which it is used? Is it equally toxic? * * * (541)

A. The answer was that para-para-prime-DDT is the most toxic of several forms of DDT, and that the commercial product has in it several other compounds, all of which are less toxic.

Q. Is it also your testimony, sir, that the commercial product has a meta form in it? * * *

A. Meta, yes it does. * * *

Q. Do you have any proof of that? Have you made an analysis of commercial DDT yourself?

A. Yes.

Q. You have. And have you found the meta in it?

A. Yes.

Q. Where did you get the DDT that you used for your sample? (542)

A. I have it on my shelf in the laboratory.

Q. Where did you get the DDT from? Was it from a manufacturer such as is used by the Suffolk County Mosquito Control Commission? * * *

A. It came from the Geigy Chemical Co.

Q. Geigy doesn't manufacture it, does he? I will put the question in a different way. Does Geigy manufacture DDT?

A. Yes, they were the first one to make it in this country.



Now, eventually, if the work is worthy of publication, the editor will reach a point where he will say, "Now, it's okay." It then will go through the editor for grammar, for punctuation, and so forth, and eventually there may even be some haggling back and forth.

An editor will say, "This table is irrelevant."

And you write back, and you say, "No, it is relevant. We have to have it."

You kick it back and forth, and eventually a decision is reached. So this whole thing can, with a good reputable journal, be a very rigorous process.

Now, this then means that when the uninitiated reader, who is not competent in a particular field, picks up Science and reads an article in it, he knows that it has gone through this procedure, and that it must not be a phony. Sure, it could still be. There could still be something the matter, but in general these data are assumed to be honest, and the conclusions have at least reasonable logic behind them because of this screening process. (554)

Q. Do other journals substantially follow similar procedures?

A. Yes.

* * *

Q. Do all journals that contain material generally with respect to the biological effects of pesticides follow this same editorial procedure?

A. I'd say it is a fair generalization, but the degree of rigorousness with which they follow it does vary. It often happens that if you can't get your paper in a good journal, you try one where you know it will be easier, and so there is a sort of--you could make a spectrum with easy at one end and hard at the other. (555)

Q. And this easy and hard refers to the amount of screening by other scientists before there is a printed publication?

A. In general, yes.

Q. In the regular course of your scientific work, are you called upon to rely upon material contained in technical journals?

A. It is absolutely essential. A scientist without the literature is like a skier without any legs.

Q. Would it be possible for you to form what you would consider a reasonably certain scientific opinion on the effects, the biological effects of DDT without reference to the literature?

A. Well, you would have to go right back to the beginning and assume and start with no knowledge. You would then work up, and this is a practical impossibility. You must rely on the literature. Before one does any research, one always spends a few weeks in the library reading to know what is known, so that you don't keep going over the same ground. (556)

Q. Is the material with respect to the biological effects of DDT that is normally found in what you would consider reputable scientific journals indexed in any way?

A. Yes, it is.

* * *

A. There are what are known as abstracting services. Chemical Abstracts (557) is one example, and Biological Abstracts is another. There is even one now done by, I think it is USDA that publishes a pesticide abstract. In any case----

Q. Stop for a moment. When you say USDA, what are you referring to?

A. U. S. Department of Agriculture.

Q. And what journal did you refer to?

A. Well, I think it is called the Pesticide Documentation Manual. I think that is the correct name.

Q. And this is an index?

A. This is an index of the publications in other journals.

Q. Have you had occasion in the regular course of your scientific work to examine these various indicies and search out the literature with respect to the biological effects of DDT? (558)

A. Yes.

Q. In the course of this litigation on the previous motion, did you prepare this accumulation of papers referred to as the technical index and compile it?

A. Yes.

Q. Have you read the papers contained therein?

A. Yes.

Q. And do you feel that they fairly and accurately represent the body of knowledge of the biological effects of DDT?

A. Yes, although it is but a small fraction of the total picture. One could arrive at the same conclusion by having a stack of printed matter that would be five times that height. It wouldn't materially change the picture.

Q. But you feel these are representative papers from reputable scientific journals?

A. Yes.

(559)

Q. And you feel-----

THE COURT: You mean an accumulation of papers?

Q. A compilation of papers from what you consider a reputable scientific journal, is that right?

A. Yes.

Q. And you rely on this type of information to form an opinion?

A. Yes.

* * *

MR. CORWIN: Is that Exhibit C for identification?

MR. YANNACONE: Yes, I think so.

* * *

Q. Have you studied the biological effects of DDT?

(560)

A. Yes.

Q. Have you studied it in your own laboratory?

A. Yes.

Q. Will you tell us in your own words generally the biological effects of DDT? * * *

A. DDT is a general nerve poison. It will kill essentially any organism in the animal kingdom. If there are exceptions to that, I haven't come across them.

Q. And this is its mechanism, and it somehow works on the nervous system?

(561)

A. Its mechanism is not thoroughly understood, although there are some hypotheses that have a good deal of support and which explain at least a good bit of what we see.

Q. Are you familiar with the natural resources of the County of Suffolk?

A. Somewhat.

Q. Have you had occasion to observe yourself the birds, the fishes----

THE COURT: Can't we stipulate that we have birds, bees, fishes, and everything else on Long Island? Now, come on, counsel. You make that stipulation, don't you, Mr. Corwin?

MR. CORWIN: That we have them, yes. If he is going to start (562) talking about how many have been killed by DDT, I want to know the whole number.

THE COURT: So far I asked you just one thing. Will you stipulate that we have birds, bees, and fishes on Long Island?

MR. CORWIN: I will stipulate that we have natural life on Long Island, all kinds of organisms.

THE COURT: All right. Let us go on from there.

Q. Can you form an opinion with a reasonable degree of scientific certainty as to the biological effect of DDT on the natural resources of an area such as the County of Suffolk?

A. Yes.

Q. Have you formed such an opinion?

A. Yes.

Q. Can you tell us what that opinion is, briefly?

A. It is my opinion that DDT is doing permanent damage to the biological world of the natural resources, specifically the wildlife resources of (563) Suffolk County--not only Suffolk County, but we are talking about Suffolk County at this point.

Q. Can you form an opinion with a reasonable degree of scientific certainty as to whether the continued use of DDT by the Suffolk County Mosquito Control Commission in any way will cause serious or permanent damage to the natural resources of the County of Suffolk?

MR. CORWIN: Objection, Your Honor. There is no evidence here that he knows what that use is, nor is there any in the record.

* * *

THE COURT: I will allow it. Go ahead.

* * *

A. Yes.

Q. What is that opinion?

A. It is my opinion that it will cause such damage. (564)

THE COURT: Does it now?

THE WITNESS: I believe that it does now.

MR. YANNACONE: I have no further questions.

CROSS-EXAMINATION by MR. CORWIN:

Q. Now, you agree, in connection with the publication of the United States Fish and Wildlife Service that some things they published were criticized by people of knowledge who are up in the field, is that correct?

A. No one is above criticism, including reputable journals.

Q. It is a fact, isn't it, that some and even many of the articles in Science are criticized?

A. Yes.

Q. Now, you said in answer to a question that Mr. Yannacone asked you that you had made an analysis of DDT yourself, is that right?

A. Yes.

Q. Will you tell us what you did, how you went about it, and what (565) your findings were?

A. Which particular analysis are you talking about?

THE COURT: And in order to determine what?

A. I do this all the time.

Q. What method did you use to determine the quantity of the meta in the DDT? Did you analyze your DDT for composition?

A. Yes.

Q. How did you do it?

A. Well, all right. Let us talk about analysis. You analyze a sample such as a bird or a brain or an ovary or what have you. You take the sample. The first thing you do is weigh it. There are a number of methods, but the method I use is to after weighing it, grind it in a mortar and pestle with some florisil and sodium sulfate until the whole thing is completely homogeneous; then it is put in a chromatographic column and it is extracted with petroleum ether; that petroleum ether (566) has a little diethyl ether in it. The extract then is concentrated to a known volume, and a known amount of this material is then injected into a gas chromatograph. The gas chromatograph is attached or is hooked to a recorder, and the recorder draws a curve which tells you how many components are in it, and with some further work, what they are.

I have here, if you would like to see what they look like, I have got a sample which shows the chromatograph. Here is a standard. The sample was injected here. The first compound that comes out is DDE. The second one is DDD, and the third one is DDT. There is a standard again.

Now here is an analysis of an osprey egg in which the osprey egg shows DDE, a little bit of DDD, and a little bit of DDT, but mainly DDE. You then have the problem--and this is very important--of establishing the fact that this particular peak is DDE and not something else.

Well, there are several ways to do this. First of all, in this clean-up procedure with the column, you have eliminated most other compounds, various (567) lipids, other materials which would interfere. That doesn't necessarily prove that this particular peak is DDT.

However, you will notice that it came out of the column in a certain length of time, which is three and a half units on this graph. The standard came out in three and a half in each case, and the DDE or should I say the unknown curve in the osprey egg also came out in three and a half units, which is strong indication, but not proof, that this particular compound is DDE.

Incidentally, DDE is a metabolite of DDT. So that insects or birds or other organisms are very slow to break this material down.

Therefore, the presence of DDE indicates that DDT has been going through this system because DDE is not commonly present in the commercial product. That is a biological product of degradation of DDT. But you still haven't proven conclusively that this is in fact DDE and not something else.

The final proof of this is to run the same sample on another chromatographic system and probably the commonest way of doing this is to do it on thin-layer (568) chromatography.

Now, I was going to bring in an exhibit to show you thin-layer chromatography, but as I say, I didn't know that I was on today. Thin-layer chromatography consists of the spreading of a thin layer, in this case of silica gel, which you might say is a glorified sand on a glass plate, and then running a solvent against it, leaving the glass plate inside of the glass tank, which has a solvent on the bottom of the tank, and then by capillary action the solvent rises up the thin layer on this plate, and it carries different components with it to a different degree, and the speed with which these components move and that has been spotted on the thin layer is proportional to the solubility, and the moving solvent versus the degree to which it is absorbed on the medium.

THE COURT: I just want to make sure, Mr. Corwin, that you understand what he is saying. Do you?

MR. CORWIN: Yes, I do, Judge.

THE COURT: I'm glad you do.

(569)

* * *

MR. YANNACONE: I didn't ask the question, Your Honor.

THE WITNESS: This is important. We have to be able to prove, however, what these things are.

THE COURT: This is important to get a good mark in college.

THE WITNESS: No, Your Honor, it is not important to get a good mark in college. It is important to know whether DDT is in the environment or whether it isn't, where it is, and how much.

THE COURT: Can't you just say that? (570)

THE WITNESS: I could say it, but he wouldn't believe it.

THE COURT: You tell it to me. I am the one who has to believe it, not him.

Q. Aren't you being a little presumptuous when you make a judgment of what I will believe and what I won't believe in what you say?

A. Yes.

THE COURT: Come on, Mr. Corwin. Let us get going. We are going to be here forever on this case if we don't get down to the issues.

MR. CORWIN: I just want to make sure of the way he makes a judgment.

THE COURT: Is this a basis for an opinion--how he makes a judgment? He is a professor, and he is a doctor. He has done all these things. He has a rating. What more do you want? The least he can do is to give an opinion, be it right or wrong. He can give an opinion. (571)

MR. CORWIN: I want to know if he is familiar with some of the work in the professional literature field.

THE COURT: Why don't you just ask him that.

Q. Are you familiar with some of the work that appears in professional literature by Mr. Woodwell?

A. Yes, I am familiar with it.

Q. Is Mr. Woodwell in the room?

A. Yes.

Q. Are you aware of the fact that he reported in his papers a much greater recovery of the ortho-para form than 70%?

A. No, I am not aware of that.

Q. Will you come back to this wildlife table that Mr. Yannacone showed you, where the ingredients of toxicity were related to these various chemicals against different forms of animal life. Does the degree of toxicity in that kind of a study depend, among other things, upon the age of the bird, if you are studying a bird?
* * *

A. Yes, certainly it is. I am sure the people who did the table were aware of it too. (572)

Q. Isn't even the sex important?

A. Yes.

Q. Is there anything in this particular literature to indicate that those things were taken into consideration?

A. Normal scientific procedures would have taken those things into consideration.

Q. And are you sure that normal scientific procedures were used in this study? Are you sure of your own knowledge, other than what you think, because you regard this as a reputable publication?

MR. YANNAZONE: Your Honor, the thing is not in evidence.

THE COURT: Counsel, his own knowledge comes from reading of things such as this, from going to school, reading books, going to lectures, going to laboratories, and going out in the field. This is what gives him his own knowledge. I don't know where else he can get his knowledge from, counsel. (573)

- Q. What is DDT--dehydrochlorinase?
A. It is an enzyme that decomposes DDT. It removes hydrogen chloride from the molecule.
- Q. Does that have something to do with the break-down of the chemical?
A. Yes, it does. It is the enzyme that -- Well, go ahead.
- Q. Is it present in nature?
A. Yes.
- Q. Is it present in greater degrees in some places than in others?
A. Yes.
- Q. Now, when you were reading the Merck table, are you familiar with that?
A. With the Merck table, the Merck index? Familiar with it or memorized it--which do you mean?
- Q. Are you familiar generally with the chemicals that are listed in it? (574)
A. It is a reference volume. I use it when I need to know one particular thing.
- Q. I will just ask you the question, and you answer me if you know.
A. Yes.
- Q. Are there many chemicals listed in Merck that are commonly available and that are far more toxic than DDT both to man and to animal?
A. Yes.
- Q. Are you doing anything about suggesting that those be banned?
A. Those are not all over our environment. DDT is.
- Q. Is DDT the only toxic chemical that is all over our environment?
A. I know of no other chemical that is as widespread as DDT, other than things like water. Let me modify that by saying that I know of no other artificial man-made chemical that is as widespread as DDT.
- Q. How many deaths have occurred from the use of DDT? (575)
A. I don't know.
- Q. Do you know whether there were any out here?
A. Yes, there have been.
- Q. Are they documented somewhere in this literature of which you say you are so familiar?
A. Yes, although I haven't been directly following up human toxicity. It is not as much my field as some other category.
- Q. You are not concerned about its effect on human beings as much as on rodents?
A. I didn't say that.
- Q. I am asking the question.
A. I didn't say that.
- Q. I am asking you the question: Are you more concerned with its effect on wildlife and animals than on humans?
A. No, I am concerned about its effect on both, but I know more about its effect on wildlife. Nobody knows a great deal about its effect on humans, and we, therefore, must relate what happens in the rest of the animal world to that which we don't know about humans. (576)
- Q. You know generally how the commission uses the DDT, don't you?
A. I have a rough idea.
- Q. And they are using the technical DDT in some form or other--emulsified and then diluted?
A. Yes.

Q. So that when we are talking about the DDT that is being used by the Suffolk County Mosquito Control Commission, we are talking about what is generally referred to as technical DDT, is that correct?

A. Yes.

Q. You said that you analyzed your DDT from your shelf, and that you found some meta form in it. How did you determine that--by your gas chromatograph? How did you determine the meta form was present in the DDT that you used, which you say you got off your shelf, and you don't know how long it had been there? How did you find the meta form in this?

A. Ortho-para is the common impurity.

Q. You said that it has a meta form in it. I am asking you how did (577) you determine that? * * *

Please answer the question. I am not concerned with what you did on the blackboard. We are talking about how you analyzed it, and how you determine if there is a meta form present in DDT? * * *

Where did your sample come from? You said it came from Geigy?

A. That's right.

Q. Well, was it technical DDT?

A. Yes.

Q. Do you think just because it was technical DDT that came from Geigy that it has got the meta form?

A. I am talking about ortho-para as the common impurity, not meta. If I said meta, I said it inadvertently. I think you brought up meta first. I may have said it. If I did, it was a mistake. Ortho-para is the common impurity of technical DDT.

Q. Can you name me the publications to which you referred in answer to Mr. Yannacone's question as to whether or not you were familiar with the (578) literature?

A. Can I name them?

Q. Yes.

A. Well, hundreds of them.

Q. Can you name them?

A. Which ones?

Q. You said that you were familiar with all of them. Are you?

A. All the technical literature?

Q. Yes.

MR. YANNAZONE: Your Honor, does he just want a list of the various names of the journals?

MR. CORWIN: No, I am cross-examining this witness as to his credibility right now for your information.

A. I am not familiar with every technical journal in biology and chemistry, and neither is anybody else.

MR. YANNAZONE: Your Honor, I request that the question be made more definite and certain. When he is talking about journals, does he mean just titles of different publications or volume number, page number? (579)

THE COURT: He means titles. Now, what are we waiting for, gentlemen?

MR. CORWIN: Well, I am asking for the indulgence of the Court while I try to get back to these basic issues and away from this other stuff.

THE COURT: All right.

Q. Do you know anything about how much DDT has been used in Suffolk County by everybody?

A. It's virtually impossible to find out how much DDT is used any-

where, because everybody is using it all the time. That's one of the big problems in the whole field. Nobody knows what is going on, except that there are vast amounts of it all over the world.

Q. Will you concede that the use of DDT on the basis of the figures that you heard here, 5040 gallons, 25% emulsion, which was purchased this year, as against about 3500 used, would you concede that that is a relatively insignificant amount of DDT used in Suffolk County in 1966? (580)

A. No, I wouldn't concede that at all.

Q. Would you have any idea of what proportion it is?

A. No, I am not sure anybody does.

Q. You don't have any idea whatever whether it is 1% or 99%, is that right?

A. That is essentially right, yes.

Q. And your judgment that the DDT used by the Suffolk County Mosquito Control Commission was seriously affecting the wildlife in Suffolk County is based on a use, the percentage of which of the total you don't know, is that correct?

A. You are asking me how much bad is bad, and I said bad is bad; and it's that.

Q. Did you hear the testimony of Mr. Taormina?

A. Yes.

Q. Do you subscribe to what he said about bad being bad?

A. Yes, essentially. (581)

Q. But you don't think that it applies to wood alcohol?

A. Wood alcohol isn't all over the place.

Q. Wood alcohol?

A. If I analyzed your body for wood alcohol, I'd find nothing, I think.

Anyway, that is what I would assume.

Q. You might be wrong. I had a drink for lunch this afternoon.

THE COURT: When you ask a dangerous question like that, you are going to get an answer.

A. I hope you didn't have wood alcohol for lunch.

Q. No, I hope not too.

THE COURT: Is that methyl alcohol?

THE WITNESS: It is methyl alcohol, and it is very toxic. Ethyl alcohol is desirable.

Q. You can buy that in almost every hardware store and paint shop in Suffolk County, can't you?

A. That's right.

Q. You wouldn't have any idea of banning its manufacture and distribution, would you? (582)

A. We are here talking about DDT, because it is everywhere.

Q. Just answer the question. * * *

Will you please answer the question, with a yes or no? * * *

A. I am not talking about wood alcohol. It has nothing to do with this case.

Q. I am trying to make an evaluation of your judgment so the Court and myself can understand something about your thinking when you make these judgments and when you say that bad is bad.

Now, you say that DDT is bad because it is all over. But you are not willing to concede or are you willing to concede that wood alcohol is all over in the paint shops, hardware stores, and it is available, isn't it? (583)

A. It is all over in the environment. It is safe enough in the paint shops, just like DDT is safe in the bottle.

Q. You don't have any objection to the manufacture and distribution of DDT, do you? * * *

You don't have any objection to the manufacture of the stuff, if somebody wants to manufacture it, do you? * * * (584)

A. And just store it?

Q. Don't ask me questions, please, Mr. Witness. I'm talking about the manufacture of it for the moment. Just manufacture, and let us stop right there. You don't have any objection to that, do you?

A. No.

Q. You don't have any objection to the manufacture of the atomic bomb by the Federal Government, do you?

A. Same question, right.

Q. You don't have any objection to the manufacture of aspirin, do you?

A. No.

Q. It kills people if it is improperly used, doesn't it?

A. Right.

Q. You wouldn't ban its distribution, would you, that is aspirin? (585)

A. No.

THE COURT: Counsel, he never said he would. He never said he would do any of these things. He is here to testify concerning DDT. If you move over maybe one step and stay within the grouping of the chlorinated hydrocarbon compounds that I heard so much about, we should make some progress in this case. I don't think it is important whether a horse drops a calf or whether a horse drops a colt. Let us stay where we are supposed to be--with DDT. I don't give two hoots about what he thinks about aspirin. I have never used it in my life, and it doesn't even interest me in this case.

MR. CORWIN: I don't care either, Your Honor, except insofar as it has something to do with how he makes his judgment.

THE COURT: He makes his judgment, as I said before, the way (586) I do, I hope. I have volumes that I get. I get my advance sheets and I read them religiously. I get my law books from the Judicature Society, from the American Bar Association, even the Suffolk County Bar Association, and I read them religiously. I did go to a half-way decent school, I hope, and from this I hope I got an education. Now, this is what this young fellow does. I don't think he gets an education from aspirin bottles.

Q. Did you spend your whole day listening to adversary procedures from people who went through the same thing and who read the same books?

THE COURT: Counsel, why do you ask him this? Mr. Corwin, it has nothing to do with what I am interested in. Believe me, his likes or dislikes don't interest me one iota. I don't care what he likes to do or dislikes to do. I am interested in the effects of this DDT. I am interest in learning the effects of a deleterious substance that may or may not be hurting people, and if it is, can I stop it. This is what I want to know. Now, let us go on with this please. (587)

Q. If the amount of DDT that was, as you said, spread world-wide, all over, was that amount that was used from the time it was started until today by the Suffolk County Mosquito Control Commission and nobody else, would you still say that what they did was serious to the natural life?

MR. YANNACONE: Your Honor, I have to object to that, because he is referring to spreading Suffolk County DDT world-wide, and then he is asking a question with respect to it. It didn't happen that way. It is not a fact in evidence.

MR. CORWIN: Are you willing to concede, Mr. Yannacone, that the use of DDT is all over the United States and maybe even in India, where a lot of it goes with our tax money, and that it might have come back to Suffolk (588)

County; that there aren't any barriers or passports needed to get this stuff mixed up in the ocean?

MR. YANNACONE: I will concede that once it is into the environment, it travels, and where it stops no one is in a position to know.

MR. CORWIN: Well, it breaks down after a while, and even your own witnesses have testified to that.

THE COURT: You mean in its used state, Mr. Corwin?

MR. CORWIN: Yes.

THE COURT: Ask him where he thinks it goes, and what he thinks happens to it.

MR. CORWIN: Well, I am asking him now if the one part per ten trillion that the mosquito commission maybe put in there is dangerous and serious.

MR. YANNACONE: I'm going to object to the characterization, because there is no evidence on the record of just what the total is, the total they used. (589)

THE COURT: Counsel, there was testimony as to this. He did quote certain proportions, and I tried to find out. I am still trying to find out, because I have certain thoughts of my own. I asked where is it--in the confined body of water or is it at the seashore? The answer should be obvious. At least, I should think so. If it is a confined body of water, there is a tendency to remain there and do that damage. If it is going to be the Atlantic Ocean and there is a gale going on, it is going to blow it from here to France Maybe. I don't know. Do you follow me? I don't think it will mean a thing to my final determinations in this case.

* * *

A. I would say quite likely it is deleterious, and I can support it with a few rather subtle findings where incredibly minute amounts of DDT have caused nevertheless significant, measurable biological effects. (590)

Q. On what animals?

A. On fish. Not just fish, but let us talk about fish.

Q. What kind of fish?

A. Goldfish. These fish were subjected to a month of toxaphene in this case. Toxaphene is a chlorinated hydrocarbon, and so the findings in it are relative to DDT. When these goldfish were subjected to water containing somewhere in the vicinity of one-hundredths of the toxic amount, these fish appeared in every way normal. They seemed to act like normal goldfish should, except when they were compared with controls that were not subjected to that amount of DDT. When their reactions were measured quantitatively, it turned out that these fish were considerably souped up; that their nervous systems were jazzed up; that their normal reaction mechanisms were quite substantially different. Even though they appeared to be normal goldfish, there was a decidedly measurable biological effect. (591)

All right. You may then say does this matter?

It certainly does matter, because one must assume on evolutionary theory that that which we have is optimum, and it is best; that it is best suitable and best adapted to the environment. Therefore, any change, any biological change by a foreign material like DDT or toxaphene is a change for the worse.

Therefore, this is a harmful effect on this population. I might also say---(592)

Q. Let me just interrupt you there so we can carry this thought a little further. Sometimes the populations of a particular species is greatly increased or decreased because of climatological conditions, isn't that so?

A. Yes, that's right. * * *

Now, there were other studies that were done on--and I am trying to show you what minute amounts will do. Up in Nova Scotia, they are very concerned----

Q. Well, I didn't go there.

A. I just want to bring out that in Nova Scotia they are very concerned, for obvious reasons, with salmon. So they tend to use salmon as their experimental animals. They set up two tanks, long, thin tanks with a temperature

gradient. The temperature gradient ran from something like 4° centigrade up to about 18° centigrade, and so these salmon had the choice of swimming from the tank to that temperature that they preferred. (593)

Well, one was a controlled tank. There was nothing but water in it. The other was a tank that had a few parts per billion of DDT.

Now, the controlled fish selected a temperature of, I believe it was in the neighborhood of 12° centigrade--no, I think it was lower than that. It was about 8° centigrade.

The ones that had the DDT in them selected a temperature that was more like 16° centigrade. In other words, they selected a much higher temperature.

So here you have the temperature selection mechanism disrupted by an amount which otherwise is unmeasurable. It is a fantastically small amount, but there was a difference in those fish. They were not normal fish. There was a physiological measurable difference.

Furthermore, there was evidence that those salmon were more susceptible to cold water. This means that in a competitive environment, those salmon have less of a chance to survive. (594)

So there has been a material change, a very subtle and a very insidious change, but nevertheless a very real and measurable one from a ridiculously small amount of DDT.

Q. How do you know that change was caused by DDT and not by something else?

A. Because there was a control tank right there with it.

Q. Was this a laboratory-controlled experiment?

A. This was a laboratory-controlled experiment. I know of some of them, and I have no reason to doubt the data.

Q. When you say that up in Nova Scotia they are concerned about the salmon, is that the same reason maybe why down in Florida they are concerned about the shrimp and the toxic effects of DDT on shrimp?

A. Yes.

Q. And why it is prohibited there?

A. Yes, right.

Q. And in Suffolk County the thing would be a goldfish, is that right?

A. I didn't say that. I didn't say anything about Suffolk County and goldfish.

Q. I thought that you did. (595)

A. No.

Q. Excuse me. This DDT that you say is all over, is it all over in equal amounts so that if you took a sample in the Great South Bay 50 feet offshore from the main dock in Bay Shore, it is going to be the same as it would be in Peconic Bay?

A. No.

Q. It is different in different places?

A. Yes.

Q. Different depending upon what?

A. On all sorts of things.

Q. Like who puts the DDT somewhere?

A. Yes, that too, but it is not only that. That would be only one item.

Q. What would be the other item?

A. Well, weather, air currents, water currents, high and low tides, (596) how high it gets, whether it leaches a marsh or whether it doesn't leach it. The degree of breakdown by microorganisms. It depends upon a vast array of factors.

Q. I would like you to use your scientific talent to answer this question: You wouldn't blame the Suffolk County Mosquito Control Commission if the tidal cycle brought some DDT into Suffolk County that somebody used on a farm in Nassau County, would you?

THE COURT: His answer is no. Now go ahead.

Q. Did you say you made some tests using this gas chromatograph? Have you used this type of a machine to make the test of substances where you were analyzing DDT.

A. Yes.

Q. Now, in order to determine a certain part, a million, a billion by the use of that machine, you have to put the substance that you are testing for in the column first to determine the characteristic blip that it makes on the tape, isn't that so? * * *

A known sample.

(597)

A. Right.

Q. Now, when you are testing a bird brain, for example, or the amount of DDT in it, do you also test for all of those substances in the Merck index that are more toxic to this particular bird than DDT?

A. Not normally. There isn't any particular reason to.

Q. Now, unless you did that, you wouldn't even be able to make a good judgment as to whether or not the bird's death was caused by a more toxic substance than DDT, would you?

A. Their presence might make matters still worse. When you take a sample biologically or otherwise, you can't analyze for every chemical in the Merck index. It is ridiculous. You analyze for those things that you at least suspect might be there, and the vast amount of literature shows--and this is certainly not controversial--that DDT is ubiquitous; it is everywhere, and so DDT is the thing you want to test for. You wouldn't test for aspirin in an osprey brain. It just wouldn't make sense. (598)

Q. Now, isn't it a fact that everybody in this room has got DDT in them, isn't that right?

A. That's right.

Q. And most of the birds you find flying around, they will have DDT in them, isn't that right?

A. That's right.

Q. And as a matter of fact if you were to make a study and use some bird as a control, you would find that a lot of them had more DDT in them than those that you found dead and analyzed in your laboratory, isn't that correct?

A. No, that's absolutely wrong.

Q. Do you have any studies to prove it?

A. Yes, I certainly do.

Q. Fine. Let us go into that.

A. Well, it is rather a long story, but I will be happy to do so.

Q. Then I withdraw the story.

MR. YANNACONE: Oh, no, Your Honor. He has opened the door. (599)
Let him testify.

Q. All right. I don't mind. Go ahead. Let us hear about this.

* * *

THE COURT: This is a most interesting case, and I might add (600) that I have had a brilliant array of witnesses thus far. I have seen witnesses for 37 years, and these gentlemen are all excellent. However, we must attempt to catch up on our calendar. Now, go ahead.

A. Well, my original relationship or connection with pesticides was by somewhat of an accident. It all started in a rather small way about four years ago, when several of us in Hanover, New Hampshire, became concerned about the fact that DDT was being used on the elm trees up there in an attempt to control Dutch elm disease. Now, I'm not going to get into whether or not DDT does control Dutch elm disease. The evidence indicates that it is not very effective in controlling Dutch elm disease, but that is another story. We can argue that some other time. Meanwhile, let us just talk about DDT and its use on the Dartmouth College campus in Hanover, New Hampshire, and throughout the town.

There were several of us who were interested in maintaining a healthy environment. In the beginning our attempt was, "Well, what could we do to put (601) a stop to this DDT usage?" We knew that it was deleterious. There are years and years of literature piled up that say what a bad actor DDT is. Yet it continues to be used. What can we do to stop it?

So, we did what most people usually do under such circumstances, we got up a petition. Well, you know what happens to petitions--they usually end up being considered, and then end up in the ash can. Actually though, it is interesting to note in that petition attempting to stop DDT that every single member of the Department of Biological Sciences at Dartmouth College signed the petition. But anyway the petition, in spite of all the signatures, ended up doing essentially nothing.

We were, in fact, told that we didn't know what we were talking about; and that while DDT had killed birds in Princeton, New Jersey; it had killed them in Urbana, Illinois; it had killed them on the Michigan State campus, plus about 25 different towns in Wisconsin; it had killed birdlife all over the place, but we were told, "It doesn't kill birds in Hanover, because we are experts. We read the (602) label. There is a different distribution on trees out here. The situation is just altogether different. There is a different climate, and it doesn't kill birds here in Hanover, however, because we do it properly. We are experts. We have qualified people to do the job."

So it was perfectly clear that we were not going to be able to stop the spraying of DDT in Hanover, and so we figured, "All right. If they say it doesn't kill birds, we will conduct a study and find out what really does happen here."

Since they don't believe what happened elsewhere, we tried to say this is going to also happen here. In fact, we have here evidence, hearsay evidence, but nevertheless evidence that it has been causing bird damage in Hanover for the last ten years. But it wouldn't stand up, of course, so we proceeded with our study.

I must say these people were indeed experts. They were very careful about how they used this stuff. They followed the directions, and they were most cooperative and most friendly. They supplied us with totals, poundage, how much DDT (603) they used. They seemed as interested in finding out what was going on up there as we were. They were most helpful, and I certainly am grateful for their assistance.

So we set up this study using the Town of Norwich, which was across the river, as a control area. Now, Norwich has never been sprayed. It has elms too, but they take no care of the elms.

MR. CORWIN: Mr. Witness, please excuse the interruption, but now when you get down to the actual findings of the study and what you did, is that in the technical appendix?

THE WITNESS: Yes.

MR. CORWIN: It is already in evidence, is it?

MR. YANNACONE: Your Honor, I submit that the witness should be allowed to finish his story. There is only a summary in the appendix. He should be permitted to finish his story. (604)

THE COURT: All right. You are almost to the end of it now, aren't you?

THE WITNESS: No, I have a long way to go.

THE COURT: All right. Go ahead.

A. So we used Norwich, which had never been sprayed, as a control area. Should I mention the people involved, incidentally?

One is a Ph.D. in biology; another is a Ph.D. in genetics; I am a Ph.D. in organic chemistry; and the fourth person, who is not an author on there, was an amateur ornithologist. He took no part in reducing the data or writing the paper.

Now we conducted population studies in both towns simultaneously. We divided these towns into several areas, and we chose areas in Norwich that were similar, as much as possible, to those in Hanover. So we had a good control. . . We put out as much publicity as we could by three radio stations, and in two newspapers-- and they cooperated considerably--for anyone who found a dead or dying bird to please bring it to us or at least call us up, and we would go get it. (605)

Then a third part of the study, if there were to be any dead birds, was to have them analyzed. But that was to come later.

Now, in the week preceding spraying, we got a few dead birds. They were rather dried up, and they were of no particular relevance.

DDT is sprayed at night, because conditions are calm, and it is the best time to spray. So on the nights of the 15th to the 18th of April, 1963, approximately five-eighths of a ton of DDT was distributed over the elms from trucks in Hanover, New Hampshire. Now, the area we are talking about is roughly a square mile. And there was about five-eighths of a ton distributed therein. This works out to 1.9 pounds of DDT per acre if distributed uniformly, which of course, it was not. It was distributed on the elms, but it was distributed on the average of 1.9 pounds to the acre.

Now, for the first few days after spraying, there was nothing. There was no noticeable difference between Hanover and Norwich. About (606) four or five days after spraying, a student, a Dartmouth College student brought in a robin that was alive. It was alive and showing a state of tremors.

Now, tremors are the known and recognized symptoms of DDT poisoning. Tremors are not by any means limited to birds. Everything with a nervous system essentially will develop tremors under the influence of DDT, and this does include human beings. It includes house flies. Tremors are the standard symptom of DDT poisoning.

This bird that was brought in showed DDT tremors. I should say it showed what we believed to be typical DDT tremors.

Well, if there were this one bird from a particular area that showed tremors, one could say, "Well, this might be a nerve disorder; it might be a disease, it could almost be anything."

In the following weeks, we had a steady stream of such birds. We ended up with some 60, I think there were. I forget the number, but a large number of birds with tremors. Every single one of these birds (607) of some 30 species came from Hanover, and not one single trembling bird ever came from Norwich, and we were getting them from both areas. We ended up with something like 150 dead birds from Hanover, and I think ten from Norwich.

Now, one could say, "Well, we had more people looking in Hanover."

But this doesn't really prove anything, because we had birds with tremors, and many of them subsequently turned out to have very sizable amounts of DDT in them. None of those birds, either with tremors or with the large amount of DDT, came from Norwich. So we got 151 dead birds in about a six-week period.

What does this mean?

One could say, "Well, it means that 151 birds died in Hanover."

This doesn't in itself sound particularly significant. But if you now look at the population in the situation, and count the living ones, you will find out what was really going on.

The robin population went into a steady decline, and within a (608) four-week period of time, from the 1st of May to the 1st of June, it declined by 70%, a mortality of 70%, down to 30% of the original population. Meanwhile, the population over in Norwich increased from 100% to 130%. So there was a net increase in Norwich and a net decrease in Hanover.

This effect was by no means limited to robins. It is just that we had the best opportunity to observe robins, because they are large, they are out in the open, there are plenty of them, everybody knows what they are, and so you end up with the best data on robins.

But we had in this 151 dead birds, we had 34 species represented. This included a number of birds from rather interesting categories. It included birds that feed---Well, I am getting a bit ahead of the story here.

We also checked the population of these other species. It turned out that the bark feeders, for example, diminished very substantially within a few weeks after spraying. The bark feeders were something like half of what they had (609) been before spraying, while in Norwich the number of bark feeders went up and increased by something like 50%.

So one could initially then say, "Well, they packed up, and they flew across the river to get away from that smelly spray," except for one thing:

We got birds from those species with tremors. We got other dead birds which subsequently showed amounts that are believed to be lethal, and I will get into why they are believed to be lethal later.

So it is a fair statement to say that while some birds may have left Hanover, a great number did not leave Hanover. In fact, they died in Hanover from DDT poisoning.

Well, I want to be sure not to skip anything important. All right.

Now, let us talk a bit about analysis. Let us say you pick up a dead bird. You analyze it, and you find there is DDT in the brain or DDT in it anywhere. That doesn't prove that DDT killed the bird, by no means. It merely means that the (610) bird was exposed to DDT and picked it up somehow. But that still doesn't say DDT did the job. It might have died of other causes. So somehow you must establish some sort of a lethal level, some dosage beyond which the probability becomes very great that DDT killed that bird.

Well, this has been established pretty well in the following way: First of all, it is known to be a nerve poison. It has been shown in rats that the concentration in the brain correlates very closely with symptoms, and when it gets beyond a certain amount in the brain, the rat dies.

Essentially, the same thing has been shown with birds. It has been shown with robins, with English sparrows, and now more recently with cowbirds. It has been shown that when the amount of DDT in the brain is somewhere under 10 parts per million, it is not generally lethal. But when the amount gets up above 50 or 60 parts per million, the bird develops tremors and dies.

The symptoms which they develop on feeding of DDT in the laboratory are exactly the same as the symptoms you see in the field. The amount in the brain of those birds who died in the field with tremors, turns out to be exactly the same as (611) the amount in the brain of those who died with tremors in the laboratory. So this is about as good a proof as you could get anywhere in science that something like 50 parts per million or greater in the brain in at least three species--and probably most of the bird world--is a toxic lethal level.

All right. We had, with the financial assistance of the Fish and Wildlife Service, we had I think it was 100 ticks from these birds from Hanover or from all around analyzed. We had birds from outside of both towns as reference birds. We shot a few robins, and we analyzed all the dead birds that we got from Norwich and a fair sampling of the ones from Hanover. We couldn't do them all, because of financial reasons. In fact, this whole bill was about \$7,000.

Now, I didn't run these analyses. I am running them now, but I didn't run them then. It turned out that every single one of the birds that had greater than (612) 50 parts per million in the brain came from Hanover; that none of the birds from unsprayed areas, including Norwich and outside of both town, had anywhere near that amount. They had a few parts per million--1 or 2 or 3, and generally no more.

So it was perfectly clear that there was a great separation in the amount of DDT. So that you could very easily tell whether DDT killed the bird or not. Many of them were up to several hundred parts per million in the brain. Actually, the lowest we got in the lethal category was about 60, and then the next lowest below that was way down in the single numbers. So there wasn't really a great deal of confusion as to what killed these birds.

So this shows, I think quite clearly, that this was a major percentage of the population. This was not a peripheral thing involving a few robins. This was a significant factor in the overall population of that town.

In fact, you didn't have to conduct a survey or a scientific study to see what had happened in Hanover. On the 1st of June, you could walk up and down the streets, and there were no birds at all. It was silent spring arrived. You could go for blocks and not see one robin. Yet, over in Norwich, there were birds all over the place. It was most remarkable, while Hanover was dead still. There were virtually birds of all species in Norwich, and it was fantastic. (613)

Well, during the summer, after this population collapsed due to the DDT, there was subsequently an influx of birds from outside, other areas where there had been no such disaster. Well, you might then raise the question: Why was there not an influx during the spring?

The answer is that the birds are on their own territory, and they stay put until the young are able to fly. So they are not circulating all over the place, and that is why we did not find trembling birds or birds with lethal amounts in the brain from Norwich, because they don't go to Norwich. They sit and rest in Hanover until the young are able to fly. The young begin to fly about the 1st of June up there, and so on the 1st of June the population had its minimum, and it then began to go up again. It never did recover to where it started, but there were robins in Hanover throughout the summer of 1963. However, they were different robins than the ones that we were counting before, earlier in the spring. The ones that we counted early in the spring ended up dead. (614)

THE COURT: All right. That will hold us for a while. I want you to know that I appreciate your discourse.

* * *

Wednesday, November 30, 1966

CHARLES F. WURSTER resumed the witness stand and further testified as follows:

* * *

CROSS-EXAMINATION (continuing) by MR. CORWIN: (615)

Q. Now, Dr. Wurster, the reason that we used toxic chemicals is so that they will kill the insects we are after, isn't that so?

A. Yes, sir.

Q. The mere fact that we say something is toxic and getting into the life-stream of evolution generally is not of any particular significance. We deliberately put it there for a purpose. If it weren't for this toxicity, we wouldn't be using it to kill mosquitos to begin with, isn't that so?

A. That's right, but it is desirable with the pesticide to use something which is selective and kills the target and not everything.

Q. Are you familiar with dieldrin?

A. Somewhat. Less so than DDT.

Q. Do you know anything about its persistency?

A. It is persistent

Q. Do you know anything about its relative persistency with DDT?

A. My impression is that it is as persistent as DDT.

Q. Do you know anything about its relative toxicity with DDT? (616)

A. It varies with different organisms, but in general it is more toxic than DDT.

Q. Are you familiar with or do you know anything about its relative world-wide presence in relation to DDT?

A. It is used to a lesser degree than DDT. It is present in many environments. It is in most of our rivers. It is, however, not as universally distributed as DDT. It would appear to be probably our second major problem among these biocides.

Q. Doctor, yesterday when you were talking about the study which you made at Hanover--by the way, what year was that?

A. 1963 and '64.

Q. You said something about a 70% reduction in the birds and in the treated area, is that right? Is my recollection correct?

A. That figure was for robins only. There is every reason to believe that the figure is an absolute minimum figure rather than a maximum figure. My own guess--and I can't support it as well as I can support the 70% figure--but my estimate is that it was approaching totality. However, because of the way we struck our averages, we have used a 70% figure, because we could support it better. My own estimation is that 70% is an absolute minimum mortality, and that the actual mortality was probably a good bit greater than that. (617)

For example, the 70% figure does not take into account the phenomenon of influx, and while influx during the nesting season is probably not a major factor, it nevertheless occurs, especially among males. This is probably part of the reason why we got far more dead males than we got dead females.

However, there is every reason to believe that that figure is a good bit greater and for a few days it was right at the bottom of the curve. This is a five-day survey, a five-day moving average. So that it tends to smooth out the wrinkles. But on the 1st of June, that mortality was a good bit greater than 70%. It was just about totality.

Q. How do you go about taking a bird count? (618)

A. It is not easy. The way we did it was to divide the town into areas which we felt were as representative as possible of the total area, and then we spent a given length of time in each of those areas counting all birds, which were identified by sight or sound. There were four people involved, and the four people rotated partners, so that any differences between individuals in counting ability were randomized and eliminated.

Furthermore, there are, of course, day to day variations in weather. For example, when it is a rainy day, you don't get anywhere near as many birds as you do on a clear day. So for that reason we struck a continuous moving average, a five-day moving average, adding on the recent figure and dropping off the one five days behind.

In other words, we made every effort to randomize this while picture, and it did give a picture that made sense when it was finished.

Q. Now, you say that there were four of you who did counting. (619)

A. There were four of us.

Q. And when you say that you did this by sight and sound, is it possible that you see a bird and hear the same bird and count it as two birds?

A. It is possible. It is also possible to miss a bird. But the differences we are talking about are not the differences between one and two birds. The differences are orders of magnitude.

Q. Yes, we will come to that. What is the area in acreage of the treated area that you had in consideration that would be town proper?

A. About one square mile, although this was not easy to find out. The people that did the spraying were extremely cooperative, but even they couldn't remember which trees they sprayed and which they didn't. There were many unsprayed trees left in Hanover. What they did was they ran up and down the street of Hanover, spraying everything that they could reach, and what they couldn't reach, they didn't spray. So it was very difficult to tell. All we knew was what streets they had driven up and down, so it was difficult to tell sometimes, but our best estimate is that the total treated area was about one square mile. But the distribution of DDT was not uniform by any means; it followed the elms. (620)

Q. Was he using a high-pressure sprayer?

A. They were using a blower.

Q. And they put that on to such an extent that it drips, isn't that so?

A. No, it is not so. At least, I have never seen it drip. When it is put on with hydraulic equipment, then it drips. There is no drip that I have seen, at least, with a mist blower, not that I have seen that many mist blowers, but I have seen them in operation.

Q. How large an area would one person be counting birds over--an acre, a block in a city?

A. The number of acres involved is in this appendix. Offhand, I forget the number--what fraction of the total.

Q. That was the next thing I was coming to. You didn't count the (621) birds in the whole square mile area?

A. No, it would be impossible. You have to sample it.

Q. Well, you have a rough idea as to what the sample was?

A. I would rather let the record speak for itself. I don't have a very rough idea. It is a number of acres. It is perhaps 40 acres or something like that, but I am quite---

Q. All right. Now, when you made this test, did you do the counting before the spraying was done?

A. Yes.

Q. And over how long a period of time did you do that?

A. We did it daily for one week before spraying and for the following eight weeks, about six to eight weeks.

Q. And did you do the same type of a count in Norwich, across the river?

A. Exactly the same.

Q. Now, you said yesterday on either direct or cross-examination--and it was when you were relating about the study--that birds have a peculiar behavior pattern, and that they have a tendency to live and stay in a given area. (622)

A. During the nesting season.

Q. During the nesting season?

A. Yes.

Q. And was this during the nesting season that the test was conducted?

A. In general, yes. Specifically for robins, it was.

Q. You were trying to, I think, minimize any indication that during the day the birds who lived in Hanover went over to Norwich, and vice versa, is that right?

A. We needed to make no such minimization. We have no evidence it occurred, although had it occurred on a few occasions, it would certainly have been no surprise. In other words, had we picked up a few tremoring birds in Norwich, it wouldn't have been nothing amazing. In fact, we got no tremoring birds and no birds with more than 50% parts per million in the brain from any unsprayed areas. But had it occurred, it wouldn't have been astonishing.

Q. Did you make any tests to determine how much DDT there was (623) in any parts of the soil in any area in Norwich at all before the spraying?

A. No, we made no soil analysis whatsoever.

Q. Mr. Witness, let me--and I hope the Court will bear with me--but may I suggest to the witness that when I ask him a question that admits of a yes or no answer, if he has some explanation, that it will be taken care of by re-direct examination, and I will ask him to confine his answers to my questions.

THE COURT: Yes. If you can give a yes or no answer, Doctor, please do that. If you can't give a yes or no answer, say you can't answer with a yes or no.

MR. YANNACONE: If Your Honor please, just to set the record straight, counsel is characterizing this as cross-examination. He brought up the whole subject about the robins and opened the door. This is his witness; it is direct examination.

THE COURT: All right. I will go along with you. However, he can even ask his own witness to answer the question the way he wants it answered. (624)

MR. YANNACONE: Yes.

THE COURT: All right. Go ahead.

MR. CORWIN: All this came about as a result of a discussion of the man's qualifications, so that I think we are on cross-examination. But I won't make a big issue of it.

Q. Did you make any tests of the amount of DDT in any of the ponds or waters or in the river that flows between the two cities?

A. We analyzed only birds, because the soil analyses had already been done by previous authors. Earthworms, leaves, soil had been analyzed in the midwest and were demonstrated to be the source of the DDT that reached the robins, that was ingested by the robins. This was thoroughly documented by Barker in 1958. (625)

Q. You don't know whether or not there were any earthworms in Hanover before the spraying or not, do you, as a result of any tests that you did?

A. I assumed that there were earthworms. I saw robins eating them. I am sure there are still earthworms.

Q. You don't know whether they had any DDT in them or not, do you, before the elm trees were sprayed?

A. I think it is a pretty safe assumption that they were loaded, and that they are still loaded.

Q. But they were not loaded as a result of the spraying of the elm trees?

A. There wasn't any other spraying in Hanover.

Q. Yesterday you were telling us, and I don't want to be argumentative, Dr. Wurster, but did I understand you to say that one of the reasons you object to this thing and want to have it banned is because it is all over?

A. It is all over. (626)

Q. So that it was all over Hanover before somebody came along, and sprayed the elm trees?

A. That's right. They have been spraying it for ten years. Furthermore, in 1964 they didn't spray any DDT, and robins continued to die.

Q. But nevertheless, in spite of the fact that they haven't sprayed any DDT, you are telling me now that before they sprayed it in that particular year, the earthworms had DDT in them, right?

A. Certainly, they did. Isn't it a safe assumption that when robins eat worms, and they die with tremors and are shown to have DDT in them, that they got it from the worms? Maybe they got it from some unique source in Hanover, but I don't believe it. You can, if you wish.

Q. I don't believe it either. I agree for the most part with what you found. But what I am trying to find out is this: Is it your statement that before this particular spraying, before and after which you made a bird count, there was DDT in the soil and in the earthworms in the soil and in Hanover? (627)

A. I would assume there was.

Q. You didn't test the bird to find out how many parts per million of DDT was already in their brains, did you?

A. There is no point in---

Q. Did you?

A. There is no point in continuing to do the same piece of work over and over again. This work on bird mortality has been repeated so many times for the last twenty years---

MR. CORWIN: Your Honor, I move to strike out the answer as not responsive, and I ask you to instruct the witness to please answer the question with a yes or no?

THE COURT: I don't think he can answer that question yes or no.

MR. CORWIN: Well, let us ask him.

Q. Can you answer that question yes or no? Did you make the test?

A. Make what test? (628)

Q. Did you make any test before the elm trees were sprayed, did you make any test of the amount of DDT in the brains of any of the robins in Hanover, New Hampshire?

A. I can't remember whether any were pre-sprayed. I think there were, as a matter of fact.

Q. Did you do it yourself?

A. No, I didn't do it myself, but it is in the record. They were done by the Wisconsin Alumnae Research Foundation, which, as far as I know, has more experience in running DDT analysis than anybody in the United States.

Q. Now, you discussed with us a little bit this morning about how you took this particular census. Is that the way bird censuses are taken by such organizations? If I am wrong in my characterization, please tell me, but I would assume that you would regard the Audubon Society as an organization which does this type of work rather professionally, isn't that so?

A. Audubon Society?

Q. Yes.

A. I wasn't aware that they did. (629)

Q. Well, they take bird counts, don't they?

A. They take bird counts, but we didn't take bird counts. We were taking a census. We had it designed on a strictly scientific basis. We were not just out counting birds.

Q. Have you checked the robin population since the test, other than the eight weeks after the spraying?

A. We did the whole thing all over again in 1964.

Q. Did they spray in 1964?

A. They sprayed methoxychlor.

Q. They didn't spray DDT in 1964?

A. They sprayed no DDT in '64.

Q. What did you find out about the population of the robins in 1964?

A. We found that robins continued to die of DDT poisoning or, I should say, what I presume to have been DDT poisoning, because methoxychlor is no problem.

Q. How many robins did you find in the area before the 1963 spraying of DDT?

THE COURT: You mean in population?

MR. CORWIN: Yes. (630)

A. Well, it was changing, and the curve of the population is published. It was changed from day to day, because this was just at the peak of migration before spraying.

Q. Isn't it a fact, Doctor, that even in the mating season or in the nesting season, I should say, that birds will fly out of the area or close to the nests at a certain time of the day for feeding?

A. Yes, it is, although it is - - -

Q. Now, Doctor----

A. Wait a minute. I want to finish that answer.

Q. The answer is yes.

A. No, it is not the answer.

Q. If you want to explain it, you can explain it later.

THE COURT: But he says his answer is not yes, Mr. Corwin.

A. The answer is yes, they fly away from the nests, but in general stay within a few hundred yards of the nest. Now, this is for robins.

Q. How wide is the river? (631)

A. The river is about--oh, I would say it is about 300 yards, I should say 200 yards at Hanover.

Q. Now, it would be significant then, if you were making this very scientific test, as to the time of day in relation to feeding when the test was made in Norwich and Hanover, isn't that true? In order to do it, you would have to make the test from both towns at the same time of day?

A. Right.

Q. Did you do that?

A. That's exactly what we did.

Q. So that you had two people in Norwich and two people in Hanover?

A. Simultaneously.

Q. And at the same time?

A. Yes.

Q. Were you able to find any documentation of any deaths to human life? Yesterday you thought there was some.

A. I didn't look further, and it is still my impression that there are some; but I wouldn't want to support it at the moment. (632)

Q. The reason I repeated the question was because one of the state people that I have with me would certainly like to know it if you have any information, and he asked me specifically.

A. It is my impression that I have seen such information.

* * *

Q. Are you familiar with any of the literature having to do with the robin count over a long period of years in this country?

A. Only superficially. It would be my expectation that the robin populations are increasing. (633)

Q. Notwithstanding the increasing use or increasing contamination, if you want to use the word, of the whole world with increasing quantities of DDT, correct?

A. There are two factors at work. One of them is that we are eliminating a certain number of robins with DDT, and the other is that we are making a vast amount of new habitats, because robins thrive very well in suburbia. We have more suburbia. We are killing off our hawks and our various predators, and so robins do very well.

Now, that doesn't say that we are not killing them with DDT. We obviously are. We are probably killing them by the millions with DDT, but we are making still more robins.

Q. Don't you think, at least, that the encroachment of what you might call civilization upon the natural domain is at least one of the contributing reasons for the decline of the osprey in some areas of Long Island, for example? (634)

A. I would assume that it was a contributing reason in some cases, but there are many cases, especially Gardiner's Island in this county, for example, and the area across Long Island Sound at the mouth of the Connecticut River, where there has been no change of habitat whatsoever, but where there has been an absolutely disastrous decline in the osprey population.

Q. Then you are aware of the fact that the people who have been watching the birds over there in the Saybrook salt marsh at the foot of the Connecticut River over a long period of years have found that sea gulls have been stealing the eggs of the osprey too, isn't that so?

A. I am glad that you brought up the subject of the osprey.

Q. That is as far as we are going to go with it at the moment, if you don't mind.

A. There is a vast amount more than that which can be said about osprey.

Q. I am sure there is. I read some of the literature myself. Now, is there anything in your study as a result of any of the related work, of which (635) you are aware, and can you tell me about how many parts per million of DDT there were in the brains of robins in Hanover in 1962, '63, '64, '65, and '66?

A. '63.

Q. Just '63?

A. That's right.

MR. CORWIN: Your Honor, will you bear with me while I inquire if there are any further questions that my associates would like to hear?

THE COURT: Go ahead.

Q. Dr. Wurster, can you tell us, and I wish you would refresh your recollection, from the study that you did, do you know offhand exactly how many dead robins you found in Hanover during the study you made back in '63?

A. In 1963 we recovered 61 dead robins in Hanover.

Q. Do you know of your own knowledge the cause of death of any of them?

A. Yes.

Q. Can you give us a tabulation of the cause of death of each of the 60 robins? (636)

A. Each of them?

Q. Yes.

A. Well, let us talk about them in groups. There is no use spending too much time about it. There was a group consisting--and the number escapes me--but something like that, as I recall, two-thirds.

MR. YANNACONE: Your Honor, excuse me, but before we go any further, counsel is cross-examining from a paper that has a lot of mathematical and statistical material in it. I think in all fairness to the witness who has to testify from it, that he ought to be permitted to refresh his recollection.

MR. CORWIN: Most certainly.

MR. YANNACONE: It is in evidence.

THE COURT: If the witness feels that he has to refresh his recollection, all he has to do is say so. All he has to say is: "We have the material. I don't know it offhand. I would like to refresh my recollection." If we have it, (637) he will have it. But until he asks, I have to allow counsel to try his case. All right, Go ahead.

A. There are a number of pages, and I may not even find it myself right offhand. I don't think it matters. It is something like two-thirds, and the actual number is unimportant at this point.

Q. Just stop right there, if you please. Do you mean to tell me that if every one of those robins was killed because some kid shot them with a BB gun, that it would be unimportant to your study? Is that what you are telling me, Dr. Wurster?

A. Did I tell you that?

Q. No, but you said it is unimportant.

A. I said it is unimportant to the substance of this case. It doesn't matter to me or to the judge whether in this case it is 30 or 35 or 40. We can talk about this general group, and nobody said anything about children with BB guns.

Q. Thank you for your opinion. Can you tell me what the general level of numbers was? Your papers refer only to percentages. How many birds were there in the count? (638)

A. In what count?

Q. In the count that you made of the number of birds. I know you said that was on an increasing level, but what was the average in the week before the spraying, the average number of robins in Hanover a week before?

A. I don't recall, I don't recall.

Q. Who were your assistants at Hanover during this robin population count? * * *

A. My ex-wife, Doris Wurster, my friend named Nick Strickland. I think I should mention their backgrounds. My wife has a Ph.D. in biology from Stanford University. Nick Strickland has a Ph.D. in genetics from London University.

Q. I am concerned with their eyesight more than their background. (639)

A. Well, you asked the question, and it seems to me what their backgrounds are is relevant.

* * *

Q. Do you know anything about the population of seagulls on Gardiner's Island, Dr. Wurster?

A. Yes, sir--well, no, wait a minute. I would say essentially no, except that I assume it to be increasing as is the gull population all up and down the East Coast.

Q. If, as you say, it is a known fact that the seagulls have been stealing the eggs of the ospreys, wouldn't you say that the increase in the seagulls might have something to do with the decreases of the ospreys?

A. Yes, it might have something to do with it.

Q. Thank you.

A. But it would not explain it.

Q. Thank you. I have no further questions

(640)

A. It would explain it partially, but it is a wholly unsatisfactory explanation to the phenomenon.

MR. CORWIN: I have no further questions of this witness at this time.

REDIRECT EXAMINATION by MR. YANNACONE:

Q. Dr. Wurster, you have been trying to explain about the ospreys, and counsel opened the door. I don't think I remembered saying anything about ospreys. Will you tell us in your own words, first of all, whether you have ever seen a live osprey?

A. Yes, I have seen many live ospreys.

Q. Have you had occasion to see osprey habitats?

A. Yes.

Q. Have you seen the osprey eggs?

A. Yes.

Q. Did you ever see a viable osprey egg?

A. Yes.

THE COURT: What is a viable osprey egg?

MR. YANNACONE: One that ultimately hatches.

MR. CORWIN: Like it was pregnant.

Q. Have you ever seen a non-viable osprey egg? (641)

A. Yes, sir.

Q. Have you ever had occasion to analyze a non-viable osprey egg?

A. Yes.

Q. Have you ever had occasion to analyze a viable or what are the remains of a viable osprey egg?

A. No.

Q. Are you familiar with the work of those people who have made such analyses?

A. Yes, I am.

Q. Now, of your own knowledge, have you done any personal investigation of the osprey and its problems?

A. None, other than literature work and the analysis of one osprey egg.

Q. Do you consider yourself familiar with the literature with respect to the osprey and its problems as they particularly refer to DDT?

A. Yes, I am.

Q. Will you tell the Court, and tell me, in your own words, at what- (642) ever length you feel necessary, what you know about the relationship of ospreys and DDT?

A. Well, this has been studied in the greatest detail by Dr. Peter Ames, formerly of Yale University and now of the University of California at Berkley. He published a paper in Auk in 1964, I think it is, and it has been recently updated in 1966. In those papers he described in detail the disastrous decline of the osprey at the mouth of the Connecticut River across Long Island Sound. He has been studying these ospreys for a number of years.

To summarize his findings, back in the 1940's, there were something like 200 pairs of ospreys in that vicinity. By 1960, the population of ospreys had declined to 71 pairs. In 1963, it was down to 24 pairs. In 1964, it was 17 pairs, and in 1965 it was down to 12 pairs.

So that means that in a 20-year period the population of ospreys has gone from 200 pairs or 400 birds down to 12 pairs or 24 birds. In other words, more than a 90%, almost a 95% reduction in that population, and the reduction is apparently continuing. (643)

It was because of the decline that Peter Ames decided to look into the situation and find out what was going on with these ospreys, since there was no apparent change in their habitat. There was no easy obvious answer.

He found that the reason for the decline was not mortality of adults but failure of those birds to reproduce. The birds had many strange--Well, let us skip that. The birds had a tendency to lay eggs which didn't hatch. They also had a tendency to eat their own eggs, which is very abnormal. This he attributed to abnormal behavior due to sublethal amounts of DDT, but that is getting, I think, a bit ahead of the story. In any case, the explanation for this decline lay in reproductive failure rather than any form of human disturbance.

In his paper, and that paper is in the appendix here, I believe it is in there, he discusses in detail factors like boys throwing rocks at the nests, motor boats rushing around the nests, picnics, nest robbing by gulls, changes in weather, and all sorts of things that could obviously been of affect to the ospreys. None (644) of these factors came anywhere near explaining this reproductive failure in these ospreys.

So at this point they were pretty suspicious about what DDT might possibly be doing in this picture, and so they ran some analyses. They found DDT in the fish that the birds were eating; they found DDT in some of the dead adult birds; they found DDT in the eggs; and they even found it in the chicks that hatched before they had ever been fed. Some of the chicks, incidentally, hatched and subsequently died.

THE COURT: You mean that had been eating from the yolk and had not been fed?

THE WITNESS: They died of the DDT that was in the egg. It was affecting the vesical, a sort of bag of lipids, and so an egg will contain more DDT than the bird that laid it. This is why eggs have more DDT than any other component of our diet, for that simple reason.

Now in 1965 he updated these analyses and made some very interesting comparisons. I made this a few minutes ago--and we can't hand this out to the whole court, because I just jotted it down--but I will relate this, and you can look at it, Your Honor. (645)

This is from his more recent paper published this year in 1966. He has references for what he considers a normal reproductive rate in ospreys. The normal reproductive succession in osprey nests among osprey population he considers to be about 2.3 chicks.

Now in Maryland, where the population has also been studied, the number of young per nest was less than half of that. It was 1.1 young per nest, and there there were residues in the egg on the average of 3 parts per million.

In Connecticut the number was half again. It was an aver of 0.5. The amount of residues in the egg---and by residues I mean DDT, DDE, and DDD, all three in total. There the parts per million residues were 5.1. (646)

So there is a direct circumstantial relationship between the number of young ospreys produced per nest and the increasing amount of DDT residues in those eggs.

Now, this, of course, still does not prove definitely that DDT caused the failure of these birds to hatch. But it sure does make one mighty suspicious, especially when you find exactly the same pattern through other birds of prey not only in the United States but in Europe as well.

I think that reasonably summarizes it. I might also mention that they analyzed fish on which these birds fed, both in Connecticut and in Maryland, and they found in both places their prey was likewise contaminated; and that the fish in Connecticut for some reason or other carried more than did the ones in Maryland.

THE COURT: Doctor, did you make this chart which you handed me? (647)

THE WITNESS: I just drew it out, yes.

THE COURT: Will counsel please look at it?

MR. CORWIN: I am looking at it. I have looked at it.

THE COURT: The court is offering it as a Court's Exhibit.

MR. CORWIN: I am most emphatically objecting to its introduction as an exhibit.

THE COURT: The purpose of that exhibit is that it will help this Court to arrive at a conclusion. It is a summary of what you have just told us, is that right?

THE WITNESS: That's right.

MR. CORWIN: I submit, Your Honor, it is hearsay, and I should be permitted to cross-examine the person who made this study upon which he based his conclusion that that was it. (648)

THE COURT: Well, cross-examine him.

MR. CORWIN: I can't cross-examine the piece of paper, because he didn't make the study.

* * *

THE COURT: Please don't argue with me. The court is directing that this be put into this case as an exhibit, and it will be a Court's Exhibit.

(The paper was received in evidence and marked as
COURT'S EXHIBIT 2.)

Q. Now, Doctor, that is a summary of material that is contained in a paper by Peter L. Ames of the Museum of Vertebrate Zoology, University of California at Berkley, entitled "DDT Residues in the Eggs of the Osprey in the Northeastern United States and Their Relation to Nesting Succession", is that right?

A. That's right.

* * *

Q. And the whole paper is in the technical appendix submitted on the motion?

A. No, it is not. That was published since this was made. (649)

MR. YANNACONE: If Your Honor please, perhaps to make it more complete I will have the actual paper reproduced and submitted as part of the record. I will give a copy to counsel.

THE COURT: Counsel, the only reason I am taking that paper is we have had a discussion here about ospreys, and how they have decreased in number. It is only to help me remember this discussion. That is all it is for, and for no other purpose.

Q. Do you know Dr. Ames personally, Dr. Wurster? (650)

A. No, I have never met him. I have corresponded with him.

THE COURT: Might I add, just to finish that off. This Court welcomes every shred of information it can get, and I don't want things kept away from the Court.

Q. Dr. Wurster, do you feel that you can form an opinion with a reasonable degree of scientific certainty on the relationship between DDT and ospreys?

A. Yes, I believe so.

Q. Do you have such opinion?

A. Yes, I do.

Q. Can you tell us with a reasonable degree of scientific certainty whether the continued use of DDT by this defendant, the Suffolk County Mosquito Control Commission, or anyone else will in any way cause serious or permanent injury to the osprey population of Suffolk County?

A. I believe it will.

Q. Now, Dr. Wurster, when counsel examined you yesterday, I think he asked you to tell how you tested the DDT, and you described the gas-chromatography method and the thin-layer-chromatographic method that you used as a check. Now, has this always been the method for testing chlorinated hydrocarbon pesticide residues? (651)

A. No, it hasn't.

Q. What is the prime method?

A. The prime method that was used on a widespread basis was published in 1945 by Schechter and Haller. It was Schechter and two or three authors and Haller. Schechter is the first and Haller was the last.

Q. Does it have a common name?

A. It is commonly called the Schechter-Haller method.

Q. And that name is common to the analytical chemistry profession?

A. Yes, it is common in the field.

Q. Can you briefly contrast the Schechter-Haller method with the method you described yesterday?

A. Yes. The Schechter - Haller method is a colorimetric method where you use an ultraviolet spectrophotometer to read the intensity of the color at a specific wave length. You first nitrate the DDT or nitrate the whole mix, and the DDT produces a blue color and you read the spectrophotometric wave length of the blue color. (652)

The Schechter-Haller method is not as specific, nor is it as sensitive or as accurate as the gas-chromatographic technique. It is, however, perfectly valid.

A chromatograph will separate cleanly DDT, DDE, and DDD. It will also separate the others, such as ortho-para; it will separate the whole cross-section of the various derivatives of DDT.

The Schechter-Haller method will not cause the separation. It gives a quantitative value for DDT. It gives some figure which is not quite quantitative for DDD and DDE. I don't know, and I wouldn't know whether anybody knows, just how quantitative it is for those other two.

However, you see, what you get with a Schechter-Haller method is all three combined, where you are getting the DDT quantitatively, and the other two less than quantitatively. So you get a total. If you add up the total from a gas (653) chromatograph, you find that it runs ten or fifteen per-cent higher than this less than quantitative total that you get from the Schechter-Haller method.

Now, this may explain, for example, why the residues that we got from our birds in Hanover were somewhat higher than were those of George Wallace at Michigan State or the other authors at other universities in the Midwest.

Q. When did the gas-chromatographic method become a matter of common analytical practice?

A. I think it was initiated by 1960, and it has become more common since.

Q. In the course of your regular work, you had occasion to use various analytical chemical methods, is that right?

A. In connection with what work?

Q. Your regular work as a scientist.

A. Yes.

(654)

Q. And you have actually done these analyses yourself?

A. Yes, I have used both techniques on means other than pesticide analysis.

Q. And you are familiar with the methods from personal knowledge and observation and actual scientific use in the laboratory?

A. I have never done the Schechter-Haller. I have done the others.

161 Q. Can you tell the Court the general limits of the quantitative sensitivity of the gas-chromatographic method you have described, yesterday?

A. Well, it depends partly upon how much trouble you take to get it to the last decimal point. I would prefer to be pretty conservative about accuracy and say that in general accuracy probably runs within 10 or 20%, and in some cases perhaps as gross as 50%. However, these figures can be greatly refined, and I think ours probably are. But the point that I am getting at is that it doesn't matter whether you have a 50% - error or not, because the differences we are (655) talking about are two orders of magnitude. We are not talking about a difference between 50 and 70. The conclusion is the same whether it is 50 or 70. We are talking about averages that are running here 100 parts per million versus those that are near 1. So it doesn't matter whether you get 1 or 2. Your conclusion is the same.

Therefore, my feeling is to be as conservative as possible on these figures rather than to try and tie it down as tightly as possible.

Q. You are willing as an analytical chemist to allow for a 50%-error in that range and still stick to the opinions you have already stated as to the biological effects?

A. Well, I would allow for it and stick to it, but I don't really believe we have an error anywhere near that rate.

Q. All right. Now, when we are talking about range of detection with the gas chromatograph, what concentrations in the instrument capable of observing with respect to chlorinated hydrocarbon pesticides?

A. It is sensitive almost beyond belief. It can detect fractions of an nanogram. (656)

Q. Would you tell us what an nanogram is?

A. Well, an nanogram is one-thousandth of a microgram. In fact, it can detect picograms, which are one-thousandth of a microgram, and a microgram is a millionth of a gram. In other words, you can get millions of these particles together, and you still wouldn't see them.

The sensitivity is so remarkable that it becomes more of a problem than anything else, because you can't get your equipment that clean, and so you find yourself washing a syringe twenty times before you get all the DDT out of it from one injection into the instrument.

Q. Now, isn't this extreme sensitivity in itself its own check in that if your procedures are sloppy or contaminated, it begins to become obvious in the type of results that you get when you run these standards or controls?

A. You find that you have to clean up the lab more than you ever (657) have before, because if you don't, you get DDT in everything you analyze.

Q. And would you be able to say, based on your analysis as a chemist, that the method you must use in performing this type of analyses are similar to the methods they use when they handle quantities of radio-active materials?

A. I think they are quite similar in that radio-active materials also are detectable down to incredibly minute quantities.

Q. In other words, when you rely on somebody's studies and their quantitative techniques and you know the techniques you use, you feel that with a reasonable degree of scientific certainty you can accept these results?

A. Yes.

Q. Now, I think the question was raised yesterday as to the effect of killing a few birds with DDT, shotguns, BB guns, or any other means. Will you contrast for the Court in your own words the difference in the type of killing that occurs from the presence of DDT as an environmental parameter and the type of killing that occurs from a single application of a more directly applied cause of death? * * * (658)

A. Well, I think your question is to contrast the significance of the individual versus the population, is that what you are getting at?

Q. That's right.

A. Well, with a chemical like DDT, this is so widespread that you have basically two factors at work. One is direct mortality. Direct mortality is probably the less dangerous of the two. With direct mortality you have the elimination of a bird, and it is out of the system. It leaves a vacuum in a sense in the eco-system in that another bird can move in and nest in that area. If it doesn't meet with the same fate, it may produce a family.

You see, habitat in many bird populations is at a premium. So that nesting sites are relatively scarce. So that often in many bird populations, there is a tendency to be a floating population, and those that are floating don't breed because of no habitat. (659)

However, if you eliminate one bird, and if you have a healthy population, another may well move into it and take over.

In other words, if you are doing it with a shotgun, and you shoot some birds, in the long run you may very well not damage that population unless you shoot incredible numbers.

Now, a very good case of that was done in Maine by several authors, including one named Aldrich and the other I have forgotten. I have the research in any case. They went into a forest to study the effect of directly applied mortality, and they shot every bird within a certain number of acres. They continued to shoot every bird all summer long. This was apparently quite a slaughter.

They had several men in there with guns all the time doing nothing but shooting birds. It is a rough-sounding experiment. The birds continued to come into this area, and they shot several times the number of birds that ever were there (660) in the first place.

Now, in spite of the continued shooting, they were never able to reduce that population below something like 20 or 25% of what was originally there, because every day there was a constant influx and in some cases they would have one species like a bay-breasted warbler would be in a territory, and they would shoot it. The next day they would shoot another bay-breast in the same territory. The third day a third bay-breast, and so it went. They were able to suppress the population to about one-quarter of the normal population.

Now, the next spring that population was completely normal. It was completely back to what it was. All of which says that if you have a total environment that is basically healthy, it is quite resilient and able to withstand direct mortality.

Now, we have another factor coming in, and this is the insidious one. It is the one that concerns me, at least, the most about DDT, and that is reproductive failure or other sublethal effects. If you had a population that is unable to reproduce itself, that population is going to collapse. You are not going to see dead birds all over the place. In fact, you never will see dead birds all over the place in any case, because they wouldn't last that long. But you have a factor at work which goes on constantly, and you don't even see it, except something like this osprey population. (661)

In the osprey, we are now down to something like 5% of the osprey population, and nobody has ever killed any of them. We have killed no ospreys, so we are dealing then with a population that is basically unhealthy, and this is a very different situation.

For example, if you take a bird that is unable to reproduce, and that bird let us say survives the nesting season and let us say it survives the years, it fills a niche. It builds a nest, and it turns to eating food. It prevents another bird from breeding, but it produces no young. This is a much more disastrous effect on a population than is something like shooting.

That is why, for example, the Fish and Wildlife Service is so concerned about the black duck, because we are apparently dealing not just with gunners shooting black ducks; gunners have been shooting black ducks for years. We are apparently dealing with reproductive failure, and this is going to collapse the population. This will eliminate them. (662)

This may well have already eliminated the peregrine falcon from the Eastern United States. It's gone. It is extinct as a breeding bird, and this has happened in the last 15 years. At this late date it is pretty hard for us to find out what happened, because we don't have any peregrine falcons.

However, in the British Isles it has quite clearly shown that the peregrines are contaminated with DDT; that there is DDT in the eggs; that the eggs are not hatching; and that the population is going to pot over this for apparently the same reason that it has already done so in the United States.

The peregrine falcon in the United States is gone. It is completely extinct. There aren't any. So far as anybody knows, there isn't a single nest anywhere in the United States of a peregrine falcon. Fifteen years ago they used to nest in the Palisades region of New Jersey, and I used to see them and see their nests. You were able to see them all along the eastern coast. Today they are gone; they are nowhere. This is what I think is really alarming. (663)

The direct mortality of whether it be 50 robins in Hanover or 500 robins or millions of robins, that I don't think is nearly as dangerous as reproductive failure and its reproductive failure in birds that are at the end of long food chains, especially those where instead of making more habitats like we are doing for the robin, we are robbing them of their habitats at the same time. So they are getting it at both ends.

Now, there is a great and long list of birds that are in that category one of which is the osprey. We are robbing the osprey of its habitat. The cases I have talked about, habitat destruction is not involved, but there are many areas where habitat destruction is involved. So the osprey is getting it from both directions. This is a basically unhealthy osprey population, and unless something is done about it the population is going to continue going down. Eventually it is going to be quite a sight for us to see an osprey. (664)

I might add that exactly the same situation is occurring with our bald eagle.

Q. Now, with respect to the effects of DDT on birds, and I think you have already told us that you have read literature on that, does DDT affect one class of bird, such as predators perhaps, more than other types of bird?

A. This is a tough question to answer. I don't think anybody really has the answer. It is my impression from going through the literature that the gallinaceous birds, namely, chicken-like birds, the grouse, the bobwhite, the pheasant, they appear to be quite resistant. Unfortunately, these are the birds on which most of the studies in the laboratory have been done. So I think we may be making an error if we take the results of studies on bobwhite and project it to bald eagles. I think this may very well be a mistake. (665)

My suspicion is that the bald eagle is a good bit more sensitive than the bobwhite. But bobwhites are easy to handle in the laboratory, and eagles are apparently impossible.

Q. Would you say at this time with a reasonable degree of scientific certainty that the residues of chlorinated hydrocarbon pesticides have become an environmental parameter for Suffolk County and other areas? * * *

Can you tell us with a reasonable degree of scientific certainty whether chlorinated hydrocarbon residues are a part of the general overall environment in which fish and wildlife are forced to survive? * * *

In Suffolk County and elsewhere?

A. Yes, it is.

Q. Would you say this was world wide?

A. There is every indication that it is world wide. (666)

Q. Is there any indication that it has become an environmental factor in Suffolk County?

A. Yes, there is.

Q. . . . Is there any way to form a reasonable scientific opinion as to how much longer DDT will remain an environmental factor in Suffolk County, assuming that from this day forward not another drop is used in this county?

A. In this county or elsewhere as well?

Q. Start with this county.

A. Well, if Suffolk County stopped entirely and everybody continued to use it, I think that for Suffolk County itself many of the problems would be solved. The osprey feeds all over the place, so he would continue to get DDT. I don't think it would solve all the problems. It would certainly materially help, at least, insofar as Suffolk County is concerned. It would eliminate problems with shellfish and crustaceans, for example. It would eliminate problems with some birds, but not all. (667)

THE COURT: How about the use of it by the farmers?

THE WITNESS: I have no knowledge of how much the farmers use.

THE COURT: Is the DDT available for purchase?

THE WITNESS: As far as I know.

THE COURT: In other words, a person can go to a feed store and get a five-pound box of it and bring it home?

THE WITNESS: I believe so. Not only DDT, but endrin, dieldrin, and all sorts.

THE COURT: Has any investigation been made concerning the use by farmers or people other than the County of Suffolk? * * *

THE WITNESS: I really don't know. I came across the figure recently of 70,000,000 pounds of DDT used in the United States in 1965 out of something like 151,000,000 manufactured, which says we are using half of what we make and exporting the rest. As to who uses it all, I wouldn't be surprised if nobody knows who uses it all. That is really one of the problems. Nobody knows where all this stuff is coming from. (668)

Q. Do you have an opinion as to whether the banning of the use by one agency, such as the defendant Suffolk County Mosquito Control Commission, will contribute to bettering the situation in the county?

A. I have no doubt that it will contribute to improvement. It certainly is not going to solve all of the problems.

Q. But it will improve?

A. It will improve it, in my opinion.

Q. Do you have an opinion if there were a failure to ban and the Suffolk County Mosquito Control Commission continued to use DDT in whatever small amounts they may use it, do you have an opinion as to whether this will contribute to the problems that you have described? (669)

A. I think it certainly will contribute towards it. The more they use, the worse matters will be.

Q. But even a little bit is bad?

A. Yes, and if they use a little bit, then it will be a little bit bad.

Q. Now, at this stage of our environment, DDT having been injected into it, I think by the testimony, for at least 20 years, . . . Can you give us an opinion on the argument that you have heard that a little bit is not going to do that much more damage? * * *

Can you give us an opinion as to the effect of adding just a little more of DDT in Suffolk County as opposed to a lot more?

A. Well, I think that as a defense position, this is exceedingly weak, (670) because what it effectively says is this: "What we are doing is wrong, but we are not really doing very much of this. Therefore, it is okay." I don't subscribe to that philosophy at all. I think that a little bad is bad, and its that simple.

* * *

Q. Do you have an opinion with a reasonable degree of scientific certainty as to whether or not any further use of DDT by anyone in the County of Suffolk should be permitted? (671)

A. My feeling is that there are such a vast number of substitutes that are effective and in many cases, most cases more effective than DDT, that DDT should go. It's outdated. We have outlived its usefulness. It is doing more harm than good, and I haven't yet discovered a single use for it where there wouldn't be a better substitute.

Now this is not my field, knowing every pesticide and means of controlling it, but of the people I have spoken to who are more concerned with this aspect, I haven't yet discovered anybody who can tell me one single use for DDT where it is unique, and where it can't be substituted by something else for a better advantage or to at least as good advantage, and in many cases to better advantage.

Now, for example, the resistance of the mosquito. The mosquito populations world wide are becoming ever more resistant to this stuff. It is losing its effectiveness, and meanwhile we are learning more and more about its disastrous effects. We have reached the point where with DDT the benefit to detriment ratio is becoming impossibly high. (672)

THE COURT: Would you say the bad effect is surpassing the good effect?

THE WITNESS: I'd certainly say it is, although I am not talking about malaria

THE COURT: No, we are not going into malaria. Generally.

THE WITNESS: If we talk about Suffolk County or I should say the continental United States, I would certainly give that opinion.

Q. Now, one more question just as a matter of chemical interest. We have heard a lot of talk about potentially lethal substances, insecticides and poisons that are readily available and oftentimes used and which are 100 times more lethal, even in humans, than DDT, such as, I think one name was parathion. Will you tell the Court what the inherent difference between a substance like parathion, which is a contact poison and of such toxicity to humans as to be a danger, and something like DDT which human beings can generally handle (673) with their bare hands and in some cases some people have actually shown that they can take a pinch of the stuff and eat it?

A. Well, the difference is one of chemical stability. Parathion, malathion, and a number of others are organic phosphates, which means they break down relatively rapidly in the environment. This means you could have no sublethal effects or at least no long-term sublethal effects, because they just don't stay in the organism or in the environment for long periods of time.

Now, parathion is exceedingly toxic. It has a tremendous toxicity, but it vanishes within a matter of days or weeks.

On the other hand, with the chlorinated hydrocarbons, we have a number of rather bad actors. DDT is probably not the worst, but on the other hand DDT is the one we are using in vast quantities. Worse compounds are dieldrin. Dieldrin is much more toxic in general to most organisms, and endrin is likewise. But fortunately we have had enough sense not to use as much of these things as DDT

So that while DDT may be less toxic than dieldrin or endrin, it is the one that is everywhere. It is our major problem, our biggest problem. But this doesn't say it is the most toxic. (674)

In any case, the problem with the chlorinated hydrocarbons, most of them anyway, excluding a few like methoxychlor, which isn't really a true chlorinated hydrocarbon because it has oxygen in it, but in any case excluding-- strike that. In any case the problem with the chlorinated hydrocarbons is one of persistence. They stay around for years.

There are reports in the literature, well documented, where DDT has remained unchanged in the soil for ten years, and the only reason they have no records beyond ten years is that the experiment didn't run. We haven't gone more than ten years.

I think Dr. Woodwell can tell us more about persistence of DDT.

Q. Are you familiar with the changes in scientific knowledge and how scientific opinions change?

THE COURT: How would that come in? * * * (675)
We all know that there are changes from minute

to minute.
MR. YANNACONE: All right, Your Honor.

* * *

(The trial was then recessed for lunch.)

AFTERNOON SESSION (676)

CHARLES F. WURSTER resumed the witness stand and further testified as follows:

* * *

RE-CROSS-EXAMINATION by MR. CORWIN:

Q. Dr. Wurster, I want to get a little bit of your philosophy about this thing. You said that when you were talking about the gas-chromatograph that it was a very sensitive and sophisticated apparatus that could indicate the presence of any given substance to a degree of one part.

A. It detects absolute amounts. It doesn't detect parts per billion. It detects nanograms, picograms and micrograms.

Q. You can make an analysis and determination as to how much of a substance you are testing for, isn't that so?

A. Yes.

Q. Now, I am going to ask you to assume for the purpose of this question that the amount of DDT contributed through the use by the Suffolk County Mosquito Control Commission is 1/3000 of 1% of total use. (677)

A. Of what total use?

Q. I am talking about the amount that the Suffolk County Mosquito Control Commission has used since it started using DDT right up until the time that it knocked off on August 5th of this year against roughly all the DDT that has been used, and I am going to ask you if you think that is a significant amount?

A. I have not yet seen any figures indicating how much.

Q. I am giving you a hypothetical question now subject to connection later on as to proof, and the Court may strike it out if I can't do it. This is just for the purpose of asking you, since you have been qualified as an expert here, to give an opinion, and I am asking you if that were the case, 1/3000 of 1% would you think it is a significant amount? (678)

A. I have answered that question innumerable times in various ways.

Q. Well, see if you can answer it yes or no, will you?

A. No, I will answer it my way.

* * *

MR. CORWIN: He said he couldn't answer it yes or no.

MR. YANNACONE: And you don't want to hear the answer?

THE COURT: He said he can't answer it yes or no.

MR. CORWIN: I am assuming that qualifies his ability as an expert.

Q. Now, you made this remark. You were talking about the ospreys and about how they were declining. You said that nobody killed an osprey, and then you went on to something else in context with a lot of other things. You don't mean that, do you? You don't know whether anybody ever killed an osprey, do you? (679)

A. I don't really know what you mean.

Q. Well, you made the statement that nobody killed an osprey. You were assuming that it was all done through this damage to the reproductive business or seagulls eating the eggs, and you were saying that we didn't have this case of bang-bang and shooting away in the forests; that this wasn't that kind of a kill?

A. I am quite sure that people have shot ospreys, if that is what you mean.

Q. So that the decline of the osprey may be in part at least due to the fact that somebody destroyed them?

A. It doesn't help them when they get shot. That's quite true.

Q. In talking about this dieldrin, you made this statement: You said that we have enough sense not to use it in quantity, and I think that was the context of how you were using it. Are you talking about society when you say "we" there?

A. Those who make the decisions whether or not to use the material for whatever reason, and I assume and I hope it is because of its extreme toxicity that there has been a tendency to be more conservative with it. I may be wrong. Maybe they had other reasons. In any case, it is not used in the quantities that DDT is used, for which we can be grateful. (680)

Q. It isn't manufactured in those quantities?

A. I am sure it would be if there was a demand.

Q. How long have we had dieldrin and somebody using it as an insecticide or pesticide or whatever it is used for, a fungicide?

A. I don't really know. I assume that it has been since DDT, perhaps 1950, but I have no real idea.

Q. You don't have any idea what the production has been or the rate of increase in its use in the past few years, is that a fair statement?

A. No, I don't know.

Q. You were talking about chlorinated hydrocarbons, and you mentioned some particular substance that had a little. You said it wasn't truly a chlorinated hydrocarbon, because it had oxygen in it. What substance was it that you mentioned? (681)

A. Methoxychlor.

Q. Isn't it a fact, Doctor, that dieldrin has an oxygen atom in it?

A. It may be. I couldn't reproduce the structure for you. I think it is. I think it is an epoxide, and so it has one atom of oxygen.

Q. You agree that it does?

A. Yes.

Q. Are you saying then that it is not a chlorinated hydrocarbon?

A. In the trade, in the business it is generally considered to be a chlorinated hydrocarbon as is methoxychlor. To be really strict about it, neither dieldrin or methoxychlor are chlorinated hydrocarbons, but they certainly should be considered such. It is really irrelevant to this discussion whether or not there is an oxygen atom in its molecule.

Q. So we really don't have to be too scientific about it?

MR. YANNACONE: I'm going to object to that. (682)

THE COURT: That is not what he said. He didn't say that.

A. There is an oxygen atom---

THE COURT: Hold it.

MR. CORWIN: I will withdraw it.

Q. In answer to a number of hypothetical questions that Mr. Yannacone asked you about whether or not you could do certain things with a reasonable degree of scientific certainty, and you were talking about hydrochlorinated carbons generally. Now, would your answer have been any different if you eliminated malathion and dieldrin?

A. Malathion is an organophosphorus compound.

Q. Well, what was this other one you were referring to that had a little oxygen in it?

A. Methoxychlor.

Q. Well, if you ruled out dieldrin and methoxychlor----

A. Methoxychlor.

Q. Yes. Would your answer have been the same to the hypothetical questions that he asked you about the persistency and the damaging effect? (683)

A. I am getting lost with these hypothetical situations here.

Q. Yes, I am a little lost myself.

MR. YANNACONE: Your Honor, I respectfully object, and I ask that he make the questions specific. A lot of questions were asked hypothetically of this witness for a few days. Which question is he referring to?

MR. CORWIN: Well, I don't want to go back and have the court reporter read them, but let me see if I can fairly restate one of them. He was talking about the effect of these things on environment, and at first he started to confine himself to Suffolk County. He then got beyond Suffolk County, and he asked you, I think, if you had an opinion as to whether or not the presence of DDT and its use up to this time was having a serious effect upon natural life because of its persistence, and he wasn't talking about DDT specifically. He (684) used the expression chlorinated hydrocarbons. Is that your recollection?

A. I don't really know whether he was talking about chlorinated hydrocarbons in general.

Q. Were you assuming that he was talking about DDT when you were answering?

A. I am answering about DDT, because that is why we're here in the courtroom.

Q. So that if he asked you this question, you gave an answer to something else?

MR. YANNACONE: I'm going to object, Your Honor, unless we start reading all the questions back one at a time. This is ridiculous.

THE COURT: Counsel, I assure you that won't happen while I am judge. We have enough with what we have to expect without going back and looking in retrospect. Let us look to the future.

Q. You made a judgment with respect to what has been referred to (685) as the benefit-risk equation, and you said that you thought the use of DDT persists and remains present in our environment, not just Suffolk County, necessarily, but all over; and that was a state of unbalance on the risk side. Is that a fair statement of yours?

A. I believe that it has become such.

Q. Are you familiar with the report of the Report of the Committee on Government Operations, Interagency Environmental Hazards Coordination, Pesticides and Public Policy, United States Senate, made by the Subcommittee on Reorganization and International Organizations, commonly referred to as the Ribicoff Report?

A. I have seen excerpts from it. I haven't read it in total.

Q. Are you familiar that there was an inquiry made by the Federal Government by the committees of Congress into this question of the benefit-risk equation?

A. No, although I would assume it had been. (686)

Q. Well, that is what it is all about. You don't agree then with the conclusion the committee came to when they said: ". . . there is no reasonable evidence to suggest that the benefit-risk equation is unbalanced in any significant way."

A. Well, I completely and totally disagree with the committee's findings. I think they have got horse-blinds on it they can't see any more clearly than that.

Q. Now, you said in answer to a question that Mr. Yannacone asked you that it would be useful and beneficial even if the use of DDT by the Suffolk County Mosquito Control Commission were to be curtailed or abandoned, is that correct?

A. Yes.

Q. Can I assume then that you would say that you were saying yes even much more emphatically if there were to be a general ban on any use of it?

A. Where?

Q. All over, world wide.

A. Oh, I wouldn't jump to that sort of a conclusion. (687)

Q. And that wouldn't be beneficial to life?

A. We are talking about Suffolk County, and I would extend it to the United States, the continental United States.

Q. Why wouldn't it make any difference if it were banned world wide? Why wouldn't that be beneficial?

A. I'm not familiar with problems in India and Ceylon.

Q. Are you familiar with the problems in Scotland with respect to the peregrine falcon?

A. Somewhat, yes.

Q. Isn't your professional opinion about what is going on over there in Scotland and Great Britain about the peregrine falcon based on the studies and the literature contributed by one Mr. Ratcliffe?

A. That's quite right.

Q. And isn't one of the studies upon which you based your conclusion one included in the appendix entitled "The Status of the Peregrine in Great Britain", by D. A. Ratcliffe? (688)

A. That's right.

Q. Do you subscribe to what he said in paragraph 5 of the summary of that report, which states as follows: "Circumstantial evidence pointed strongly to agricultural toxic chemicals as the cause of decline, through contaminating prey taken by peregrines, which then accumulate the poison indirectly. This explanation is supported by the discovery of four different kinds of chlorinated hydrocarbon residues in an infertile peregrine's eggs, is that what you took into consideration?"

A. Your knowledge of the situation on the peregrine in Great Britain is out of date. Since that came out, there has been a much later edition published, and it is around here somewhere. I think Mr. Yannacone has it completely up to date, and it gives a long, long list of analyses which further substantiate the presence of various chlorinated hydrocarbons in the peregrine falcon's eggs. The prime factor in Great Britain seems to be dieldrin rather than DDT. There is DDD there also and there is DDE. There is heptachlor epoxide. These are all chlorinated hydrocarbons, and they are all among the worst actors. (689)

Q. But you are only interested in banning the use of DDT?

A. That is what we are here for in the courtroom.

Q. Let us stick to the banning of DDT in Suffolk County and in the United States, where you say you are more familiar with it. You regard it as being more beneficial to nature if we didn't continue to use it. Is that a fair statement of the way you feel?

A. DDT nation-wide?

Q. Yes?

A. Yes.

Q. And you mentioned, particularly with respect to its use in Suffolk County--not just by the commission, but by its general use by everybody--that it has an adverse effect on shell life; that if its use was discontinued, the scallops and oysters might come back in larger quantities, isn't that so? (690)

MR. YANNACONE: I will object to that. I don't think the witness testified to that.

THE COURT: He didn't say that. He said it didn't affect oysters. It did affect blue crabs, and I think he more or less stopped at that. I don't think he went beyond, and neither did he anticipate a comeback of this.

MR. CORWIN: When Mr. Yannacone was asking him questions about the effects that would flow if you were to issue an order banning its use, he indicated--at least this is the impression I got from his testimony: "Yes, that is what we want. It would be helpful."

THE COURT: He did say it would be helpful; that he did say. (691)

Q. Now, is that right?

A. I will say it again anyway. I think it would be helpful.

Q. So that then it is a fair statement to say, is it not, that the damage that has been done up to the present regarding this thing of long-range is not necessarily irreparable?

A. No, I don't agree with that at all.

MR. YANNAcone: I'm going to object to the word "irreparable".

THE COURT: Well, I like blue crabs, and I would like to see them back in the Sound again. I will permit the witness to answer the question. I want to hear his opinion.

* * *

A. This is a tough area to handle in that well, first of all, you have to define what one means by irreparable. I don't know what you mean. But we can discuss the subject.

Q. You answered Mr. Yannacone's question as to permanent, serious substantial, and irreparable damage. What did you mean? (692)

MR. YANNAcone: If your honor please, I didn't say anything about irreparable on direct examination that I can remember. I said substantial and permanent. Counsel is talking about irreparable.

MR. CORWIN: Well, irreparable is in the complaint, so we will ask this question based on his qualifications.

A. I wouldn't want to even guess how long it will be before the peregrine falcon is a breeding bird in the Eastern United States. It will be a long, long time, even if all of the DDT in the environment is eliminated this minute, which it is not going to be.

Q. That is because of the possibility that the decline and fall of this poor bird may be due to other factors than DDT which might have a considerable bearing? Isn't that so?

A. It has a bearing, but if you want to believe that, you may. I don't.

Q. I do believe it. I realize you disagree with me. Now, we don't (693) have the dodo bird around here any more, do we?

A. The dodo has nothing to do with the peregrine.

Q. We don't have the passenger pigeon around any more, do we, and the Canadian goose is on the decline and fall, is that right.

A. It is nowhere near extinction.

Q. We have a few of them. What bird am I thinking of that nests around Alabama, and there is only a half dozen or so of them. What bird am I thinking of?

A. That is the whooping crane.

Q. The whooping crane, yes. We only have about a half a dozen of them. Now, in fact, Doctor, there are millions of species of animals, is that right?

A. That's right.

Q. And they are presently in our ecology and our environment?

A. Yes. (694)

Q. And in spite of the fact that there are millions of them, would you agree with me that of all the species that have ever existed, the millions that exist today constitute not more than 1%?

A. Quite right. I don't know whether it is 1%, nobody knows, but it is small.

Q. A small fraction, and you give 20% one way or another. You don't think your acknowledgement of that fact should temper your feelings that because there aren't any more ospreys, things are really bad?

A. Well, if you follow your line of reasoning, we might as well eliminate all of our wildlife and be done with it.

Q. I don't think that necessarily follows. Do you think that my question indicates that as sequitur?

A. Well, it suggests it.

Q. It does to you, but it doesn't to me. Now, you were talking about the study made of the osprey by Ames and Mersereau. You recognize, don't you, that in the summary of the original report, which is a part of your appendix, that he said or they said: "Available evidence does not provide conclusive proof that DDT compounds have contributed to the failure of osprey eggs to hatch." (695) That is in the summary, isn't it?

A. I am aware of it. I am also aware-----

Q. Just are you aware of that?

A. I am also aware that the report has been updated by a more recent publication in 1966.

Q. As a result of the updating, did Ames now say that there is conclusive proof that DDT has contributed to the failure, and if so, to what extent?

A. No, he didn't say that.

Q. No, of course not.

A. I want to say one more thing. If we wait until there is conclusive proof, they will be gone first, and so will the bald eagle, just like the duck hawk is not gone.

Q. You said, Doctor, that when they started to make this study, they were suspicious of DDT and that was the reason that they made this study. That indicates to me that somebody is indicting this particular substance at the outset of what is supposed to be a scientific investigation. * * * (696)

You wouldn't agree with that, would you?

A. No, to the contrary, I would agree that they had every reason to be suspicious of DDT, as do we. Documentation before the beginning of that study goes back for twenty years. Why should they not have been suspicious?

Q. Correct. Now, let me ask you this: Were they suspicious about anything else?

A. They were obviously suspicious about a great number of factors, and they discussed all of them in their report, such as the motor boats.

Q. I wonder if among other things they refer to the fact that in the defendant's exhibit D, it was shown that there was more dieldrin in the Connecticut River than DDT? Do you suppose they referred to that? (697)

A. That wasn't published when they started this work.

Q. So it wouldn't have any effect on the situation at all?

A. When you analyze water from the Connecticut River, you might find DDT one minute and none the next, and vice versa. The fact that the report shows no---Actually, the report doesn't show no DDT in the Connecticut River. The report shows that the authors presumed it to be this. I'm not sure what they mean by presumed, but they presumed it to be.

Q. And that is in the table with respect to one area?

A. That's right.

MR. YANNACONE: I'm going to object, Your Honor. It says North Field.

MR. CORWIN: I am sorry, North Field.

Q. In any event, since they expected the DDT did they in making this study, if you know, examine for and rule out the possibility that the reproductive failure of the osprey in the marshes around Saybrook at the mouth of the Connecticut River was due, for example, to dieldrin, if you know? (698)

A. I don't know. If it were due to dieldrin, the conclusion would still be pretty much the same thing.

Q. Did they rule out all of these other chemicals in the Merck tables that you said yesterday were much more toxic than DDT?

A. I only know what I read from their manuscript, and I assume you have read that too.

Q. And as far as you can tell from the manuscript, the only thing they had tested for was DDT, isn't that so?

A. As far as I know, that's right. Let me add to that though. Their subsequent analyses were not done by the Schechter-Haller method but were done by gas chromatography and, if I'm not mistaken, it was by the Wisconsin Alumnae Research Foundation, which may very well have detected dieldrin and these other things, had they been there. I would actually be rather surprised if there weren't traces of those things present.

Q. But not knowing that, Doctor, nevertheless, you have no com- (699)
punction about answering Mr. Yannacone's question that your opinion was based upon a reasonable degree of scientific certainty, and it was based on that study and that Ames report, is that correct?

A. Yes, that's right.

Q. I have one more question. We were interrupted when we were talking about the names of the four people who did the bird count up in Hanover, and you mentioned Mrs. Wurster and yourself. You mentioned Mr. Strickland. Who was the fourth one?

A. The fourth was named Hans Weber.

Q. Where does Hans Weber live?

A. Hans Weber lives in Hanover.

Q. Did you and Mrs. Wurster live in Hanover?

A. Yes.

Q. Where did Mr. Strickland live?

A. Hanover.

Q. Did I understand you correctly to say that you four people worked in two crews of two each and made counts simultaneously in point of time of day and in both of the cities on each side of the river? (700)

A. Yes.

Q. And every one of the counts was made under those conditions?

A. (Witness nods head in an affirmative manner.)

Q. When you nod your head, the reporter doesn't get that down.

A. Yes, I'm sorry. Yes.

Q. Do you know Walter Dykstra?

A. No, I don't.

MR. CORWIN: I have no further questions.

REDIRECT EXAMINATION by MR. YANNAZONE:

Q. Is Dr. Ames' opinion different now than it was in the paper referred to by counsel just before, to the best of your knowledge?

A. No. To the contrary, it is substantiated by more data.

Q. Do you want to summarize for us what that opinion is?

MR. CORWIN: I don't think that this witness can summarize somebody else's opinion, Judge.

MR. YANNAZONE: His published opinion, I'm sorry, Your Honor. (701)

THE COURT: How will it help me?

A. Well, actually, I think we covered it.

Q. All right.

A. We covered it before.

THE COURT: Yes, I believe you have.

Q. Now, this report, which is commonly referred to as the Ribicoff Report, you have seen this thing at sometime or other or the results from it, is that right? It is the report referred to generally as the Ribicoff Report?

A. Yes, but I haven't sat down and read it.

Q. For the sake of questioning, I am going to ask you to assume a few things. This talks about the committee finding no reasonable evidence. Are you of your knowledge familiar with the methods of congressional committee investigations?

MR. CORWIN: I'm going to object to this. This is irrelevant and far afield.

THE COURT: Will you do me a favor, please? (702)

MR. YANNACONE: Subject to connection, Judge.

THE COURT: Will you do me a favor, please? I have enough trouble with my own court without worrying about Congress. Let Congress take care of their business.

MR. CORWIN: What do you want me to concede?

MR. YANNACONE: Will the Court take judicial notice that congressional committee investigation methods are not the formal methods of physical or biological science?

THE COURT: You don't want me to get fired, do you?

MR. YANNACONE: Well, then I want to elicit, Your Honor----

THE COURT: I have reached my 29th birthday, and I have watched television. I have been in Washington. If at this late stage I don't know how they conduct one of those investigations, then I don't belong on this bench in the first place.

MR. YANNACONE: Can we stipulate for the record, Your Honor, so that we can go on to the next expert? (703)

THE COURT: Here you have a very brilliant man, and you ask him a question like that. You are insulting his intelligence. He is a doctor of philosophy, and he has his master's degree. He has everything in the world, and you ask him whether he is familiar with it. Why I tell you those children back there in the courtroom are familiar with it. Now, go ahead.

Q. Dr. Wurster, just one last question. Do you consider the methods of that committee as scientific as you understand the word "scientific"?

A. No, I wouldn't say so.

THE COURT: They have a bunch of men who sit up on a high table, and they have people who come before them. They ask them questions, and they tell them a lot of things. Hardly any of these people are probably able to give any information, but nevertheless they take the information. They then arrive at a conclusion that may be without basis or with basis. It all depends on how lucky you are. Now, let us go on from there. (704)

Q. Now, you were asked to assume by the counsel the amount of DDT used by the Suffolk County Mosquito Control Commission to be 1/3000 of 1% of the total used in the County of Suffolk.

MR. CORWIN: I didn't say the County of Suffolk.

MR. YANNACONE: What did you say?

MR. CORWIN: We were talking about world-wide use.

Q. All right. That the Suffolk County Mosquito Control Commission uses 1/3000 of 1% of total use in the world of the DDT use, and you were then given or rather you were not given the total amount of DDT used in the world. Is it therefore possible by applying normal methods of mathematical and arithmetic reasoning to determine just what that amount is quantitatively? (705)

A. No, it is impossible. 1/3000 could be millions of tons.

Q. Or it could be nothing almost?

A. Or it could be nothing almost.

Q. It depends upon the gross volume used?

A. That's right.

Q. Now, you then said that you could not answer counsel's questions with a yes or no, and there was no such discussion of the matter.

THE COURT: Which question?

MR. YANNACONE: I'm coming to it.

Q. Assume that the amount of DDT used by the Suffolk County Mosquito Control Commission was 1/3000 of 3% of the total use--and I don't want to misquote--but what was the rest of that question? (706)

THE COURT: Counsel, please continue with your question. I can't have this delay every time, even looking at one another.

MR. YANNACONE: Well, Your Honor, I would like the witness to answer the question any way he wants to. At the time it was asked of him he said he couldn't answer it yes or no.

A. Well, I thought that this question of how much bad is bad----

THE COURT: He said when it is bad, he doesn't care how bad it is; that it is bad in his opinion. That is exactly what he said.

MR. YANNACONE: That is all.

RE-CROSS - EXAMINATION by MR. CORWIN:

Q. That same logic goes for your percentage reduction of robins, isn't that so?

A. I don't understand that.

Q. You don't follow that?

A. No.

Q. All right. You don't follow that. (707)

MR. CORWIN: I have no further questions, Your Honor.

THE COURT: Good. Are you through with him?

MR. CORWIN: I am through, Judge.

THE COURT: Now, for my purposes you are excused. Thank you. Now, gentlemen, unless you people want this young man for anything else, I don't like to have witnesses hanging around just to see them sitting around when they have work to do.

MR. YANNACONE: He has to go back and teach school.

THE COURT: Go ahead, young man, and I want to tell you this on the record: I thank you for the excellent information you have given to this Court, for what it is worth.

THE WITNESS: Thank you, Your Honor.

MR. YANNACONE: Mr. Dennis Puleston, please.

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