International Association of Defense Counsel

Trial Academy

David Otis Wilson and Debra B. Wilson v. The Roe Chemical Company, Inc.

Faculty Hypothetical
(Product Liability – Personal Injury Case)

INTRODUCTORY NOTE

The *Wilson v. Roe* hypothetical will be used for the faculty demonstrations during the International Association of Defense Counsel Trial Academy. This hypothetical problem is designed to simulate the material that one would receive on the eve of trial. Faculty members will demonstrate trial techniques and tactics using this hypothetical. Students will not use this fact scenario for student demonstrations, but students should familiarize themselves with the facts for better understanding of the faculty demonstrations. Advance preparation will serve you well during the Trial Academy.

All years in this problem are hypothetical and are stated in the following form:

YR-0 indicates the actual year in which the case is being tried (i.e., the present year);

YR-1 indicates the next preceding year (i.e., the present year minus one);

YR-2 indicates the second preceding year (i.e., the present year minus two); etc.

The day of the week that may be stated in the problem may not coincide with the date on the calendar. In the case of conflict, the date applies and the day of the week should be adjusted accordingly.

*****Due to a heavy backlog in the court system, this matter is just now going to trial.***

IADC TRIAL ACADEMY

Wilson v. Roe

Table of Contents

OVERVIEW OF THE FACTS

The Defendant, The Roe Chemical Company, Inc., produces and sells a liquid weed killer called Pre-Merge Dinitro. It is manufactured and sold in five-gallon containers. Its net profits were $20 million in the most recent fiscal year and 100% of its profits are derived from sales of products manufactured at its facility in Franklin. At the time of the accident, David Wilson was a 49 year-old farmer. He bought the product from defendant's outlet store. While attempting to pour from the container, either the container or the plaintiff slipped and the weed killer splashed over his body. He was diagnosed with a progressive nerve and muscle disease. Wilson sued the Defendant under the State of Roosevelt's product liability statute, which allows the fault-based defense of comparative negligence with a finding of 51% negligence on the part of the plaintiff being a bar to recovery. The statute and case law provide for a "risk utility" analysis and defense. The applicable statute of limitations is three years.

The Plaintiff bases his claims on Defendant's failure to warn, i.e., the Defendant's warnings on the label attached to the container were inadequate and the container was defectively designed and therefore was unreasonably dangerous for its intended and foreseeable uses. Defendant Roe denies that the product was in a defectively designed container and that the warning was inadequate, and Defendant asserts the defense of comparative negligence. Plaintiff seeks recovery of medical expenses, impaired earning capacity, physical and mental pain and suffering, loss of enjoyment of life, and punitive damages. Plaintiff's wife, Debra Wilson, also brings a claim for loss of consortium.

Roosevelt's case law provides that federal labeling statutes do not pre-empt state tort claims based on inadequate warnings or instructions. It also provides that a defendant is entitled to a presumption that a warning or instruction that is provided will be heeded by its recipient (a jury instruction will be given on this issue). This presumption is rebuttable.

Evidence indicates that the subject container was shipped from the factory almost two months prior to Plaintiff's purchase. During this interim shipping period, but prior to Plaintiff's purchase, Roe decided to change the label to include additional language concerning the danger of absorption. The state evidentiary rule with respect to subsequent remedial measures mirrors the Federal Rules of Evidence. State law does not permit bifurcation as a matter of right. It is discretionary with the court on motion by either party.

IN THE CIRCUIT COURT OF FARRAH COUNTY
STATE OF ROOSEVELT

DAVID OTIS WILSON and	**)**	
DEBRA B. WILSON,	**)**	
Plaintiffs,	**)**	**Civil Action No. YR-4-1001**
	)	
v.	**)**	
	)	
THE ROE CHEMICAL COMPANY, INC.,	**)**	
Defendant.	**)**	

COMPLAINT AND JURY CLAIM

Now come the plaintiffs, David O. Wilson and Debra B. Wilson, and for their causes of action against the defendant, The Roe Chemical Company, Inc. state:

FACTUAL ALLEGATIONS

1. The Plaintiff, David O. Wilson, (hereinafter "Wilson") is a natural person residing in Franklin, Roosevelt.

2. The Plaintiff, Debra B. Wilson, is a natural person residing in Franklin, Roosevelt who at all material times was married to David O. Wilson.

3. The Defendant, The Roe Chemical Company, Inc., (hereinafter "Roe") is now and was at all material times a corporation organized and existing under and by virtue of the laws of the State of Roosevelt with its principal place of business at Route 3, Franklin, Roosevelt.

4. At all material times, Roe manufactured, sold, and distributed a weed-killer known as "Pre-Merge Dinitro" (hereinafter "Dinitro").

5. On Saturday, July 29, YR-5, Wilson purchased the product Dinitro from Roe's outlet store, "Roe's Chemical Outlet," located at 538 Fifth Street, Franklin, Roosevelt.

6. While using the product, on Friday, August 4, YR-5, Wilson was exposed to the weed-killer. Some of the chemicals in the product were absorbed into Wilson's bloodstream.

7. As a direct result of this absorption, Wilson developed peripheral neuropathy and myopathy of his entire nervous system and body, resulting in all of the nerves, muscles, and tissues of his body becoming severely and permanently damaged, atrophied, and weakened.

8. As a result of his exposure to Dinitro, Wilson has and will continue to suffer severe pain, numbness, cramping, extreme fatigue, and total impotence.

9. Because of his pain and the permanency of his injuries, Wilson has suffered severe emotional distress and has permanently lost his ability to function as a farmer; he is fearful of developing cancer.

10. As a result of the aforesaid injuries, Wilson has incurred medical expenses in the sum of $50,000 and will be required to expend large sums of money for further care and treatment in the future.

COUNT I

11. The Plaintiff, David O. Wilson, repeats and realleges Paragraphs 1-10 inclusive as if specifically set forth herein.

12. The Defendant's product directly and proximately caused Wilson's injuries and damages, and was and is unsafe for its intended purpose and created an unreasonable and hazardous condition.

13. The Defendant is liable under the State of Roosevelt's Manufacturer's Liability Statute by reason of:

(a) failing to provide adequate warnings of the inherent danger of the product;

(b) failing to provide adequate directions for safe and proper use of the product;

(c) placing a dangerous product in the stream of commerce; and

(d) designing, manufacturing, and marketing a container that was defective and was unreasonably dangerous for its foreseeable and intended use.

WHERFORE the plaintiff, David O. Wilson, states that he has been damaged by the Defendant in the amount of $2,500,000 and demands judgment in that amount, together with interest and costs.

COUNT II

14. The Plaintiff repeats and realleges paragraphs 1-13 of Count I.

15. The Defendant's product was negligently formulated, manufactured, and packaged.

16. The Defendant's said negligence was a direct and proximate cause of Wilson's injuries.

WHEREFORE the plaintiff, David O. Wilson, states that he has been damaged by the Defendant in the amount of $2,500,000 and demands judgment in that amount, together with interest and costs.

COUNT III

17. Plaintiff, Debra B. Wilson, repeats and realleges paragraphs 1-16 of Counts I and II.

18. As a direct and proximate result of the injuries sustained by her husband Wilson, the Plaintiff, Debra B. Wilson, has lost and will lose in the future the services, society, companionship, and consortium of her husband.

WHEREFORE the plaintiff, Debra B. Wilson, states that she has been damaged by the Defendant in the amount of $1,000,000 and demands judgment in that amount, together with interest and costs.

COUNT IV

19. Plaintiff, Debra B. Wilson, repeats and realleges paragraphs 1-18 of Counts I - III.

20. As a direct and proximate result of the injuries sustained by her husband, David O. Wilson, Plaintiff, Debra B. Wilson, has been required to remain home to care for her husband and operate the farm and has been unable to continue her college studies and therefore will suffer a loss of future earning capacity.

Wherefore the plaintiff, Debra B. Wilson, states that she has been damaged by the Defendant in an amount in excess of $250,000 and demands judgment in that amount, together with interest and costs.

COUNT V

20. Plaintiffs, repeat and reallege paragraphs 1-19 of Counts I - IV.

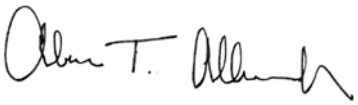
21. The Plaintiffs claim that they are entitled to punitive damages as a result of the Defendant's strict liability and demand damages in an amount sufficient to punish the Defendant and deter such conduct.

WHEREFORE the plaintiffs demand judgment in an amount to be determined by the jury.

JURY CLAIM

Now come the Plaintiffs and demand a trial by jury of claims set forth in this Complaint and any subsequent amendments thereto and responsive pleadings.

The Plaintiffs,

By: 

By their Attorneys,
Alfred Thomas Allworth, Esquire
Allworth, Taylor, Lindner & Alton
31 Fifth Street
Franklin, Roosevelt 30640

Dated: July 27, YR-4

IN THE CIRCUIT COURT OF FARRAH COUNTY
STATE OF ROOSEVELT

DAVID OTIS WILSON and	**)**	
DEBRA B. WILSON,	**)**	
Plaintiffs,	**)**	**Civil Action No. YR-5-1001**
	)	
	)	
v.	**)**	
	)	
THE ROE CHEMICAL COMPANY, INC.,	**)**	
Defendant.	**)**	

DEFENDANT'S ANSWER,
AFFIRMATIVE DEFENSES, AND JURY CLAIM

ANSWER

Now comes the Defendant, The Roe Chemical Company, Inc., and for its answer to the Complaint states the following:

1. The Defendant admits paragraphs 1-4 of the Complaint.

2. The Defendant is without information sufficient to admit or deny the allegations contained in Paragraph 5.

3. The Defendant denies each and every other allegation contained in every other paragraph of the Complaint.

AFFIRMATIVE DEFENSES

First Affirmative Defense

The Defendant adequately warned all users of the product, Pre-Merge Dinitro, of the potential danger of improper use thereof, by affixing appropriate warning labels to each container.

Second Affirmative Defense

The warnings on the label were submitted, along with all tests to the relevant agencies of the United States government. These agencies approved both the label and the sale of the product.

Third Affirmative Defense

The container was not defectively designed and was reasonably safe for its intended use.

Fourth Affirmative Defense

The Plaintiff's own negligence proximately caused whatever damages he claims in that he did not exercise ordinary care for his own safety in handling the product or the container, and Plaintiff's recovery is barred or reduced as a result of such negligence.

Fifth Affirmative Defense

The Plaintiff did not use the product in the manner intended by this Defendant.

Sixth Affirmative Defense

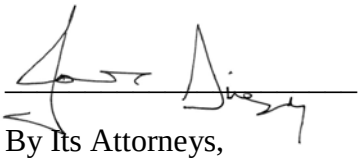
The Plaintiff knew of and assumed the risks associated with use of the product.

WHEREFORE, having fully answered all counts of the Complaint, Defendant prays to be dismissed with costs.

JURY CLAIM

The Defendant demands a trial by jury as to all allegations set forth in the Complaint, this Answer, and any further responsive pleadings.

Respectfully submitted,
The Defendant,



By Its Attorneys,

Joshua Digby, Esquire

Irwin, Allen, Digby & Cleveland,
384 Fifth Street
Franklin, Roosevelt 30640

[Certificate of Service on Plaintiffs' Attorneys]

STATEMENT OF DEBRA WILSON

My name is Debra Wilson, and I am David Wilson's wife. At the time of David's accident we had been married for two years. I am 33 years old. David has a son George from a prior marriage who lives with us. What has happened to David has greatly affected our marriage and our life. David is my third husband, and we are trying to keep our marriage together. We had planned to have a child but David's impotence has changed all that. His inability to have sex has devastated him emotionally. Before the accident, we had sex two to three times a month, but because of his impotency, we don't have sex now and whatever tenderness he had for me is gone. I've tried talking him into seeing a marriage counselor or taking Viagra but he won't. Now he can't even walk without getting tired.

On August 4, YR-5, the day of the accident, I was in the kitchen baking and washing dishes. There is a window over the sink, so I saw and heard what happened. David was about 60 yards away — I'm not too good on judging distances. The window was half up. I remember being angry because as usual David was doing all the work. George was off somewhere else doing God knows what. George can't get a job because of his drug and legal problems and his bad attitude. To tell you the truth, I'm scared stiff of George. He looks at me strange all the time; at least, I think he is looking at me, if you know what I mean.

They were working around the truck and tractor that day, and it was about noon. I was looking out the window watching David because I am always nervous about the way he handles chemicals. David put the Dinitro container on the bed of the pick up truck to pour it. That's the only safe way; otherwise it will spill. That's the way all of the farmers around here do it. His back was to me so I couldn't see exactly what he was doing. I looked down for just a minute and then I heard a yell and a clatter. I looked up from my dishes and saw David on the ground, soaked with that horrible chemical. George was just standing there looking at him. I rushed out of the house and saw David washing himself off at the faucet. He was cursing. George said something like, "It happened again, didn't it?" I yelled at David that I had warned him about being careful with those chemicals. He shrugged and said he had 30 years' experience, and nothing like that had bothered him before. I don't know what he meant by that. I'm sure he's never spilled any chemical on himself before.

David is very careful about everything he does on the farm. The accident wasn't his fault. We went inside our house, and he scrubbed himself raw in the bathtub. He didn't seem worried, but, just in case, he followed the instructions on the Dinitro label. I read it, and it seemed to say that if you washed it off, nothing would happen. What a lie! Then I burned the clothes he was wearing.

At the time of the accident, David was in wonderful shape for a 49 year-old man. He had a job in town and ran the farm – with precious little help from that son of his. He's always had a little arthritis, but a week after the spill he started getting weaker and weaker. He fell down in the field and got real scared. Finally, after about a month of this, I took him to Dr. Weeks. He told David that his arthritis was getting worse, and he was simply working too hard for a man who was almost 50. That was bunk. David then went to a specialist, who made the diagnosis of the muscle disease caused by the chemicals in the Dinitro.

David can't work now. We can't pay the bills, especially for his 19-day hospital stay. These doctors tell me he will not get any better. Hopefully he will, if he doesn't die of inactivity first. He's just wasting away, sitting in a chair watching TV all day long.

Since we can't afford to hire anyone to run the farm, I've had to quit college and go back to work at Sam's Bar here in Franklin where I work 20 hours a week and earn $20 an hour. For the past four years, I had been taking accounting courses at Franklin City College as a part-time student. I planned to complete my college courses over the next four or five years and then work for a C.P.A. firm in Des Moines or some other big city. It doesn't look like that's going to happen now.

I met David at Sam's Bar. I don't like the work because the men are always coming on to me. David put up a fight about my going back to work there, but we really need the money and there aren't any other jobs in town that I can get.

My life was a mess before I met David, but he helped me turn it around. Before the accident he was a wonderful husband and provider. He works — or worked — 14 hours a day before the accident. We went on food stamps last month. It humiliated David when I went to the state office and signed up for those benefits, and it embarrasses him every time we use them in town. He's a very proud man. He's so different now than he was before – he is withdrawn, moody, and impatient.

July 15, YR-4.

[Statement given to Plaintiffs' attorneys]

STATEMENT OF GEORGE WILSON

My name is George Wilson. I'm 21 years old, and I live in a room over the barn on my father's farm. My mother and father split up when I was 15 and then my father married this cocktail waitress he met in a bar; her name is Debbie. I think she talked my dad into leaving my mother. I don't like her and she doesn't like me. That's why I live in the room over the barn. My mom moved back to live with her parents, and I don't see her more than once a year at Christmas. I work hard and really run the farm, especially now that my dad can't work. I don't get paid anything regular but my dad gives me money when I need it and has promised that I'll get the farm when he retires.

I've had a few problems with the law in the past four years, mostly because the local cops don't like me and are always looking to hassle me. Debbie's brother works on the police force, and I am sure he has a lot to do with that. About three years ago, I was stopped for making an illegal turn and the cops found about an ounce of pot in my truck. It was a bogus bust; the stuff wasn't even mine, but I didn't have much of a chance winning that argument. The judge gave me a choice of 6 months in jail or 3 months in rehab if I admitted I "had a problem." I spent 3 months at the clinic in Cedar Rapids. Then for six months I had to give a urine sample every week to the local probation department.

My dad was pretty cool about the drugs, and he told me one night that he done his fair share of partying when he was in the army. Debbie, on the other hand, is a real pain in the ass about it, always giving me grief and calling me a stoner and telling my father that I'll never amount to anything and that I don't deserve to get the farm when he retires.

Debbie's way too young for my father, and they have never gotten along. She still hangs out at Sam's bar in town on some nights when my father is too tired to stay up and she was doing that even before the accident when he had to work the night shift when they did inventory at the plant. She loves all of the attention the men give her. Even before the accident, they used to argue about her hanging out there and coming home loaded. She doesn't like me, and the feeling is mutual.

I was helping my dad on the day of the accident. He was in the back yard, about 100 yards from the house, right next to the barn. I had gone inside the barn to get my pair of gloves to wear and had just come out when I saw him put the can of Dinitro on the edge of the tailgate of the pick up truck. He was tilting the can with his left hand and balancing the 1-gallon pail with his right hand on top of his right leg. I could just tell he was going to spill that stuff on himself again. The Dinitro came pouring out the 5-gallon container and all over him again. He was soaked. He's really not as careful as I am around those chemicals. I spilt some of that Dinitro on my hands last month, and I had a fever for a week. I was real sick, but I still went to work.

When it happened to me, I read the label and I remember saying to him, "hey Dad, did you ever read the bad things they say this stuff can cause?" and he told me he doesn't read labels anymore "because they all say the same thing and they're just trying to scare you into being careful." After spilling the stuff, Dad looked real concerned, and glanced at the container. It almost was as if he hadn't read the label before. He did have his gloves on, I remember that. He ran over to the faucet and washed himself off. By then Debbie was coming up to us, and she was yelling at me. She must have been looking out the window while she was sitting in the kitchen reading one of her magazines. Of course she blamed me for not doing the filling as if she ever lifts a finger or knows anything about farm work.

They went inside, and an hour later Dad came back out and we finished our chores. I asked him how he felt, and he said, "Fine." He said that he followed the directions on the label about what to do if there was a spill and that he wasn't concerned.

A few days after the spill I noticed that Dad didn't look so good. I thought he was getting sick just like I had gotten sick but he shrugged it off. I got concerned when he started to loose his balance and began to fall a lot. I didn't see him fall but he would come in from the fields and tell me. When he told me, he looked real worried. At first he tried to joke about it, saying that his arthritis was acting up. Then he began to fall more often and got weaker and soon he couldn't do any work. Finally he went to a slew of doctors. He's not much better. It's been a drought year, and the crops are doing bad. It would help to have an extra hand, but we can't afford it.

August 10, YR-4.

George Wilson

[Statement made to Plaintiffs' attorneys and made available to Defendant's attorney during discovery]

EXCERPTS FROM DEPOSITION OF DAVID WILSON
(Taken on October 26, YR-4)

Q. **Please give us your full name, date of birth, and address**.

A. David Otis Wilson, November 18, YR-55. I live on Route 4 here in Franklin.

Q. **What's your wife's name?**

A. Debra - Debbie. We got married in YR-7. I have one child George who was born in YR-25. He lives with my wife and me on the farm. Debbie and I don't have any children. When we got married we planned on having a couple, but that was before that chemical made me impotent.

Q. **What do you do?**

A. I'm the farm manager for Consolidated Farming, Inc. I've been working for Consolidated for the past 15 years or so. I also have my own little farm. It's 53 acres, and I've been farming that land for over 30 years. We grow corn, wheat, and soybeans.

Q. **Okay, first let's talk about your job with Consolidated Farming. You said you have been with the company for about 15 years; what is your wage rate and what are your job responsibilities?**

A. I get a salary, and that salary is, oh, about $60,000 a year. The hours vary, you know, because in the spring with the planting it takes a lot more time, and, of course, in the fall with the harvesting it takes a lot more time. So during those times of the year, I'm out, oh, 6 a.m. until dinner, then go to our farm and work until dark. Then in the wintertime and summer months, those hours they're a lot more reasonable, they're sort of regular hours, 40, 45 hours, whatever. I don't get no overtime, and I've gotta supervise, you know, the workers and make sure they're doing the stuff right and make sure the equipment is working okay and checking the crops, make sure they're getting fertilized and pesticided and all that good stuff, you know, like they're supposed to.

Q. **What types of benefits does Consolidated Farming provide you? By that, I am inquiring about whether they give you vacation time and holiday time, provide you with any health care coverage or a retirement program?**

A. Oh yeah, Consolidated, they, they've got good benefits. I get health coverage, you know, it's one of those good plans with a company, think it's Anthem Blue Cross/Blue Shield. Best I recollect, they pay for most, most everything. I usually have to pay some portion, but then they cover all the other stuff. My employer pays for the cost of that; I don't have to contribute anything except when I use the plan, and then I usually have some expenses with it. I also get two weeks' vacation. Naturally, I have to take it during the slow seasons, but that's no problem, and I usually get holidays excepting those that are during, you know, planting and harvesting season, and then there's just too much work to do.

Q. **What about a retirement plan; does Consolidated Farming offer a retirement plan for you?**

A. Yeah, they got a plan. I don't know the exact details of it or anything, but it's okay. You best talk to them about just how it works.

Q. **Has Consolidated Farming gone through any changes in personnel lately?**

A. Well, around the time of my accident, they had just started to reorganize the company, and a lot of people were being shifted around and some people were being let go. I don't think I would have lost my job, though.

Q. **Now, I understand that you have not been able to return to work since this accident. Have you been receiving any benefits or money from the company while you have been away from the job?**

A. Yeah, they give me some disability benefits, short-term disability benefits. A couple hundred dollars a week to my recollection. But I don't think that's gonna last too much longer. The company told me I was either gonna have to go back to work or I was gonna lose my job soon. I don't have much more time to decide.

Q. **You also indicated, Mr. Wilson, that you had this farm, 53 acres of farming. Do you farm this land and work for Consolidated, or how do you handle this farm of yours?**

A. Well, you know, I been working this farm for 30 years. It's not too big, and so I can sort of squeeze it in after my work hours. Naturally, during the heavy seasons in the spring and the fall, I have extra help, but I also got George, you know, and he helps me, so we've been able to handle it all these years.

Q. **So, since this accident, have you been able to manage the farm or are you having problems with the farm?**

A. Well, you know, there's always problems, and I don't do so well, but I, I'm getting better at it, and so I'm expecting to maybe keep it up.

Q. **When did the accident happen?**

A. On August 4th, a Friday, about noon.

Q. **Where did it happen?**

A. Right behind my house, about 50 yards from the house, near the barn out in the open area. There are a few trees in between where we were standing and the house. It was a clear day; otherwise I wouldn't of been spraying.

Q. **Please, in your own words, describe the accident.**

A. Okay, I was standing on the ground right behind the pickup truck; the tailgate was down (indicating). On the tailgate was a case of oil, just a pasteboard box of oil cans. I put the Dinitro on top of the oil cans and I was pouring from the five-gallon container of Dinitro herbicide into a one gallon pail I bought with the Dinitro from Roe's Outlet Store, here in Franklin.

Q. **What happened next?**

A. Well, in order to do this, the way the can is made, you have to pull a spout off — flexible spout out of the top of the can, and it just more or less pops out — and you screw off the cap. And then to avoid spilling it, the way I've gotten accustomed to doing it is actually putting the pail up to the spout of the five-gallon can as I tip it over. It's more or less this high to me (indicating), about chest height. And as I was tipping the can over - it was full, it was a brand-new can – it slipped on top of the box of oil, and I didn't lose hold of it (indicating), but it fell down under the tailgate on the bed of the truck, and the Dinitro splashed out onto me on the left side of my neck (indicating) and my front (indicating) and my legs (indicating) and a little bit on my cheek (indicating).

Q. **You were holding the five-gallon bucket close to your body?**

A. I was holding it the way I've always held it. I was standing, as I said, at the tailgate of the truck. Just reached up and was tipping it over the pail, as I've done many times before.

Q. **How many times?**

A. Oh, about 200 to 300 times, with all types of weed-killers, not just Dinitro. They come in the same kind of container.

Q. **What were you wearing?**

A. Jeans, a long-sleeve work shirt, and boots.

Q. **Were you wearing work gloves?**

A. Nope.

Q. **Why not?**

A. I have gloves, but I wasn't wearing them - they get in the way, they make it tougher to handle the spout and such.

Q. **You know weed-killers are dangerously toxic, don't you?**

A. Yes sir. Otherwise they wouldn't work.

Q. **Have you ever spilled any chemical on you using this method?**

A. No, never, though I've come awful close.

Q. **Mr. Wilson, if you've come close before, and you know chemicals are dangerous, why did you continue to use this method?**

A. The way I do it is the safest way possible. Every farmer I know does it that way. How was I to know I'd get hurt like this if this weed-killer spilled on me? There are no directions on how to pour it on the label. Anyway, because of my injuries, no one I know uses Dinitro anymore. They even stopped selling it in their outlet store now.

Q. **Did the Roe Outlet provide you with any pamphlets or literature on the products?**

A. No sir, but they told me that Dinitro would be safe and would work if I followed the directions. They never told me about those tests which killed those animals. All I got was the five-gallon container and the label.

Q. **How did you first decide on Dinitro as a product to be used on your soybeans?**

A. Well, I thought it would be effective as a herbicide. It worked well as a direct spray underneath the rows at this time of year, and I used it - I think it was the year before. I'm not sure. It was at least one of the years before, I had used Dinitro. It's not the only effective herbicide, but it's the cheapest. And it's made by Roe, who hires a lot of people here in Franklin. They had a good reputation before my accident. The same thing happened to Doug Jones last year, but with a different weed-killer. He had to sue and settled for a million. My lawyer represented him too.

Q. **After you bought the product, did you read the instructions on the label?**

A. Well, I read through them. The label is on the back of the container, but it's real easy to read. I always try to read such instructions. I can't say that I remembered every word of it, but I looked at it, and I noticed the warning. Of course I know pesticides are dangerous if you get them in your mouth and such.

Q. **And rather than pouring the Dinitro directly into the machine, you poured it into the one-gallon pail, which you then used to pour the Dinitro into the machine?**

A. Yes, sir. But I did that to measure it. If you don't measure it right, you're either putting out too much and wasting it, or you're not putting out enough and it don't work.

Q. **When you read the label on the container of Dinitro, did you notice the large skull and crossbones on the label?**

A. Well, to be honest, I don't really remember it. I — you know, these labels all say the same thing. They're just a bunch of words the government and lawyers make the company put on there to cover their asses, if you'll excuse my French. And I've seen those skull and crossbones before, and I know what they mean — be careful, don't swallow, things like that. I handle all herbicides carefully, I don't need a label to tell me to do that.

Q. **Did you notice the word DANGER in large letters?**

A. Yes, sir.

Q. **Did you notice the word POISON in large letters?**

A. I'm sure I did. I know that it's dangerous and poisonous, but when I read "poisonous," I thought it meant don't swallow the stuff, like I needed them to tell me that. I don't know anything about what do you guys call it – absorption? I saw that word used but didn't know that absorption meant if you got it on your clothes or your skin for a second it would cause all the problems that I now have. Do you think I would have used it if I'd known? I followed the instructions, washed, and thought that would help. Otherwise, why put in medical instructions? And it says "Fatal If Swallowed," not "Fatal If It Gets on Your Skin." It killed all of those animals in the tests, and it damn near killed me. They should have put something about those dead animals on the label if they wanted to warn people – that would have gotten my attention and made me more careful when handling the stuff.

Q. **And you didn't pay that much attention then to the danger warnings?**

A. No. I feel like that once you've read one of those labels, you've read them all.

Q. **What was your immediate physical reaction when you spilled the chemical on yourself?**

A. Well, I was surprised, and I was worried, I guess you could say, that it was going to hurt me. So I immediately washed it off. I remember cursing, but that's all.

Q. **Did the chemicals burn or sting you?**

A. Not right at that time, no, sir.

Q. **Did you feel giddy, weak, or nauseous?**

A. No, sir, not at that time.

Q. **Did you breathe any of the fumes?**

A. Well, I breathe them all the time when I'm pouring weed-killers like Dinitro. I couldn't help but breathe them.

Q. **No, I meant to ask, did you breathe them while the Dinitro was on your clothes?**

A. Well sir, I was breathing the whole time so if that stuff gives off fumes, then I guess you'd have to say I was breathing them.

Q. **What did you do then?**

A. I washed off at the faucet.

Q. **Did you follow the directions given on the product label?**

A. Well, to tell you the truth, all I needed to do was what I did, was to go wash it off. I washed it off outside, and then I went inside with Debbie and washed off four or five times with soap and water in the tub. The instructions, I remember, were to just wash it off, and that's what I did.

Q. **And you did remove the clothing that you had been wearing?**

A. Oh, yes, sir. I took them right off and Debbie burned them. She was real insistent about that.

Q. **Why?**

A. I don't know. She's real paranoid about chemicals, even though she knows farmers couldn't get along without herbicides and insecticides. I keep on telling her what used to say on TV, "without chemicals there would be no life itself," or something like that.

Q. **Were there any witnesses?**

A. Yes, Debbie was in the kitchen, and George was right there helping me out like always. He's a good kid. He's had a rough time since his mother and me split up and she moved away. He's had a few problems with pot and the local cops. He lives over the barn because he likes his privacy. I know he and Debbie sometimes don't get along but most often we are one big happy family. He's been real good since my accident, helping out, driving me around. He wants to take over the farm some day – says he has plans for some new crops to plant. He's always got new ideas and plans that boy.

Q. **When did you go to the doctor?**

A. About three weeks later, after I kept getting weaker and weaker and started to fall a lot. Debbie made me go to Dr. Weeks, our family doctor, around the last week in August.

Q. **What did he tell you?**

A. He said my arthritis was acting up, gave me some aspirin, and told me to rest. But it didn't help. I never felt that way before, even when my arthritis was at its worst, during winter. It was like my feet were weighted down, and I had little balance.

Q. **Who did you go see then?**

A. Dr. Jason, right after Labor Day. He put me in the hospital for 19 days of hell. I never had been prodded or tested like that – not even when I was in the army. I also saw Dr. Donald. I don't like him. I had to see him because of this lawsuit. He put me in the hospital for a few more tests. He just about stuck me to death with more needles.

Q. **In the last ten years, what other physical problems have you had?**

A. Oh, about YR-11 I had pneumonia, a couple of years before that I had a minor heart attack. I was in the hospital because of my heart for two weeks. My daddy died of heart trouble when he was 59. In about YR-14 I had to go to the Campbell Clinic for rheumatoid arthritis. I still have a little problem with my arthritis. I just put up with the pain. Before that I hadn't had any problems since I was in the service.

Q. **When were you in the service?**

A. I served in Desert Storm. I don't recall the years.

Q. **Where did you serve?**

A. I was in Kuwait near the Iraq border..

Q. **What kinds of health problems did you have in the service?**

A. Well, a lot of soldiers in my outfit complained of Gulf War Syndrome but I never thought much about it..

Q. **Are you presently on any medication?**

A. Yes, but I'm real bad about remembering to take them.

Q. **Do you have any allergies?**

A. No, sir, none that I know about.

Q. **Before this accident, what other types of pesticides or weed-killers did you use?**

A. I used Treflan, a premerge herbicide you mix in the soil before planting; MSMA, a contact herbicide you apply after the weeds start to grow; Cotoran; Ansar 529; Carmex DL; and some others I can't remember just now. I have used all types to grow my crops.

Q. **How long have you used these types of chemicals?**

A. Near to 20 years. Dinitro only for a year. They're all real effective.

Q. **Have you ever spilled or breathed these chemicals?**

A. Breathed, yes, because you can't help that. I don't think I've spilled any, not that I can remember. Maybe on my hands, but that's all.

Q. **How have you been keeping the farm going?**

A. I haven't. George helps, but I've lost close to $30,000 worth of crops because of the drought. If I had been able, I could have prevented it. Debbie's too busy with her job to help out even if she could. She works at Sam's in Franklin. I hate her working there, but we do need the money. She brings home good tips. She's had to stop going to school too, she was going to be a CPA.

Q. **I know what your Complaint says, but at any time, Mr. Wilson, did you or have you experienced the following symptoms: excessive sweating?**

A. Sure, at times I've sweated a lot.

Q. **Excessive thirst?**

A. Well, what do you mean by excessive – I've always drunk a lot of water – but not anymore or less since the accident.

Q. **Fever?**

A. George told me he thought I had gotten a fever after the spill but I never checked.

Q. **Excessive fatigue?**

A. Well, not excessive. Pretty extreme though. I've been tired; I can't walk because of my muscles.

Q. **How much Dinitro spilled on you?**

A. About a gallon, I figure. More than half of that liquid was that horrible chemical, assuming they're telling the truth on that label.

Q. **Mr. Wilson, were any tests performed on your limbs or extremities for signs of numbness, weakness, cramping, and nervous response at the hospital?**

A. Yes. They ran every kind of test on me that I could imagine. And they took muscle tissue out of my leg and a million blood tests. They were all real painful. It was 19 days of hell.

Q. **What did the test show as to the numbness, weakness, cramping, or nervous responses in your limbs or extremities?**

A. Well, finally they figured out that the Dinitro caused it all. I didn't really believe it, but they showed me those blood tests. They even say I had a near-lethal dose. They say I'm lucky to be alive, but as bad as I'm feeling, I wish I was dead. I can't work, can't even make love to my wife. I feel useless, like a 90 year-old man.

Q. **Can you basically tell me what other physical problems you've had? How would you describe your medical problems, other than a general weakness?**

A. Well, I have a problem with night vision. If I'm riding in a car at night, I have trouble picking up the oncoming headlights in the distance. And in the daytime, I have a hard time seeing far away. I used to have excellent vision as far as distances go – day or night. I also don't hear as good and have headaches. I have a problem holding my water, if you know what I mean. I have to get up three or four times a night, and I've never done that before. My knees have numbness in them, which is a real nuisance. And right now, I'm sitting here, and I feel like I have to get up and go. I have a nervous tension build-up problem. My wife and I have a problem in that I'm impotent and that we can't have sex, which is a strain. And I lost about 25 pounds. I've gained back 10 of it, but it's all flab. But my main problems are that I'm weak, nervous, and I have real bad headaches. Oh, let me add one more thing. Right after the spraying, I had a problem with hemorrhages in my bowel movements, which was very painful and scary. I had to go to the emergency room because of my bowels. That was two months after the accident. And while the hemorrhages have gone away, I still have a real problem with diarrhea and things like that.

Q. **You mentioned impotency. Just what exactly is the problem?**

A. How much do you want to know? I can only get half an erection. I've had a few problems before, like all men. Debbie and I had a satisfying relationship, about two to three times a week. I don't feel like I'm much of a man anymore. I'm scared she will leave me for some young man.

Q. **How much were your total medical bills?**

A. About $50,000, but that's just my best guess.

Q. **What was your annual income before the accident?**

A. After expenses, I cleared $2,000 from the farm each year and I had my regular job that paid about $60,000 a year plus benefits. Since the accident, the farm's been losing money. I don't know how much. I can't farm, I can't work at the company, and I can't even fix farm equipment like I used to each winter and make some extra money.

Q. **How has your wife taken all of this?**

A. How do you think she's taken it? She's worrying herself to death. I snap at her all of the time. She's doing good just to be putting up with me. She's had to go back to work, which I don't like. And she had to give up her college courses. Our marriage isn't like it

used to be. She's young and wants to go out and do things but this disease makes me too tired.

Q. **If you feel that you've been misled in using an unsafe product, what gave rise to your misconception of the danger of this product?**

A. Would you mind putting that in English?

Q. **Sure, I'm sorry. If, as you claim, Roe misled you about the safety of Dinitro, what do you say caused you to misunderstand the danger of using it?**

A. That's better. Well, I guess that's why we're here, because the label wasn't clear and the weed-killer was far more dangerous than I thought it was, evidently, since I've got these problems.

Q. **How do you feel now; what can you do?**

A. I feel a little better. I can oversee the farm by truck. I can get up from a chair without too much difficulty, and I feel a little strength returning in my arms. But I'm no way anywhere near what I used to be. They tell me it's permanent**.** I'm scared about what more is going to happen to me. I learned after getting sick that Roe knew that Dinitro also caused some lab animals to get cancer. I'm always thinking about that now.

EXCERPTS FROM DEPOSITION OF DR. WILLIAM JASON
(Taken on October 2, YR-4)

Q. **Would you state your name, Doctor?**

A. William Lawrence Jason.

Q. **What is your address, sir?**

A. 10 South Boulevard, Franklin, Roosevelt.

Q. **And what is your occupation or profession?**

A. I am a medical doctor specializing in neurology.

Q. **Doctor, would you outline for the jury your educational background?**

A. I received my B.S. from the University of Maryland and graduated from the University of Tennessee Medical School in Memphis. I did my internship and residency at the University of Tennessee Medical Center and my fellowship in neurology at Roosevelt Memorial Hospital. I've been in private practice here in Franklin since YR-39.

Q. **Are you a member of any of the medical societies?**

A. American Medical Association, the Mid-South and Farrah County Medical Societies, the American Neurological Academy, and several others. In fact, I belong to all of them that are appropriate for this part of the country. I belong to the American Institute of Hypnosis. That's an ANA Division of the American Medical Association, and I belong to the National Institute of Acupuncture Research.

Q. **Doctor, are you on the staffs of any hospitals?**

A. Yes, I am.

Q. **Would you name those, please?**

A. I have privileges at Roosevelt Memorial Hospital here in Franklin, Methodist Hospital here in Franklin. I am a member of the University of Roosevelt teaching staff as an assistant professor.

Q. **What do you teach?**

A. Neurology.

Q. **Can you explain what neurology is?**

A. Neurology is the specialty of diagnosing and treating diseases of the central nervous system, as well as the peripheral nerves and muscles.

Q. **And is neurology a recognized specialty by the American Medical Association?**

A. Certainly.

Q. **Doctor, are you board certified in neurology?**

A. I am board eligible.

Q. **Doctor, in pursuing your specialty of neurology, have you published any papers on that subject?**

A. Yes, several —in drug research, some chemical exposure and things like this.

Q. **Did you have occasion to examine David Wilson?**

A. Yes, for the first time on September 1, YR-5. He was referred to me from Dr. Weeks, a general practitioner. Dr. Weeks gave me a complete history and described the accident as told to him by Mr. Wilson.

Q. **What records of his treatment have you reviewed in connection with your treatment of Mr. Wilson and your formulation of opinions for this case?**

A. I've been provided with some of his records and some letters in my files from the chemical company. I've also had some copies of letters sent to me since I started treating David. The actual diagnosis was made at the Roosevelt Hospital through blood analysis. It was then sent to the chemical company that manufactured the herbicide. We also did a muscle biopsy and several nerve conduction tests. We had an EMG done, an electrical investigation of muscle potentials and also nerve conductions. This was done by Dr. Richard Gerd, who is an associate of mine.

Q. **What was the result of that test?**

A. It was abnormal. The findings were consistent with peripheral neuropathy and myopathy. He had a myopathic picture on the EMG.

Q. **What does that mean?**

A. It means that the muscle potentials are pathological in showing high bursts in extended movement, electrical patterns.

Q. **What does that mean as far as Mr. Wilson's function?**

A. In saying myopathic, that means that the muscles have pathology, that it is an abnormal muscle.

Q. **Did the test indicate a muscle weakness?**

A. Muscle damage.

Q. **Was that damage limited to his extremities or was it generalized in Mr. Wilson's body?**

A. It was generalized but more so to his extremities.

Q. **Doctor, was it brought to your attention at the time you saw Mr. Wilson that he had been exposed to the chemical 2-sec butyl 4,6-dinitrophenol which is sold as Dinitro?**

A. Yes. He told me in detail about the accident. After my initial examination, we did the tests and got all of the reports and the muscle biopsy report and the chemical report from the Duckworth Pathology Lab. They confirmed that Dinitro was in his bloodstream. I talked to the physician at the Roe Chemical Company who sent me their findings. The levels found in his blood were around 5 micrograms per milliliter, and that was a rather dangerous level, if not lethal.

Q. **Have you familiarized yourself with the ways that Dinitro may be introduced into the human body?**

A. Yes, either orally or by contact with the body - absorption into the bloodstream through contact with the skin, airborne or swallowing it. I've read the medical literature regarding this Dinitro chemical. There are a few case reports of people with peripheral neuropathy that were exposed to chemicals with very similar chemical structures. The patients had symptoms very similar to Mr. Wilson's. There are no large well-controlled studies in the literature of Dinitro or the other chemicals that have similar structures. Some of my colleagues have told me that they have treated farmers who have used Dinitro and other herbicides and pesticides and who developed neuropathies.

Q. **What does lethal mean?**

A. A dose level that would kill you.

Q. **Kill an ordinary person?**

A. Yes. I am not saying that Mr. Wilson is not an ordinary person. You said, "kill an ordinary person." I am not saying he is an abnormal person. I do not know why it didn't kill him.

Q. **Doctor, do your records indicate when you last saw Mr. Wilson?**

A. Yes. I see him about every three or four months now. I saw him two days ago. He still had paresis, of course, easy fatigability, multiple complaints, of course, of pain here and there. But this is just from his inability to sit down and take it easy. He moves around a lot, he's very tense. He, of course, has chest pains and things like that due to muscle contractions and not cardiac disease by any means. He has difficulty with erections, the inability to get an erect penis. As a matter of fact, I first thought the cause was his difficulty with bladder function. When I first met with both Mr. and Mrs. Wilson, she brought it out quite emphatically that she had noticed a change prior to when he went in the hospital - in fact, back several days after he had this chemical exposure, and since that time I don't think he has had an erection. At one time, he was quite a muscular man from descriptions that have been given me, and he is not now, and it is hard to assess just how much of a percentage of paresis he has. I started to give you one, but it would be difficult to do. He certainly is weak enough that he fatigues easily, that his gait, ability to walk any distance, would be shortened. He is somewhere, I suppose, around 40% to 50% weaker than he was prior from the descriptions I could get. It would be hard to say just how much, and only speculation on my part. But at the present time he fatigues very easily.

Q. **Has there been any damage to Mr. Wilson's kidneys or liver?**

A. Well, during the time I have been seeing him, the only time I saw him with reference to liver function was during the hospital stay, and he definitely had damage there. Of course, this is to be expected. It is quite apparent from reading the animal studies that have been published on Dinitro.

Q. **In what respect? The result of the Dinitro?**

A. Yes.

Q. **Doctor, do you have an opinion to a reasonable medical certainty, based upon your education, training, experience, review of relevant literature, and treatment and**

examination of Mr. Wilson, as to whether Mr. Wilson's contact with the Dinitro directly caused the injuries you have described to us?

A. Yes. It is my medical opinion, based on my tests and Mr. Wilson's prior medical history, that the cause of the pathology was related to the absorption of the chemicals through his skin. It was found to be in his blood. His contact with the chemical caused everything - impotency, etc. He has peripheral neuropathy with myopathy. He will not have any significant improvement in the future, though he will live out a normal life expectancy unless he develops liver cancer resulting from his exposure. I doubt whether he can have sexual intercourse again.

Q. **Do you have an opinion as to whether or not Mr. Wilson is permanently and totally disabled from performing the duties of a farmer?**

A. Yes. He tries to do jobs that he had been doing around the farm, and he cannot. I have no idea of his educational background, what he can do on the labor market. He certainly can't go back to farming like he was doing. He is certainly not disabled to the point that he couldn't do a sedentary job, like selling postage stamps or something of that sort, handling mail. He cannot go back and farm like he was doing. I am sure that's permanent. It is my opinion his exposure to this chemical caused his neuropathy and his myopathy. I also believe it substantially increased the odds that he may develop liver cancer later in life.

Q. **This one exposure?**

A. Yes. There is no threshold known or accepted for carcinogens. This man had worked with this material before, and it is probable that he absorbed some of this material before either through his skin or inhalation. He gave no history of ever being sick before this very, very large exposure, so I would think it is reasonable to conclude that this one large exposure caused the condition.

Q. **Is it possible that muscle weakness from a chemical could occur because of repeated exposure to a chemical?**

A. Yes, it is possible.

Q. **And were you aware of his exposure to any other chemical outside of Dinitro, say, over a period of a year or two?**

A. No.

Q. **Are you aware of any other significant chemical exposures before YR-6?**

A**.** None that he reported.

Q. **Are you aware of any other significant illnesses in Mr. Wilson's past?**

A. He didn't report any to me and neither has Dr. Weeks.

Q. **Let me ask you, assume someone's blood level was 4.3 micrograms per milliliter one month after an alleged exposure. Would you tell me whether that would mean that more than that amount of had been previously present?**

A. It probably would. Chemicals are metabolized either by the liver or kidney. Dinitro is primarily broken down by the liver over a period of time, and so I would assume such a person would have had a higher level one month before the blood was tested.

Q. **Now, assume that Mr. Wilson had exposure, as he told you, to his arms, chest, and those areas that you designated in your report, and he immediately washed off and then took a bath with soap and water and never again wore the clothing that he had on, shoes, nor any portions of his apparel. Would you assume that such a dosage after being washed off could within that period or time be absorbed through the skin?**

A. It is absorbed rapidly through the skin, that's clear from all of the literature. If he were heavily exposed, a significant and potentially lethal amount could be absorbed in a few minutes. I performed a differential diagnosis and was able to rule out all other possible explanations for his symptoms, leaving his Dinitro exposure as the only explanation for his problems.

Q. **Are there any peer-reviewed studies of an association between Dinitro and peripheral neuropathy and myopathy?**

A. Not in the literature but some of my colleagues have told me about several patients who have been exposed to Dinitro and have developed neurological problems. The Roe Company has a horrible reputation for making killer chemicals. I personally have not treated other victims of Dinitro, but I have had to treat victims of other types of herbicides made by Roe. One man died as a result of absorption through the bloodstream because he spilled another type of Roe weed-killer on himself that I understand had a molecular structure similar to Dinitro.

Q. **I believe it is on the record that Mr. Wilson used Treflan, that he used Cotoran, Ansar 529 MSMA, MSMA, Cotoran plus MSMA, Carmex DL, which is a contact killer, and Riverside 612.**

A. Yes, and that's a lot of chemicals.

Q. **Given the fact that Mr. Wilson used all these chemicals over a twenty-year period or so, would your opinion be any different as to the cause and effect of his problems?**

A. Well, if the chemicals you mentioned had chemical structures similar to Dinitro then it is possible that they may have contributed to his problem but this recent large exposure to Dinitro overwhelmed his defense clearance mechanism. This caused him to suffer his injuries. The literature documents how long these chemicals stay in the serum.

Q. **If he had been exposed to all the chemicals we just discussed over a number of years, isn't it possible that those exposures may have caused his alleged problems?**

A. I said before if they had similar structures it's possible. It is more likely that long-term exposures to such chemicals put him at greater risk for developing liver cancer and the recent massive exposure caused his neuropathy and myopathy. It just makes common sense that because the neuropathy and myopathy occurred so soon after the exposure, that the Dinitro caused the problems. Plus, we know Mr. Wilson had high levels of Dinitro in his bloodstream.

Q. **Doctor, aren't there case reports in the peer reviewed literature that describes many of the same symptoms Mr. Wilson allegedly developed in servicemen suffering from Gulf War Syndrome?**

A. Mr. Wilson didn't "allegedly" develop symptoms. He has them and he has a well-defined medical condition called peripheral neuropathy and myopathy. This is not something he made up. Yes, case reports of the type you describe are published in the literature. The temporality of his recent exposure and the later development of symptoms

plus the animal data Roe generated make it clear to me the cause of Mr. Wilson's problems was Dinitro poisoning and not some "alleged" form of Gulf War syndrome.

Q. **By the way doctor, how much are you paid for your services as an expert witness in this case?**

A. My standard fee is $550 per hour, with a 4-hour minimum for depositions and court appearances.

Q. **How much do you charge for your regular examinations of Mr. Wilson?**

A. Well his insurance company's reimbursement rate is $100 for a half hour visit.

EXCERPTS FROM DEPOSITION OF DR. MARTIN DONALD

(Taken on November 19, YR-4)

Q. **Would you state your name, please?**

A. Martin W. Donald.

Q. **And you are a physician with an office in Franklin?**

A. Yes.

Q. **Dr. Donald, what is your specialty?**

A. Internal medicine.

Q. **And you are Board Certified in internal medicine?**

A. Yes.

Q. **Are you Board Certified in neurology?**

A. No, but at the time I took my Board in internal medicine, neurology was really considered part of internal medicine. So I have training in organic neurology as part of internal medicine.

Q. **Did you examine David Wilson?**

A. Yes, at the request of Roe Chemical Company. I know their medical director. I saw Mr. Wilson in the hospital for my personal examination. I had access to all of his records and past history. Apparently he's seen more than one doctor, besides Dr. Jason. Mr. Wilson told me his version of the accident, his spilling the pesticide on him, the symptoms, etc. Apparently Dr. Jason made the diagnosis after getting the results of blood tests from the chemical company. I did a complete physical examination. His deep reflexes were equal and active. The superficial reflexes were present. Sensation is apparently intact. Babinski signs are negative. The patient swayed with the Romberg test, but does not fall.

Q. **Of what significance is the fact that he swayed with the Romberg but didn't fall?**

A. Well, that means that his swaying is probably more a result of muscle weakness than it is of central nervous system disease.

Q. **What other tests did you perform?**

A. X-rays, blood chemistry tests, liver scan. They were all negative. He refused to take an electromyograph or submit to another biopsy, so I had to rely on his previous tests, which, in my opinion, were done incorrectly.

Q. **Would you tell me what an electromyogram is, and what it is designed to ascertain?**

A. Well, they stimulate the muscles electrically and see how they respond to a standard electrical current. It is designed to show how the muscle functions. An electromyogram is a test for the diagnosis of myopathy. His past test results were very, in my opinion, inconclusive. They seemed to indicate myopathy, but not to a medical probability.

Q. **Would you tell me what objective findings you made, if any, that showed that Mr. Wilson, when you had him in the hospital at that time, was suffering from muscle weakness, if he was?**

A. He swayed with the Romberg test.

Q. **Is that a symptom of muscle weakness alone or can that be a symptom of other things?**

A. It can be a symptom of many other things, too numerous to list also. There are many things which might cause swaying on the Romberg test.

Q. **In other words, the fact that one swayed on the Romberg does not necessarily indicate muscle weakness, would it?**

A. No, not necessarily.

Q. **It could?**

A. Sure.

Q. **Anything else that you found?**

A. The other thing was that he was clumsy in his movements in walking and his gait.

Q. **Would you describe that a little more in detail? You say he was clumsy in his movements. You mean in walking?**

A. Yes, but he is a 51-year-old man, a farmer at that.

Q. **Anything else that you found objectively that would indicate to you that he was suffering from a muscle weakness?**

A. His muscles generally were flabby. He was soft. He was not very muscular for a farmer. In my opinion he does have neuropathy but not myopathy. He has arthritis and heart problems. He's not a young man. He's been around toxic chemicals all of his life, and apparently is not very careful with them.

Q. **Now, of course, you did review hospital records and a history of other records and what he told you of his exposure?**

A. Yes.

Q. **Now how would you describe the present muscle weakness you found?**

A. I would describe it as moderate. This man is like a weak individual who was just in very poor physical condition but able to be up and around.

Q. **All right. Do you think his condition will improve over time?**

A. It should.

Q. **Why?**

A. All he needs to do is exercise. Even assuming he had a toxic reaction to Dinitro, which I do not believe, the chemical is out of his body.

Q. **He indicated that he was impotent but I believe your report said he told you he had engaged in intercourse but it was not satisfactory. I think you used that word.**

A. Yes, he told me he had intercourse but that he would lose his erection after a few minutes. He said it had happened before in his life, but now it happened every time.

Q. **Is it because of the flabbiness of his muscles?**

A. I doubt that. There are many causes for impotence, but initially this may have been organic from the effect of the nerve endings. I also think it is primarily psychological.

Q. **Well, at the present time, based upon your examination, would you think that his present condition would prevent intercourse?**

A. Probably not. He does have pretty good bowel and urinary function.

Q. **We have talked about, and you mentioned in your testimony, the amount of chemical, and I am looking through the hospital records again and I see a report from the Duckworth Pathology Group dated September 18, YR-5 signed by Dr. Duckworth, and in that report he mentions the serum level. And in there he indicates that since Mr. Wilson's exposure to the compound occurred approximately one month before, the serum level of 4.3 micrograms per milliliter was good presumptive evidence of previous toxic levels in his blood. Would you agree with that statement?**

A. The fact that Dinitro was in his blood one month after the accident may suggest that it was in his blood at the time of the accident. The fact that the chemical was in the blood does not mean it had a toxic effect and caused neuropathy.

Q. **Do you believe the exposure caused his problems?**

A. No, I don't think so. There are no published reports of people developing the type of problems Mr. Wilson says he has from exposure to Dinitro. Assuming the results seen in the animal studies are applicable to humans, he would have needed to have been exposed over a prolonged period of time and to much higher doses. He denies this occurred. The tests indicate a significant level in his bloodstream. This suggests he spilled it on himself and walked around with the chemical on his skin. You will have to ask him about that. I think his symptoms are consistent with the complaints of veterans who suffer from Gulf War Syndrome.. Dr. Jason did not appear to include that in his differential diagnosis.

Q. **Have you looked over the literature on this chemical compound?**

A. Yes, and it supports my belief that this man does not have neuropathy or myopathy caused by acute exposure to Dinitro. The case reports that Dr. Jason mentioned in his deposition relate to other chemicals that may have similar structures but are not Dinitro. Plus, no large epidemiological studies have been done on people exposed to these chemicals. The data Dr. Jason relies upon is not the type of data from which sound scientific conclusions about general causation can be drawn. The animal data cannot be extrapolated to humans.

EXCERPTS FROM DEPOSITION OF DR. D. B. TOWE

(Taken on December 20, YR-4)

Q. **Dr. Towe, would you state your full name, please?**

A. Dr. Daniel Baker Towe.

Q. **Who is your employer?**

A. Roe Chemical, working in the Toxicology Department, for five years.

Q. **Would you give us a little bit of your educational background?**

A. Four years of undergraduate study in the field of biology. Four years of graduate study in toxicology.

Q. **Do you have a doctorate in toxicology?**

A. Ph.D.

Q. **In your employment with the toxicology department with Roe Chemical, what is your main job?**

A. I'm head of the department.

Q. **Just what do you do?**

A. I run experiments on design chemicals and recommend what should be put on labels.

Q. **Are you familiar with the product Pre-merge Dinitro?**

A. Yes, through the experiments which I conducted at the labs here at Roe. We ran a series of several tests on different compounds for alkyldinitro phenols. We ran a series of tests on three different lab animals, including rats, mice, and rabbits. We then published those results in an article I co-authored.

Q. **What was the purpose of the tests?**

A. The purpose of the test was to find out the toxic effects in relation to how it would affect man — or how it would affect these animals, and to help write the warning labels.

Q. **What different compounds did you test?**

A. The different compounds of dinitrophenol that are structurally similar. We experimented with five of the chemicals: 2,4- dinitrophenol; 4, 6-dinitro-o-cresol; 2-sec buty1 4,6-dinitrophenol; 2-cyclohexy1 4,6-dinitropheno1; 2-cyclohexyl 4,6-dinitrophenol compound with dicyclohexylamine.

Q. **Would you go into a little more detail on the tests that you performed and give us the results of some of the tests on the different lab animals?**

A. The first experiment we did was on rabbits. Each chemical was tested on 20 rabbits. We exposed four groups of 5 rabbits to a different concentration. We also had 5 controls that were dosed with saline. We found no statistically significant differences between the exposed rabbits and the control rabbits. This suggested that skin exposure to Dinitro would not produce harmful effects in humans.

Q. **Were there any differences regardless of whether they were statistically significant?**

A. Rabbits in three of the test groups exhibited symptoms consistent with a fever.

Q. **Were any of those chemicals that produced this result 2-sec butyl 4,6-dinitrophenol?**

A. Yes.

Q. **What was the concentration of the Dinitro that produced the symptoms?**

A. The rabbits reacted only to the highest concentration. The highest concentration was undiluted Dinitro.

Q. **Was there any reason for using rabbits?**

A. Yes. An animal is selected on the basis of its similar physiological comparative anatomy to man, and that's why we chose rabbits.

Q. **There were two other lab animals that you mentioned, laboratory rats and mice, correct?**

A. Yes.

Q. **Would you explain the testing on those animals and the results?**

A. The skin absorption testing on the rats was done in the same manner as the rabbits. We also did two other experiments to determine the effects from ingestion. We created 5 groups of 20 rats. Each group was fed one of the 5 chemicals we tested. Four rats in each group of 20 were fed a single dose of varying concentration. We also had 5 controls. The other experiment involved oral daily dosing 100 rats over a six-month period with each of 5 groups being fed one of the chemicals.

Q. **Was 2-sec butyl 4,6-dinitrophenol tested for six months?**

A. Yes.

Q. **What results did you get in your single dose experiment?**

A. Some of the rats getting the highest dose developed high fevers. We found this reaction in response to three of the chemicals. One rat out of the 100 that we tested in the single dose experiment died at the highest dose.

Q. **What chemical was fed to the rat that died?**

A. The chemical was fed to the rats in their water and mixed with their food. The total daily amount fed to the rats was equal to .01%, .10%, 1% or 5% of their body weight. The average weight of the rats was 400 grams.

Q. **What results did you find in the chronic testing?**

A. Some rats at the two highest doses developed what appeared to be neurological deficits. However, the frequency of this result was only marginally statistically significant.

Q. **Based upon the tests and the results, did you conclude that any of the compounds had any toxic effect in the rats?**

A. Yes. The skin testing produced some pyretic effects. The one death from the single oral dose was not a statistically significant result. Only 6 rats died in the chronic testing.

Q. **And what caused the pyretic effect that you mentioned?**

A. The mechanism that caused the pyretic effect is not understood completely.

Q. **Which chemicals produced the reactions you've mentioned?**

A. 2-sec butyl 4,6-dinitrophenol, 4,6-dinitro-o-cresol, and 2,4- dinitrophenol.

Q. **So, three out of the five compounds had some toxicity, and Dinitro had a fatal effect in one rat in the single dose experiment and killed 2 rats in 3 of the 5 groups tested?**

A. Yes.

Q. **Are 4,6-dinitro-o-cresol and 2,4-dinitrophenol structurally similar to 2-sec butyl 4,6-dinitrophenol?**

A. Yes.

Q. **Describe the testing that was done on the mice.**

A. The mice were tested in much the same way as the rats except the long-term studies ran eighteen months. That was pretty much a lifetime study for mice.

Q. **What results did you see in the testing that was done with skin application?**

A. The mice had slightly greater toxic reactions to the chemicals than rats and rabbits. More mice developed fevers at lower concentrations with the skin absorption than the rats. In addition, 2 of the mice died from the skin absorption study done with Dinitro (2-sec butyl 4,6-dinitrophenol).

Q. **What results were seen in the single oral dose testing?**

A. Five of the mice fed the two highest concentrations of Dinitro died within 7 days of being dosed.

Q. **This means that 50% of the mice fed the two highest quantities of Dinitro died?**

A. Yes.

Q. **What results did you achieve with the chronic feeding study in the mice?**

A. Among the one hundred exposed mice, we were surprised to find two that died from liver cancer. We had not seen this in the rats. Approximately 20% of the mice exposed to Dinitro became ataxic. Some of those had begun to drag their hind legs before they were sacrificed and autopsied.

Q. **What were the findings on autopsy?**

A. Some of the animals exhibited muscle wasting and loss of nerve axons.

Q. **Were any of the rabbits or rats autopsied?**

A. No.

Q. **How much was fed to the mice that became ataxic?**

A. Mice exhibiting this symptom had received the three highest concentrations.

Q. **What is the average weight of the mice that were used?**

A. Approximately thirty grams.

Q. **Of the three compounds that you described had a toxic effect, which, in your opinion, was the most toxic?**

A. 2-sec butyl 4,6-dinitrophenol. It proved to be the most toxic when applied both to the skin and by ingestion.

Q. **Going back to the skin absorption studies for a moment. How long was the chemical allowed to stay on the skin of the animals?**

A. We followed the animals for two weeks after the single application. That excludes of course the few that died within two weeks of the chemical being applied to the skin.

Q. **What precautions were taken by the lab technicians to prevent any contact with these compounds?**

A. The only precautions taken to handle the chemicals were extreme care, plus gloves, of course.

Q. **You didn't handle these chemicals under a hood or in an enclosed environment?**

A. No.

Q. **Your chemists are trained to be safe and careful in handling dangerous chemicals, aren't they?**

A. Yes.

Q. **So, it was your opinion that there was no danger to the lab technicians as long as they handled the compounds with care?**

A. Yes, and wore gloves.

Q. **And there was no reason to worry about any type of accident, any type of spill of the compounds?**

A. No. Even a spill of the compounds on the skin would not have caused any reaction from the body. All that needed to be done was immediate washing. That's what we put on the label.

Q. **Did you see any reason to put directions on the label about how a person should pour or get the chemicals out of the container?**

A. No. I was only interested in the effect of the compounds, which were safe when properly used.

Q. **If the laboratory animals had been washed immediately after application of these compounds, would there have been any toxic effect to them?**

A. If we had done those tests and left the chemical on for only a short period, 15 minutes, there would be no fatalities.

Q. **So, in other words, some applications were left on for an appreciable amount of time?**

A. Yes.

Q. **Could you tell us when the first animal died after application of the 2-sec butyl 4,6-dinitrophenol?**

A. Twenty-four hours after application of the 2-sec butyl 4,6-dinitrophenol, a death occurred among the mice.

Q. **Dinitrophenols, as a group, have been in use for how long or since when?**

A. Dinitrophenols were first used approximately 100 years ago.

Q. **But you don't know if that is a commercial use?**

A. It has been in commercial use over that period of time. It is used extensively in sprays for control of pests, insects, mites, et cetera.

Q. **Is the compound 2-sec butyl 4,6-dinitrophenol included in your answer?**

A. Yes.

Q. **In your opinion, Dr. Towe, would contact with skin by this chemical have any harmful effects or toxic effects on a human being regardless of the concentration?**

A. Obviously, any compound if used in heavy concentration may cause problems, but if used properly, it will not produce toxic reactions.

Q. **What, in your opinion, is a concentration of Dinitro that will not cause a problem if spilled on skin?**

A. We can't foresee that someone would take a bath in the stuff. We can't be blamed for that. If so, aspirin would be considered abnormally dangerous. Weed killers have to be toxic to work, period.

Q. **And what, in your opinion, would be a safe concentration of Dinitro?**

A. Providing that it wasn't put on the skin and held on for a prolonged period of time, I believe that a heavy concentration of the chemical would not be harmful.

Q. **Could you narrow down approximately what a heavy concentration might be? 50 percent?**

A. Even if a l00 percent application of this compound were applied to your skin, and was washed off within, say, 20 or 30 minutes, the effects of the chemical would most likely not be absorbed into the skin. Perhaps a little irritation, but nothing to the extent that it would be fatal. Our tests indicated what the symptoms of poisoning would be, and we

put it on the label. I have heard Mr. Wilson admit that he suffered none of those symptoms.

Q. **Do you think it could have any permanent, harmful effects?**

A. Nothing permanent if it was washed off in a reasonable amount of time.

Q. **Did you ever do any studies on humans using Dinitro?**

A. Not personally.

Q. **Doesn't the mortality in the lab animals suggest Dinitro can cause serious illness or death in humans?**

A. No. The animal mortality is explained by the dose given to small animals: It would take a much larger dose to yield the same effects on a human being.

Q. **If a human being were ten times larger than a rabbit or rat, are you saying it would take ten times more concentration of the chemical to have the same effect?**

A. Yes.

Q. **In your opinion, are these chemicals toxic?**

A. Yes.

Q. **In your opinion, are these chemicals hazardous if used in a reasonable manner?**

A. No.

Q. **Would you have advocated against the marketing Dinitro if you found it to be hazardous or an ultra-hazardous chemical?**

A. Yes. I've stopped Roe in the past from putting products on the market that were too toxic or dangerous. We err on the side of caution. Of course, the government also plays a role.

Q. **What is Roe's procedure after tests are made?**

A. We confer with other specialists in the field, our marketing department, and suggest language to adequately warn users. We carefully consult federal law, write the label, and then submit it and all tests to the government. In the case of Pre-merge Dinitro, the government approved the label and warnings. They were clear, concise, and informative. We put skull and crossbones, indicated that it could be fatal, put "absorbed through the skin," "do not get on skin," even medical instructions. We at Roe feel a double obligation to the farmer, to provide him with chemicals that will work and to properly warn him. Accidents happen, but we cannot be blamed. As a part of my job, I receive all medical reports when any of our chemicals cause any injury. Despite hundreds of thousands of applications, there are only a handful of unsubstantiated adverse reaction reports. This product has an extremely low incident rate.

DEPOSITION OF ARTHUR STEELE

(Taken on November 26, YR-4)

Q. **Please state your name**.

A. My name is Arthur Steele.

Q. **Would you tell us about your education, Mr. Steele?**

A. I have a B.S. in mechanical engineering from the University of Denver in YR-45 and an M.S. from the University of Denver in mechanical engineering in YR-34.

Q. **Do you have any professional recognition or licensing?**

A. I'm a registered professional engineer in the states of Colorado and Nebraska.

Q. **Did you have to take an examination to receive that title?**

A. Yes, that's by examination.

Q. **What is your post-graduate experience and education?**

A. I've attended numerous seminars, and I have taught several seminars.

Q. **Sir, would you tell us what your teaching experience has been, please?**

A. I was a lecturer of mechanical engineering at the University of Denver for several years, where I taught design — machine design, fluid mechanics, hydraulics — all the senior laboratory courses in mechanical engineering. I was an assistant professor at the Colorado School of Mines, where I taught engineering graphics, design, and the design of mechanical components for buildings. I was an adjunct professor at the University of Colorado, where I taught engineering of thermal dynamics.

Q. **Are you a member of any professional societies?**

A. I'm a member of the American Society of Mechanical Engineers. I have held several offices, including chairman of the local sections and regional offices. I'm a member of the Society of Engineers. I have held several offices in that society. I'm a member of the National Society of Professional Engineers.

Q. **What sort of work do you do now, Mr. Steele?**

A. I am a consultant in the areas of mechanical engineering and mechanical technology.

Q. **Have you on other occasions testified about contested matters in court?**

A. Yes, I have testified numerous times, mostly for plaintiffs.

Q. **Mr. Steele, have you reviewed any materials in preparation for forming your opinions in this case?**

A. Yes, I have.

Q. **What have you reviewed?**

A. I reviewed the deposition of David Wilson, the container label, and the advertising for the product; and I have, of course, examined the container.

Q. **Have you formed an opinion as to what caused this accident?**

A. Yes, I have.

Q. **What is your opinion as to the cause of this accident?**

A. A defective container and lack of proper warnings and instructions.

Q. **Have you formed an opinion as to whether this accident was foreseeable to Roe Chemical Company?**

A. Absolutely.

Q. **In what way, please, sir?**

A. The company knows that it produces a very dangerous product and that this product has to be used by farmers. It has to be extracted from the container that it's supplied in into other containers so it can be mixed and diluted before being transferred into spraying equipment. So it is very foreseeable that the product can be spilled and the company knows it. The company's advertising indicates that if the product is absorbed through the skin, it can be fatal.

Q. **What is your understanding of how this material is to be used?**

A. The material has to be poured into some type of container for measuring into a mixing container.

Q. **In what way do you contend that a hazard is created?**

A. May I demonstrate with these containers? This container is empty by the way; if it was full, it would weigh more.

Q. **How much would it weigh?**

A. About 50 pounds. It would be difficult to lift.

Q. **You were going to demonstrate?**

A. Yes. In order to extract the liquid from the container, it has to be poured. In order to pour the liquid, the container has to be tilted. When the container is tilted, the horizontal location of the end of the spout moves. Also, because the container bottom is round and has a hard edge, it presents a much smaller surface area as the can is tilted. Those combined factors make it very difficult and dangerous to pour from the Dinitro can.

Q. **Do you have an opinion as to the steps that should be considered in designing a container such as this?**

A. You first consider the product (in this case, the Dinitro). Consider the hazards of the use to the person using it, to the people around, and what has to be done in order to use the product.

Q. **Mr. Steele, in your opinion, can the hazards that you have referred to be designed out of a container such as this?**

A. Absolutely. And if the hazards could not be designed out, there should be an adequate warning. We know from the advertising that contact with the skin with this product can be fatal.

Q. **Do you have an opinion with respect to the warning on this container?**

A. Yes, I do.

Q. **And what is that opinion?**

A. The warning is a partial warning. It does not include the information that is contained in the advertising that absorption through the skin can be fatal. Information that is only contained in the advertising may not be seen by the consumer.

Q. **Are there any other complaints you have with respect to the label?**

A. None that I can think of at this time.

Q. **Have you attempted to design an alternative product to the can in question?**

A. Yes, I have.

Q. **In your opinion, how would you modify this can to make it safe?**

A. First, the process of tipping needs to be eliminated, because that creates an unstable activity with a full can. One way to eliminate the tipping is to replace the flexible spout with a spout that has a spigot on the end of it. With a spigot, the can can be laid on its side so that it's stable, and metering can be accomplished simply by opening and closing a valve. (photograph.) Second, the shape of the container could be modified to have a broader base, and the forward edge of the bottom rounded. (photograph.) When that type of container is tilted, the size and shape of the bottom surface in contact with the support remains essentially the same.

Q. **Sir, isn't it a fact that the spout is a very common type spout?**

A. Oh, yes, it's common and quite safe for gasoline or water. However, Dinitro is very toxic when absorbed through the skin. Having the spout which is actually stuck down into the container encourages a person to handle the chemical. It is definitely not a safe design.

Q. **Are there any other alternative designs that you would suggest?**

A. Yes. I might suggest that the liquid could be extracted from the container in other methods, such as pumping or siphoning.

Q. **And how would that work?**

A. Well, a bulb siphon could be utilized so that once the bulb is squeezed and the flow is started, the fluid would flow out by gravity.

Q. **Do you hold any further opinions in this case?**

A. Well, basically, no. Of course, there are many types of spouts that would be safer.

Q. **Isn’t it a fact that the type of container with which the user is the most familiar might be the safest container for the job?**

A. In most circumstances, yes.

Q. **Do you have any further comments?**

A. I don’t believe the instructions with respect to wearing gloves are adequate. Rubber gloves would be safe, but not cloth or leather, since they would absorb the chemical and keep it in contact with the skin.

STATEMENT OF PHILLIP DOOGAN

My name is Phillip Doogan. I am a chemical consultant with Roe. I got my degree in toxicology and agriculture. My job is to go out to farmers and retail stores and sell our products. I am an expert in weed killers, how to use them, and what they can and can't do. I consult and advise our customers on proper uses, what crops need what weed killers, things like that. I've done this for 25 years. I've also farmed for 5 years in South Roosevelt. I'm not familiar with the Franklin area. I am very familiar with Pre-merge Dinitro. It's probably the best weed killer we have. Without it, lots of farmers in this state would go broke. I am also familiar with the facts of this case. I don't know Mr. Wilson.

First, you have to understand that all weed killers are toxic – that's what makes them work. Without chemicals like 2-sec butyl 4,6-dinitro, there wouldn't be enough food in this country. I received all reports on Dinitro. I have never gotten an adverse report about Dinitro, but I've heard second hand that such claims have been made. There is a problem with every weed killer with spillage – I know because of my own farm work and my meetings with farmers. We discuss the hazards of handling chemicals. The way Mr. Wilson poured Dinitro was very, very careless. Maybe I would expect that from an inexperienced farmer but not one with 30 years' experience. He says the splashing caused his injuries. I'm not a medical doctor, but I know of three instances where farmers have spilled Pre-merge on their arms. They never became ill or anything. I myself, two years ago, spilled some on my shirt – and I was fine. Any farmer knows that gloves *have* to be worn when pouring chemicals. I understand Mr. Wilson did not do so. Again, that action is careless and negligent. If he normally was so careless, over his 30 years, I can see how he would be so sick. Back 6 decades ago, that's what happened to old farmers who didn't know any better.

December 3, YR-4

Phillip Doogan

Phillip Doogan

[Statement given to defendant's attorneys and made available to plaintiff in discovery proceedings.]

EXHIBITS

Laboratory Medicine
Franklin Hospital
Franklin, Roosevelt 30640

September 20, YR-5

E. L. Garfield
Medical Department
607 Building
Roe Chemical Company
Franklin, Roosevelt 30640

Dear Mr. Garfield,

Enclosed is a serum sample and an aliquot of a 24-hour urine on Mr. David Wilson, a 49-year-old male who has been exposed to dinitrobutyl phenol. On September 6th of this year, we sent you a serum and urine sample on this patient. The results appear to be presumptive evidence of previous toxic levels in his blood, and we would like to follow this up with a second sample.

The urine was collected with toluene as a preservative and the 24-hour volume was 1240 ml.

Thank you for your time.

Sincerely yours,

Tom McGee, M.D.

TM:dm

cc: Dr. William Jason

Duckworth Pathology Group
Laboratory Medicine

No. 71-11595

September 18, YR-5

PATHOLOGIST'S REPORT

ANALYSIS FOR 2-SEC BUTYL 4,6-DINITROPHENOL ("DINITRO")

1. Serum -4.3 microgram per ml
2. Urine -less than 1 microgram per ml

COMMENT: This analysis was performed at the Roe Chemical Corporation in Franklin, Roosevelt. Dr. Charles Kramer, from Roe, says that in their employees they try to maintain serum levels less than 4 microgram per ml. Increased blood levels typically cause a hypermetabolic stimulation which simulates a hyperthyroid state with increased body temperature, etc. The half-life of dinitro in the human body is not known; however, Roe employees who develop the hypermetabolic state recover from the disorder in 8 to 10 days, usually. Since Mr. Wilson's exposure to the compound occurred approximately one month ago, the serum level of 4.3 micrograms per ml appears to be good presumptive evidence of previous toxic levels in his blood. A couple of case reports have been published of people developing peripheral neuropathy after significant exposures to chemicals similar to Dinitro.

Dr. Duckworth

cc: Dr. William J. Jason

ROE CHEMICAL COMPANY
Medical Department

October 1, YR-5

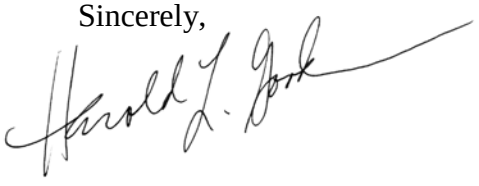
Tom McGee, M.D.
Department of Laboratory Medicine
Franklin Hospital Laboratory
Franklin, Roosevelt 30640

Dear Dr. McGee:

The serum and urine sample recently submitted for analysis for Dinitro is reported as having less than 1 microgram per liter in each of the two samples. The sensitivity of the analytical method does not extend below 1 microgram per liter. I am sure that you are aware of the icteric coloring of the serum specimen. If this color resulted from Dinitro, I am sure the serum level of this material would be extremely high.

We have not had any case reports of myopathy or peripheral neuropathy following exposure to Dinitro. Not surprisingly, there are also no epidemiological data suggesting an association between these chemicals and peripheral neuropathy and myopathy. I would be extremely interested in any facts on the case that you are at liberty to furnish me.

Sincerely,



Harold L. Gordon, M.D.
Roe Corporation Medical Director

cc: Dr. William Jason

September 24, YR-5

Dr. J. M. Weeks
188 S. Bellevue
Franklin, Roosevelt 30640

Dear Dr. Weeks:

I went to Dr. Jason as you suggested and thought maybe I should write you to tell you what he said.

Dr. Jason said considering the amount of Dinitro that I had in my blood that I was lucky to be here at all. He said it would have killed 99 out of 100 people. The experiments on the rats and mice killed a lot of them. It upset their metabolism and that because I had such a large dose that maybe I passed that level so quick that it saved my life. A few also died of cancer. This really has me worried.

Dr. Jason said that I had made some progress but that I had reached a plateau and that it would be at least two years from now before I would be able to do much of anything at all. Even then he said that I would never recover from the damage to my muscles and nerves. Who knows whether I'm developing cancer as I write to you?

Dr. Jason prescribed another form of cortisone and wants me to continue taking it for quite some time yet. He said it had given me a boost and if it were discontinued that I would go backward and become much weaker than I am now. He said that with the cortisone I could recover to the point that I would recover in three years, and without it, it would take eight or nine years.

He wants me to come back in six months.

Yours very truly,

David Wilson

WILLIAM JASON, M.D.
12 N. Bellevue
Franklin, Roosevelt 30640
Phone 901/725-0011

November 2, YR-5

Dr. Harold L. Gordon, M.D.
Medical Director
Roe Chemical Company, Inc.
Franklin, Roosevelt 30640

RE: David Wilson

Dear Dr. Gordon:

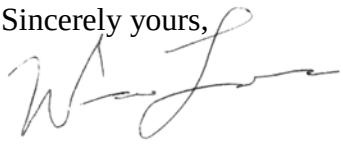
In response to your letter dated October 1, YR-5, there are published case reports of people developing neurological symptoms following exposure to chemicals very similar to 2-Sec Butyl 4,6-dinitrophenol. There are also strong animal data, that Roe and others have developed, that prove that Dinitro can cause neuropathy and myopathy. I agree that there is no definitive proof of cause and effect from acute exposure to 2-Sec Butyl 4,6-DPN and myopathy and neuropathy. Perhaps if Roe had funded more research, definitive proof would be available. It is pretty evident that Roe Chemical Company and the chemical industry has not done a good job studying this toxic chemical.

There is no doubt that Mr. Wilson has peripheral neuropathy and severe myositis which developed soon after Dinitro absorbed into his skin. The objective evidence of myositis, neuropathy, and serum levels of Dinitro are closely correlated.

The myositis responded to the usual treatment, which is not specific but does indicate that the myositis was probably caused by a mechanism consistent with muscle inflammatory diseases. In other words, since the basic etiological agent is not known in any of the muscle inflammatory diseases known as myositis, it is entirely possible that the absorption of the chemical and high blood level produced the same mechanism as in any myositic condition.

Any question of the role of Dinitro in causing Mr. Wilson's myositis will have to be settled by debate since science has been unable to conclusively answer this question.

Sincerely yours,



Dr. William Jason, Jr.
Neurologist

Drs. Gotten, Hawkes, Tyrer & Ogle
Neurological Surgery
92 North Bellevue
Franklin, Roosevelt 30640

May 24, YR-6

Dr. J.M. Weeks
188 S. Bellevue
Franklin, Roosevelt 30640

Dear Dr. Weeks:

Thank you for the opportunity to see your patient, David Wilson, in neurosurgical consultation. I am including the report of my examination and opinion. Coincidentally, after agreeing to see him I found a note in our files reflecting a prior consultation with Dr. Perkins, the physician who previously operated this practice, in connection with symptoms suspected of being caused by exposure to chemicals in the Gulf War. The note merely reflected Mr. Wilson's inquiry concerning the symptoms of such exposure, with which Dr. Perkins was only slightly familiar. He apparently referred Mr. Wilson to the VA for further information and possible care.

David Wilson, informed me that on May 17, YR-6, he was struck on the head by his car door. He was not rendered unconscious, but he was dazed momentarily. He did not experience any subsequent headaches. The following morning, as he described it, he felt "funny" with recurrent feelings of dizziness and a peculiar sensation about his head. His worry immediately increased over the head injury he had had in the past, and as you know, he was taken to the hospital in Blytheville where he was observed for a short period without receiving definitive treatment. Currently, the patient states that he is feeling better although he continues to have recurrent dizzy spells. The patient says he is not prone to worry; however, he has a new wife, and in the past several days she has given him reason for concern on several occasions. Their relationship is rather stressful due to those issues and due to his son, from a prior marriage, in the house. In addition, he has been missing considerable sleep, and he feels this may in some way contribute to his present illness.

The neurological examination was entirely within normal limits. X-rays of the skull, obtained at the Methodist Hospital, were normal. An electroencephalogram did not reveal evidence of any abnormality.

It is my feeling that this is an emotional problem, and the symptoms he describes are primarily on the basis of an acute anxiety state. I do not feel that additional investigative studies are indicated at this time. I reassured the patient that there was no indication of any active disease of the nervous system, and both parties seemed relieved and satisfied with the treatment that they had received. I instructed the patient that if he had additional difficulty, he should return for reevaluation.

I also suggested he may wish to consider therapy or counseling, either individually, as a couple or as a family if these issues persist.

Sincerely yours,

William S. Ogle, M.D.

THE ROE CHEMICAL COMPANY, INC.
Franklin, Roosevelt 30640

Memorandum

To: Director of Marketing
From: Director of Operations
Re: Labeling for Dinitro
Date: March 15, YR-5

Thank you for your comments regarding your concerns about the possible adverse impact on sales of a change in the labeling of Dinitro. However, we have come to the conclusion that including specific language reflecting that the product can be fatal if absorbed through the skin is appropriate although not necessary as a safety consideration. This decision is not based on any new information in our possession concerning the toxicity of the product or the danger to users of the product. Rather, it is being made out of an excess of caution given the litigious nature of today's society and the willingness of plaintiffs' lawyers to take frivolous cases against manufacturers in the hope of extorting settlements out of them. Our prior customer contacts and history have shown us that few customers read the labels on these products and certainly don't do so after the first time they use our product.

Therefore, the labeling for all shipments as of July 1, YR-5 (the expected date by which the new labels will be available) will reflect this change. The new label will include the following language directly below the words "Danger - Poison" and the skull and crossbones:

KEEP OUT OF REACH OF CHILDREN AND FARM ANIMALS
MAY BE FATAL IF SWALLOWED OR ABSORBED THROUGH THE SKIN

[Part of paint advertisements published by defendant before 8/6/YR-6 and furnished to plaintiffs in discovery.]

How to apply

To preserve a height differential between beans and weeds, the directed spray should be applied as soon as possible after the soybean plants are 5 inches tall. If treatment is delayed more than a few days, the weeds will catch up. The treatment can be repeated once or twice at 7- to 14-day intervals if necessary to control late-germinating weeds. Do not use after soybeans begin to bloom.

Plan your weed control program around PREMERGE . . . it pays

A directed spray application of PREMERGE costs only about 70¢ an acre. For this small investment you get positive control of the worst weed pests—cocklebur, annual morning glory, coffeeweed, pigweed and many other broadleaved weeds such as velvetleaf, common ragweed, smartweed.

Good weed control coupled with good fertility and management can increase soybean yields 20 or more bushels per acre. Growing weeds costs money—money you can save by using dependable economical PREMERGE dinitro weed killer.

SOYBEANS SHOULD NOT BE GRAZED OR USED FOR FORAGE WITHIN THREE WEEKS AFTER APPLYING A POSTEMERGENCE SPRAY.

WARNING: Before using PREMERGE dinitro weed killer, read and observe all the precautions given on the label.

POISON

DANGER

ABSORBED THROUGH THE SKIN
• MAY BE FATAL IF SWALLOWED
Do Not Get in Eyes, on Skin, on Clothing • Avoid Breathing Spray Drift • Do Not Take Internally • Do Not Wear Contaminated Clothing or Shoes • Keep Away from Heat and Open Flame • Keep Out of Reach of Children and Farm Animals

FIRST AID TREATMENT—ANTIDOTE

SYMPTOMS OF POISONING. Excessive Fatigue. Sweating. Thirst and Fever. If symptoms of poisoning develop from any type of exposure, SEND FOR A PHYSICIAN.

FIRST AID: Have patient lie quiet in coolest spot available. If feverish, cool with cold compresses or by immersion in cool water.

If Swallowed, SEND FOR A PHYSICIAN. Induce vomiting by giving an emetic such as two tablespoonfuls of table salt in a glass of warm water; repeat until vomit fluid is clear, then give two teaspoonfuls of baking soda in a glass of warm water. Treat as in FIRST AID, above.

If Splashed in Eyes, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention. If Spilled on Skin, immediately remove contaminated clothing, including shoes, and wash skin with soap and plenty of water. If symptoms of poisoning develop, send for a physician and treat as in FIRST AID, above. Discard contaminated clothing and shoes or clean them thoroughly before re-use. NOTE TO ATTENDING PHYSICIAN: Active ingredient is a metabolic stimulant. Treat symptomatically.

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

[Part of paint advertisements published by defendant before 8/6/YR-6 and furnished to plaintiffs in discovery.]

Gives you the upper hand on broad-leaved weeds in soybeans

NOTE: PREMERGE may be fatal if swallowed or absorbed through the skin. Avoid breathing spray drift, and do not wear contaminated clothing or shoes. Read carefully and observe the warnings and precautions on the container label.

Keep out of reach of children and farm animals.

ROE

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Pesticides Regulation Division
Washington, D.C. 20250

Roe Chemical Company
P. O. 1984
Eleanor, Roosevelt 01932

Attention: Mr. O. H. Hammer

Gentlemen:

Subject: PREMERGE
USDA Reg. No. 98765-A

This is in reply to your letter of October 28, YR-37, informing us of the change in formulation for the above product.

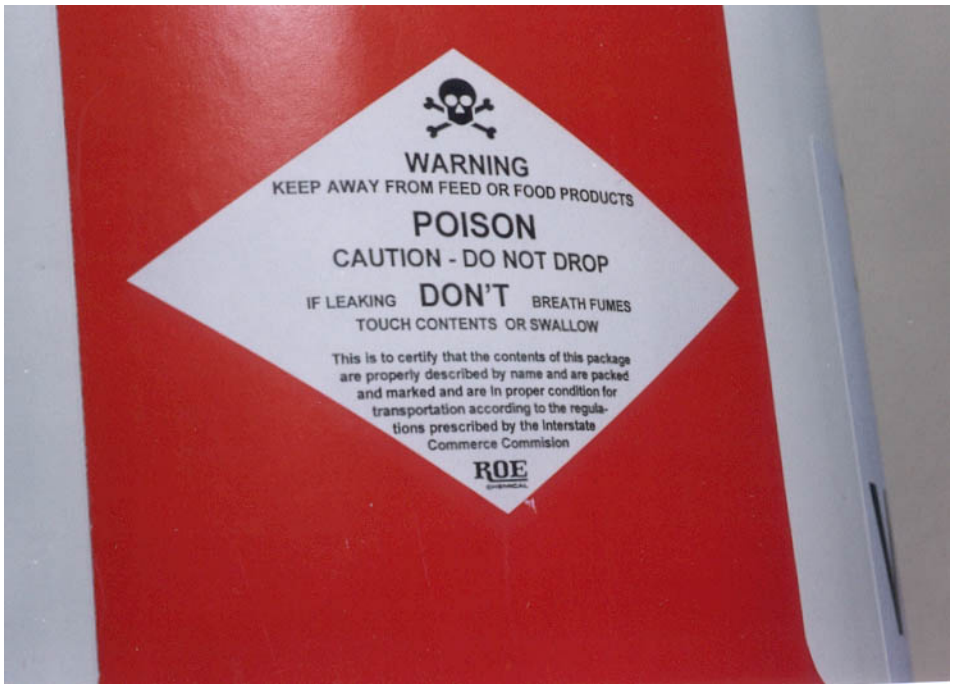
It is our understanding that this product under the new formula is to replace the old product accepted for registration on October 29, YR-37. The Regulations for the Enforcement of the Act provide that after the effective date of a change in claims or formula the product shall be marked only under new claims or formula, except that a reasonable time may be permitted to dispose of properly labeled stock or old products.

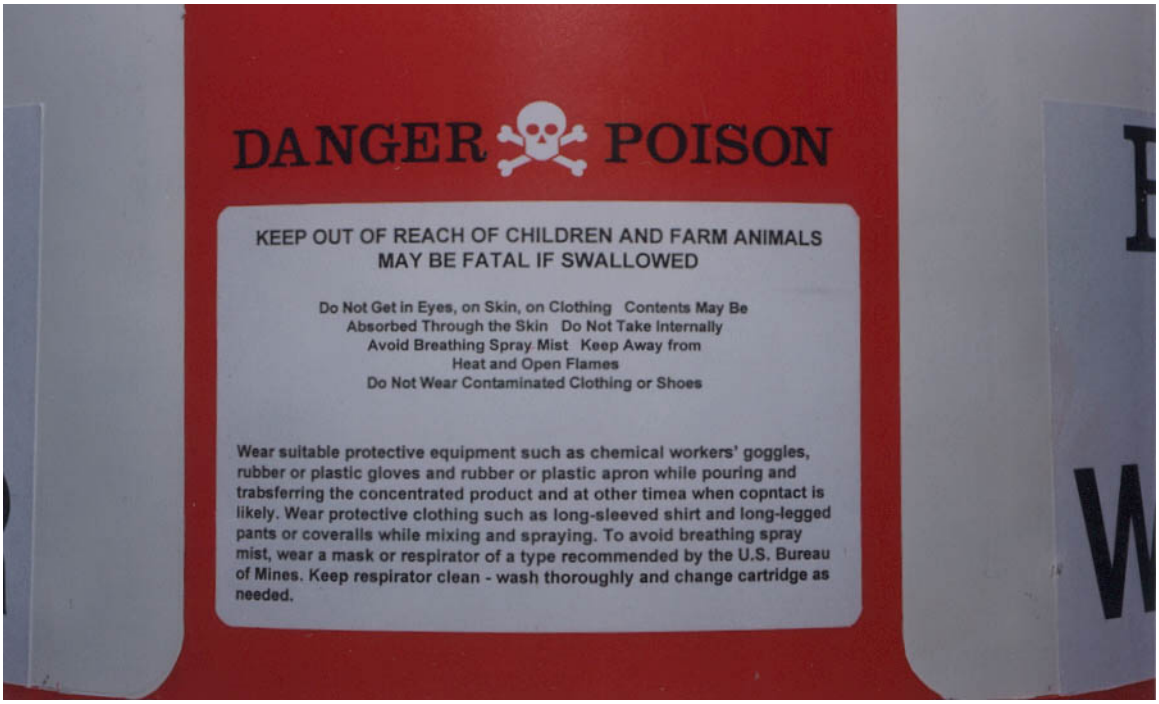
Sincerely yours,

Ima Bureaucrat
Assistant Director
For Registration

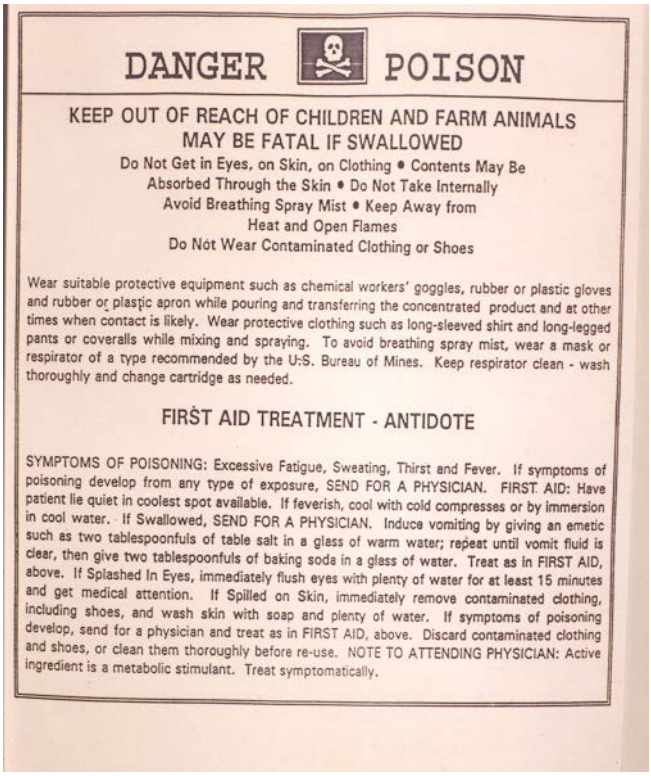
WILSON

Labeling on can sold to Wilson





Labeling on can sold to Wilson



DANGER POISON

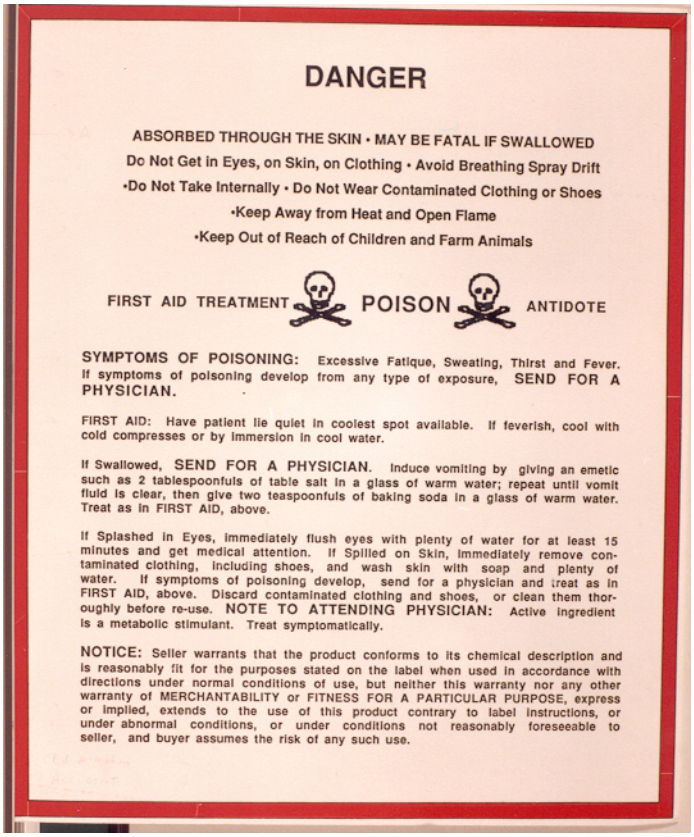
KEEP OUT OF REACH OF CHILDREN AND FARM ANIMALS
MAY BE FATAL IF SWALLOWED

Do Not Get in Eyes, on Skin, on Clothing • Contents May Be Absorbed Through the Skin • Do Not Take Internally Avoid Breathing Spray Mist • Keep Away from Heat and Open Flames Do Not Wear Contaminated Clothing or Shoes

Wear suitable protective equipment such as chemical workers' goggles, rubber or plastic gloves and rubber or plastic apron while pouring and transferring the concentrated product and at other times when contact is likely. Wear protective clothing such as long-sleeved shirt and long-legged pants or coveralls while mixing and spraying. To avoid breathing spray mist, wear a mask or respirator of a type recommended by the U.S. Bureau of Mines. Keep respirator clean - wash thoroughly and change cartridge as needed.

FIRST AID TREATMENT - ANTIDOTE

SYMPTOMS OF POISONING: Excessive Fatigue, Sweating, Thirst and Fever. If symptoms of poisoning develop from any type of exposure, SEND FOR A PHYSICIAN. FIRST AID: Have patient lie quiet in coolest spot available. If feverish, cool with cold compresses or by immersion in cool water. If Swallowed, SEND FOR A PHYSICIAN. Induce vomiting by giving an emetic such as two tablespoonfuls of table salt in a glass of warm water; repeat until vomit fluid is clear, then give two tablespoonfuls of baking soda in a glass of water. Treat as in FIRST AID, above. If Splashed In Eyes, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention. If Spilled on Skin, immediately remove contaminated clothing, including shoes, and wash skin with soap and plenty of water. If symptoms of poisoning develop, send for a physician and treat as in FIRST AID, above. Discard contaminated clothing and shoes, or clean them thoroughly before re-use. NOTE TO ATTENDING PHYSICIAN: Active ingredient is a metabolic stimulant. Treat symptomatically.



DANGER

ABSORBED THROUGH THE SKIN • MAY BE FATAL IF SWALLOWED
Do Not Get in Eyes, on Skin, on Clothing • Avoid Breathing Spray Drift
•Do Not Take Internally • Do Not Wear Contaminated Clothing or Shoes
•Keep Away from Heat and Open Flame
•Keep Out of Reach of Children and Farm Animals

FIRST AID TREATMENT POISON ANTIDOTE

SYMPTOMS OF POISONING: Excessive Fatigue, Sweating, Thirst and Fever. If symptoms of poisoning develop from any type of exposure, **SEND FOR A PHYSICIAN.**

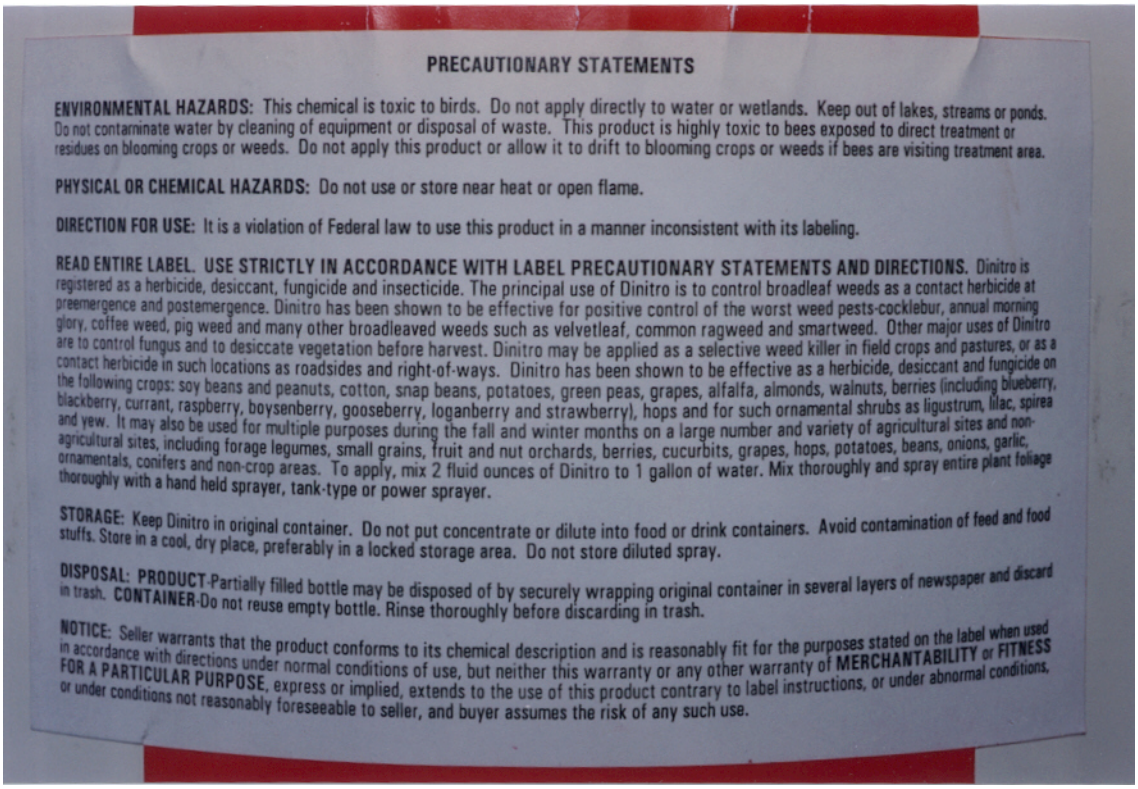
FIRST AID: Have patient lie quiet in coolest spot available. If feverish, cool with cold compresses or by immersion in cool water.

If Swallowed, **SEND FOR A PHYSICIAN.** Induce vomiting by giving an emetic such as 2 tablespoonfuls of table salt in a glass of warm water; repeat until vomit fluid is clear, then give two teaspoonfuls of baking soda in a glass of warm water. Treat as in FIRST AID, above.

If Splashed in Eyes, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention. If Spilled on Skin, immediately remove contaminated clothing, including shoes, and wash skin with soap and plenty of water. If symptoms of poisoning develop, send for a physician and treat as in FIRST AID, above. Discard contaminated clothing and shoes, or clean them thoroughly before re-use. **NOTE TO ATTENDING PHYSICIAN:** Active ingredient is a metabolic stimulant. Treat symptomatically.

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

Labeling on can sold to Wilson



PRECAUTIONARY STATEMENTS

ENVIRONMENTAL HAZARDS: This chemical is toxic to birds. Do not apply directly to water or wetlands. Keep out of lakes, streams or ponds. Do not contaminate water by cleaning of equipment or disposal of waste. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting treatment area.

PHYSICAL OR CHEMICAL HAZARDS: Do not use or store near heat or open flame.

DIRECTION FOR USE: It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH LABEL PRECAUTIONARY STATEMENTS AND DIRECTIONS. Dinitro is registered as a herbicide, desiccant, fungicide and insecticide. The principal use of Dinitro is to control broadleaf weeds as a contact herbicide at preemergence and postemergence. Dinitro has been shown to be effective for positive control of the worst weed pests-cocklebur, annual morning glory, coffee weed, pig weed and many other broadleaved weeds such as velvetleaf, common ragweed and smartweed. Other major uses of Dinitro are to control fungus and to desiccate vegetation before harvest. Dinitro may be applied as a selective weed killer in field crops and pastures, or as a contact herbicide in such locations as roadsides and right-of-ways. Dinitro has been shown to be effective as a herbicide, desiccant and fungicide on the following crops: soy beans and peanuts, cotton, snap beans, potatoes, green peas, grapes, alfalfa, almonds, walnuts, berries (including blueberry, blackberry, currant, raspberry, boysenberry, gooseberry, loganberry and strawberry), hops and for such ornamental shrubs as ligustrum, lilac, spirea and yew. It may also be used for multiple purposes during the fall and winter months on a large number and variety of agricultural sites and non-agricultural sites, including forage legumes, small grains, fruit and nut orchards, berries, cucurbits, grapes, hops, potatoes, beans, onions, garlic, ornamentals, conifers and non-crop areas. To apply, mix 2 fluid ounces of Dinitro to 1 gallon of water. Mix thoroughly and spray entire plant foliage thoroughly with a hand held sprayer, tank-type or power sprayer.

STORAGE: Keep Dinitro in original container. Do not put concentrate or dilute into food or drink containers. Avoid contamination of feed and food stuffs. Store in a cool, dry place, preferably in a locked storage area. Do not store diluted spray.

DISPOSAL: PRODUCT-Partially filled bottle may be disposed of by securely wrapping original container in several layers of newspaper and discard in trash. **CONTAINER**-Do not reuse empty bottle. Rinse thoroughly before discarding in trash.

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty or any other warranty of **MERCHANTABILITY** or **FITNESS FOR A PARTICULAR PURPOSE**, express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.


ROE
CHEMICAL
PREMERGE®
DINITRO
WEED KILLER
DANGER POISON
KEEP OUT OF REACH OF CHILDREN
READ ANTIDOTE
AND COMPLETE PRECAUTIONS ON SIDE LABEL


WEED KILLER
DANGER POISON
KEEP OUT OF REACH OF CHILDREN
READ ANTIDOTE
AND COMPLETE PRECAUTIONS ON SIDE LABEL
ACTIVE INGREDIENT: 2-sec-butyl-4,6-dinitro-phenol, as the alkanolamine salts (of the ethanol and isopropanol series) 51%
INERT INGREDIENTS 49%
Contains the equivalent of 3 lbs. of 2-sec-butyl-4, 6-dinitrophenol per gal.

Form **1040** Department of the Treasury—Internal Revenue Service (99)

U.S. Individual Income Tax Return

YR-6 OMB No. 1545-0074 IRS Use Only—Do not write or staple in this space.

For the year Jan. 1–Dec. 31, YR-6, or other tax year beginning , 2013, ending , 20 — See separate instructions.

Your first name and initial	Last name	Your social security number
David O.	Wilson	1 2 3 4 5 6 7 8 9
If a joint return, spouse's first name and initial	Last name	Spouse's social security number
Debra B.	Wilson	9 8 7 6 5 4 3 2 1

Home address (number and street). If you have a P.O. box, see instructions. — Apt. no.
456 County Road

▲ Make sure the SSN(s) above and on line 6c are correct.

City, town or post office, state, and ZIP code. If you have a foreign address, also complete spaces below (see instructions).
Franklin, Roosevelt 12345

Foreign country name | Foreign province/state/county | Foreign postal code

Presidential Election Campaign
Check here if you, or your spouse if filing jointly, want $3 to go to this fund. Checking a box below will not change your tax or refund. ☐ You ☐ Spouse

Filing Status

Check only one box.

1 ☐ Single
2 ☑ Married filing jointly (even if only one had income)
3 ☐ Married filing separately. Enter spouse's SSN above and full name here. ▶
4 ☐ Head of household (with qualifying person). (See instructions.) If the qualifying person is a child but not your dependent, enter this child's name here. ▶
5 ☐ Qualifying widow(er) with dependent child

Exemptions

6a ☑ **Yourself.** If someone can claim you as a dependent, **do not** check box 6a
b ☑ **Spouse**

c **Dependents:**

(1) First name / Last name	(2) Dependent's social security number	(3) Dependent's relationship to you	(4) ✓ if child under age 17 qualifying for child tax credit (see instructions)
			☐
			☐
			☐

If more than four dependents, see instructions and check here ▶ ☐

d Total number of exemptions claimed

Boxes checked on 6a and 6b 2
No. of children on 6c who:
• **lived with you**
• **did not live with you due to divorce or separation (see instructions)**
Dependents on 6c not entered above
Add numbers on lines above ▶ 2

Income

Attach Form(s) W-2 here. Also attach Forms W-2G and 1099-R if tax was withheld.

If you did not get a W-2, see instructions.

7	Wages, salaries, tips, etc. Attach Form(s) W-2		7	60,000
8a	**Taxable** interest. Attach Schedule B if required		8a	
b	**Tax-exempt** interest. **Do not** include on line 8a	8b		
9a	Ordinary dividends. Attach Schedule B if required		9a	
b	Qualified dividends	9b		
10	Taxable refunds, credits, or offsets of state and local income taxes		10	
11	Alimony received		11	
12	Business income or (loss). Attach Schedule C or C-EZ		12	
13	Capital gain or (loss). Attach Schedule D if required. If not required, check here ▶ ☐		13	
14	Other gains or (losses). Attach Form 4797		14	
15a	IRA distributions 15a	b Taxable amount	15b	
16a	Pensions and annuities 16a	b Taxable amount	16b	
17	Rental real estate, royalties, partnerships, S corporations, trusts, etc. Attach Schedule E		17	
18	Farm income or (loss). Attach Schedule F		18	
19	Unemployment compensation		19	
20a	Social security benefits 20a	b Taxable amount	20b	
21	Other income. List type and amount		21	
22	Combine the amounts in the far right column for lines 7 through 21. This is your **total income** ▶		22	60,000

Adjusted Gross Income

23	Educator expenses	23		
24	Certain business expenses of reservists, performing artists, and fee-basis government officials. Attach Form 2106 or 2106-EZ	24		
25	Health savings account deduction. Attach Form 8889	25		
26	Moving expenses. Attach Form 3903	26		
27	Deductible part of self-employment tax. Attach Schedule SE	27		
28	Self-employed SEP, SIMPLE, and qualified plans	28		
29	Self-employed health insurance deduction	29		
30	Penalty on early withdrawal of savings	30		
31a	Alimony paid b Recipient's SSN ▶	31a		
32	IRA deduction	32		
33	Student loan interest deduction	33		
34	Tuition and fees. Attach Form 8917	34		
35	Domestic production activities deduction. Attach Form 8903	35		
36	Add lines 23 through 35		36	
37	Subtract line 36 from line 22. This is your **adjusted gross income** ▶		37	60,000

For Disclosure, Privacy Act, and Paperwork Reduction Act Notice, see separate instructions. Cat. No. 11320B Form **1040** (YR-6)

Tax and Credits	38	Amount from line 37 (adjusted gross income)		38	60,000
	39a	Check if: ☐ **You** were born before January 2, 1949, ☐ Blind. ☐ **Spouse** was born before January 2, 1949, ☐ Blind. **Total boxes checked ▶ 39a**			
Standard Deduction for— • People who check any box on line 39a or 39b or who can be claimed as a dependent, see instructions. • All others: Single or Married filing separately, $6,100 Married filing jointly or Qualifying widow(er), $12,200 Head of household, $8,950	b	If your spouse itemizes on a separate return or you were a dual-status alien, check here ▶ 39b ☐			
	40	**Itemized deductions** (from Schedule A) **or** your **standard deduction** (see left margin)		40	12,200
	41	Subtract line 40 from line 38		41	48,800
	42	**Exemptions.** If line 38 is $150,000 or less, multiply $3,900 by the number on line 6d. Otherwise, see instructions		42	7,800
	43	**Taxable income.** Subtract line 42 from line 41. If line 42 is more than line 41, enter -0-		43	41,000
	44	**Tax** (see instructions). Check if any from: **a** ☐ Form(s) 8814 **b** ☐ Form 4972 **c** ☐		44	5,261
	45	**Alternative minimum tax** (see instructions). Attach Form 6251		45	
	46	Add lines 44 and 45 ▶		46	
	47	Foreign tax credit. Attach Form 1116 if required	47		
	48	Credit for child and dependent care expenses. Attach Form 2441	48		
	49	Education credits from Form 8863, line 19	49		
	50	Retirement savings contributions credit. Attach Form 8880	50		
	51	Child tax credit. Attach Schedule 8812, if required	51		
	52	Residential energy credits. Attach Form 5695	52		
	53	Other credits from Form: **a** ☐ 3800 **b** ☐ 8801 **c** ☐	53		
	54	Add lines 47 through 53. These are your **total credits**		54	
	55	Subtract line 54 from line 46. If line 54 is more than line 46, enter -0- ▶		55	5,261
Other Taxes	56	Self-employment tax. Attach Schedule SE		56	
	57	Unreported social security and Medicare tax from Form: **a** ☐ 4137 **b** ☐ 8919		57	
	58	Additional tax on IRAs, other qualified retirement plans, etc. Attach Form 5329 if required		58	
	59a	Household employment taxes from Schedule H		59a	
	b	First-time homebuyer credit repayment. Attach Form 5405 if required		59b	
	60	Taxes from: **a** ☐ Form 8959 **b** ☐ Form 8960 **c** ☐ Instructions; enter code(s)		60	
	61	Add lines 55 through 60. This is your **total tax** ▶		61	5,261
Payments	62	Federal income tax withheld from Forms W-2 and 1099	62 5,000		
If you have a qualifying child, attach Schedule EIC.	63	2013 estimated tax payments and amount applied from 2012 return	63		
	64a	**Earned income credit (EIC)**	64a		
	b	Nontaxable combat pay election 64b			
	65	Additional child tax credit. Attach Schedule 8812	65		
	66	American opportunity credit from Form 8863, line 8	66		
	67	Reserved	67		
	68	Amount paid with request for extension to file	68		
	69	Excess social security and tier 1 RRTA tax withheld	69		
	70	Credit for federal tax on fuels. Attach Form 4136	70		
	71	Credits from Form: **a** ☐ 2439 **b** ☐ Reserved **c** ☐ 8885 **d** ☐	71		
	72	Add lines 62, 63, 64a, and 65 through 71. These are your **total payments** ▶		72	5,000
Refund	73	If line 72 is more than line 61, subtract line 61 from line 72. This is the amount you **overpaid**		73	
	74a	Amount of line 73 you want **refunded to you.** If Form 8888 is attached, check here ▶ ☐		74a	
Direct deposit? See instructions.	▶ b	Routing number _____ ▶ c Type: ☐ Checking ☐ Savings			
	▶ d	Account number _____			
	75	Amount of line 73 you want **applied to your 2014 estimated tax** ▶	75		
Amount You Owe	76	**Amount you owe.** Subtract line 72 from line 61. For details on how to pay, see instructions ▶		76	261
	77	Estimated tax penalty (see instructions)	77		

Third Party Designee Do you want to allow another person to discuss this return with the IRS (see instructions)? ☐ **Yes.** Complete below. ☐ **No**

Designee's name ▶ | Phone no. ▶ | Personal identification number (PIN) ▶

Sign Here Under penalties of perjury, I declare that I have examined this return and accompanying schedules and statements, and to the best of my knowledge and belief, they are true, correct, and complete. Declaration of preparer (other than taxpayer) is based on all information of which preparer has any knowledge.

Joint return? See instructions. Keep a copy for your records.

Your signature	Date	Your occupation	Daytime phone number
Spouse's signature. If a joint return, **both** must sign.	Date	Spouse's occupation	If the IRS sent you an Identity Protection PIN, enter it here (see inst.)

Paid Preparer Use Only

Print/Type preparer's name	Preparer's signature	Date	Check ☐ if self-employed	PTIN
Firm's name ▶			Firm's EIN ▶	
Firm's address ▶			Phone no.	

REPORT OF ARTHUR STEELE

Arthur Steele
123 Broadway
Denver, Colorado

November 6, YR-5

Scientific Examination and Evaluation of Chemical Accident in Franklin, Roosevelt, August 4, YR-5

Introduction

Scientific examination and evaluation were requested of a chemical container to determine the cause of an accident during which a user of the container splashed chemical onto his person. Mr. David Wilson was pouring from a 5-gallon container of Dinitro herbicide into a 1-gallon pail. As Mr. Wilson was tipping the can to pour the chemical, the bottom of the can slipped and chemical splashed onto various parts of his body. The 5-gallon can had a flexible spout on the top of the can. There was no reported leaking around the spout.

Examination and Evaluation

Examination of the involved components conclusively establishes that the splashing of the chemical onto Mr. Wilson was a result of the design of the spout. The use of the flexible spout on a 5-gallon container of hazardous liquid chemicals renders the container unreasonably dangerous to reasonably foreseeable slippage of the container during pouring.

The environment of use of a product must be considered before design of the product is completed. Foreseeable hazards should be designed out of the product, if possible. If hazards cannot be designed out, they should be guarded against. If guards are not feasible, then adequate warnings and instructions should be used.

It was to be expected that the herbicide would be used by farmers in the field and foreseeable that portions of the liquid herbicide would have to be transferred from the container in which it was sold to other containers for transfer to spraying equipment. There are potential hazards associated with spilling or splashing the liquid chemical on one's person.

To design out these hazards associated with transferring the chemical, the shape of the container could be designed differently to broaden the base, thereby creating a more stable surface and alleviating the risk of accidental tipping of the container during transfer of the chemical. Another design change that would have alleviated the risk of injury would be to use a rubber bulb siphon. An appropriately designed siphon and tube would have eliminated the need to tip

the container at all. Finally, yet another alternative means would be to place a spigot near the bottom of the can.

Considering the environment of use of the chemical container, the reasonably foreseeable hazards associated with spilling and splashing the chemical during transfer operations, and the ready availability of alternative designs known in the art to eliminate the hazards, the design of the container was unreasonably dangerous to the normal and foreseeable use to which it was being put at the time of Mr. Wilson's accident. The appropriate design hierarchy is first to design hazards out of the product, second, to design additional safety features to guard against hazards, and third, to warn and instruct. The use of warnings or instructions in place of designing out the hazard or designing in additional safety features is in my opinion negligence and renders the design defective.

Arthur Steele

REPORT OF HAROLD WHITEHOUSE

December 5, YR-5

Comments about Scientific Examination and Evaluation of Arthur Steele

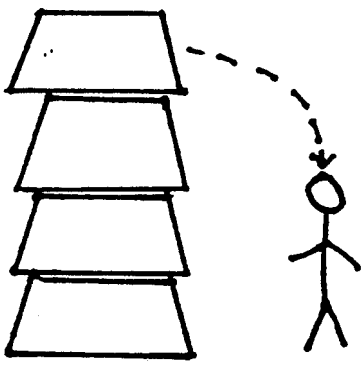
Introduction

The report of Mr. Arthur Steele, dated November 6, YR-5 and entitled "Scientific Examination and Evaluation of Chemical Accident in Franklin, Roosevelt, August 4, YR-5" has been reviewed. Mr. Steele is of the opinion that the use of a flexible spout rendered the 5-gallon liquid chemical container unreasonably dangerous to reasonably foreseeable slippage of the container during pouring of the chemical. He recommends three alternatives: (1) use a different container shape to alleviate tipping hazards; (2) use a spigot; or (3) use a siphon bulb. Each of these alternatives creates hazards and other problems as discussed below.

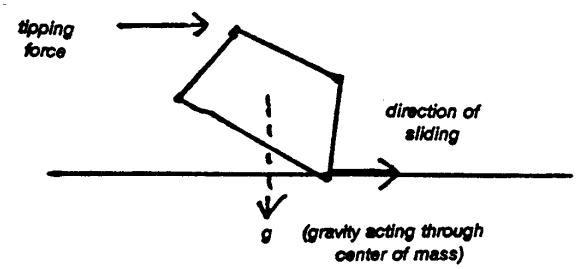
1. Alternative shape of the container.

To alleviate a tipping problem, the container must be configured so that the center of gravity (center of mass) does not extend past the base of the container during pouring of the chemical. If this is to be accomplished by increasing the area of the base, then falling hazards and sliding hazards may be created as follows:

A. Falling Hazard:



B. Sliding Hazard:



A falling hazard would be present whenever the containers are stacked. A sliding hazard is created by the tendency of the container to try to right itself. On a low friction surface, the edge of the container can slip or slide along the surface, thereby exacerbating the risk of splashing the chemical.

There is also the problem created by changing the design and therefore the performance characteristics of a container that consumers have become accustomed to using. Consumer expectations and behavior are difficult to change even with specific instructions and warnings.

Finally, the cost of designing and manufacturing a new container would probably outweigh the risks associated with accidental splashing or spilling.

2. Use of a Spigot

The use of a spigot (or stop-cock) increases the risk of leakage because spigots protrude from a container and can be damaged by impacts. In particular, a spigot located near the bottom of a container makes leakage a virtual certainty if the spigot is damaged. A spigot located near the top of a container would still require that the container be tipped or tilted to dispense the chemical.

3. Use of a Siphon Bulb

The use of a siphon bulb would require a detached, additional component. This component can be lost. Its absence would require that the container be tipped or tilted. Without a flexible spout, loss of the siphon bulb increases the risk of splashing or spilling.

Use of a siphon would require additional instructions that illiterate users could not understand.

Finally, users who are instructed to use a siphon to dispense the chemical may prime the siphon hose by mouth if the siphon bulb is lost or damaged. This could lead to ingestion of the chemical.

HAROLD WHITEHOUSE

IN THE CIRCUIT COURT OF FARRAH COUNTY
STATE OF ROOSEVELT

DAVID OTIS WILSON and	)	
DEBRA B. WILSON,	)	
Plaintiffs,	)	**Civil No. YR-4-1001**
v.	)	
	)	
THE ROE CHEMICAL COMPANY,	)	
INC.,	)	
Defendant.	)	
	)	

JURY INSTRUCTIONS

(In addition to the customary charges given in any civil action involving issues of tort liability such as weight of evidence, burden of proof, etc., the following specific charges have been approved by the court and will be read in full.)

1. It is the law that the manufacturer, supplier, or seller who markets a product which is in a condition unreasonably dangerous to the ultimate user or consumer when placed on the market and which remains in substantially the same condition until used by the ultimate user is liable to one who may be reasonably expected to use or be affected by such product when used for its intended use and who is injured as a proximate consequence of the unreasonably dangerous product.

2. The plaintiff charges (1) that he suffered injury or damages to himself proximately caused (2) by one who sold a product in a (3) defective condition or which was unreasonably dangerous (4) to him as the ultimate user or consumer and (5) that the seller was engaged in the business of selling such a product and that (6) the product was expected to, and did, reach the user and consumer without substantial change in the condition in which it was sold.

3. The plaintiff charges that the weed killer and its container were defective in manufacturing and design and were used as they were intended or were reasonably foreseeable to be used. Defective means unreasonably dangerous.

4. A defect is that which makes the product unreasonably dangerous. Unreasonably dangerous means the product sold must be dangerous to an extent beyond that which would be contemplated by the ordinary consumer who buys it or the risk of danger in the design outweighs the benefits.

5. An act or omission is a proximate cause of an injury if it was a substantial factor in bringing about the injury; that is, if it had such an effect in producing the injury that reasonable people would regard it as a cause of the injury.

6. The plaintiff also charges that such product and the container in which it was sold was defective in its warning and instructions. When a seller or manufacturer has reason to anticipate that damage may result from a particular use, he may be required to give adequate warning of the danger, and a product sold without such warning is in a defective condition.

7. Where a product contains ingredients to which a substantial number of the population are allergic and ingredients are those whose danger is not generally know, or if known is one which consumers would reasonably not expect to find in a product, the seller is required to give warning against it if he has knowledge of the danger.

8. The seller and manufacturer of a product whose use could result in foreseeable harm has a duty to give a warning which adequately advises the user of the attendant risks and which provides specific directions for safe use.

9. The warning must adequately indicate the scope of the danger and must reasonably communicate the extent or seriousness of harm that could result.

10. Failure to give adequate warnings renders the product unreasonably dangerous.

11. The manufacturer must also provide sufficient instructions with the product to permit it to be used with reasonable safety. Supplying even adequate instructions will not satisfy the manufacturer's duty to warn if the user is not hereby alerted to the hidden dangers in the product.

12. A manufacturer or other defendant whose product is accompanied by warnings or instructions, is entitled to assume that appropriately worded warnings or instructions will be heeded by those who receive them.

13. It is a question of fact for the jury whether particular warnings or instructions are appropriately worded

14. The law places the burden on the plaintiff to reasonably satisfy you of the truthfulness of each of the material elements of his claim. If you are not reasonably satisfied that the plaintiff has met this burden, then you will find that the defendant is not liable. If, however, you are reasonably satisfied that the plaintiff has met the burden of probing the material elements of his claim, then you will consider the following affirmative defense asserted by the defendant.

15. The defendant contends that the plaintiff was comparatively at fault. Comparative fault is negligence on the part of the plaintiff which combining with a defect in a product contributes as a proximate cause in bringing about the injury.

16. Comparative fault, if any, on the part of the plaintiff does not bar recovery by plaintiff against the defendant, but the total amount of damages to which plaintiff would otherwise

be entitled shall be reduced by the percentage that the plaintiff's comparative fault contributed as a proximate cause of his injury.

17. If the plaintiff is more than 50% at fault, he is barred from recovery.

18. The negligence of the plaintiff, David Wilson, does not reduce or bar Debra Wilson's recovery, if you find the defendant at least 1% at fault and that she suffered damages.

19. Negligence is the doing of something which a reasonably prudent person would not do, or the failure to do something which a reasonably prudent person would do, under circumstances similar to those shown by the evidence. It is the failure to use ordinary or reasonable care.

20. It is the law that mere compliance with federal statutes, regulations, or agencies is not a complete defense to a manufacturer or seller.

If after a consideration of all the evidence in this case, you are not reasonably satisfied of the truthfulness of the plaintiffs' claim, your verdict should be for the defendant. This would end your deliberations. On the other hand, if after a consideration of all the evidence in the case you are reasonably satisfied of the truthfulness of the plaintiffs' claim, your verdict should be for the plaintiffs with said award to be reduced by the plaintiffs' comparative fault, if any. If you so find, it will be necessary for you to arrive at an amount to be awarded in the verdict from which I will read to you and describe later in my charge.

I now give you the following rules of law to assist you in your deliberations in arriving at an amount in the event you find for the plaintiffs.

21. The plaintiffs seek compensatory damages. Under our law, the parties are not entitled to recover so-called punitive damages in this action. The purpose of awarding compensatory damages is to fairly and reasonably compensate the injured party for the loss or injury sustained. Compensatory damages are intended as money compensation to the party wronged, to compensate him for his injury and other damages which have been inflicted upon him as a proximate result of the wrong complained of.

22. The measure of damages for medical expenses is all the reasonable expenses necessarily incurred for doctors' and medical bills which the plaintiff has paid or become obligated to pay and the amount of the reasonable expenses of medical care, treatment, and services reasonably certain to be required in the future. The reasonableness of, and the necessity for, such expenses are matters for your determination from the evidence.

23. In determining the amount of damages for loss of earnings, you should consider any evidence of the plaintiff's earning capacity, his earnings, the manner in which he ordinarily occupied his time before the injury, and his inability to pursue his occupation,

and determine what he was reasonably certain to have earned during the time so lost, had he not been disabled.

24. It is for you to determine from the evidence the nature, extent and duration of the injuries of the plaintiff, David Otis Wilson. If you are reasonably satisfied from the evidence that the plaintiff David Otis Wilson has suffered permanent injuries and that such injuries proximately resulted from the wrongs complained of, then you should include in your verdict such sum as you determine to be reasonable compensation for such injuries.

25. The law has no fixed monetary standard to compensate for physical pain and mental anguish. This element of damage is left to your good sound judgment and discretion as to what amount would reasonably and fairly compensate the plaintiff David Otis Wilson for such physical pain and mental anguish as you find from the evidence the plaintiff did suffer. If you are reasonably satisfied that the evidence that the plaintiff David Otis Wilson has undergone, or will undergo, pain and suffering or mental anguish as a proximate result of the injury in question, you should award a sum which will reasonably and fairly compensate him for such pain, suffering, or mental anguish already suffered by him and for any pain, suffering, or mental anguish which you are reasonably satisfied from the evidence that he is reasonably certain to suffer in the future.

26. Debra B. Wilson has also brought this suit. She claims loss of consortium. If you find for the plaintiff, Debra Wilson, you may also determine the amount of money that will reasonably compensate her for any damages sustained by loss of her husband's company, fellowship, cooperation, and assistance in the marital relationship as a partner in the family unit. Loss of consortium includes the impaired ability of her husband to perform his usual services in the care of the home (and in the education and rearing of the children), as well as her loss of his society, companionship, and comfort, taking into account the length of time of such loss and the reasonably certain duration of any future loss of consortium.

27. Mrs. Wilson has also made a claim for loss of future earning capacity. In determining a claim for loss of future earning capacity you must consider the reasonableness of the plaintiff's claim and the likelihood that the plaintiff would have completed her educational requirements and would have competed in the job market.

ECONOMIST REPORT

APPRAISAL OF ECONOMIC LOSS TO DAVID WILSON

J. Smith
SMITH ECONOMICS, INC.
1234 Orchard Drive, Suite 200
Palo Alto, California 94301
(650) 123-4567

SUMMARY

The total net present value of economic loss as a result of the injury to Mr. Wilson amounts to $1,591,600. The components of this loss figure include earnings, home services, and medical care expenses. No dollar amounts for pain and suffering, loss of enjoyment of life, etc. have been included in this analysis. Also, unless specifically stated, this evaluation makes no offset for any monies received prior to the issuance of this report.

All future losses are adjusted for probable earnings growth, price increases, and probable interest returns. Because this loss is discounted to net present value, it is the probable fund required today to compensate for probable losses from the date of the incident in August, YR-5 to the trial and to replace the future lost stream of earnings and other future needs. The assumptions and data described in the following sections are the basis for this loss analysis.

CASE BACKGROUND

Mr. David Wilson sustained severe injury to the nerves, muscles, and tissues of his body when he was exposed to a weed killer on August 4, YR-5. Among the problems he continues to experience are weakness, nervousness, and severe headaches. Mr. Wilson's physicians do not anticipate any significant improvement in the future or that he will be able to return to his former employment. It is understood that Mr. Wilson should be able to handle most of the responsibilities associated with his small farm.

Mr. Wilson had been farming for approximately 30 years prior to his injury and had been employed as the manager/supervisor at Consolidated Farming ("Consolidated") for the past 15 years. His condition has precluded him from returning to Consolidated, and he has found that it will be necessary to hire additional help on his small, personal farm. Mr. Wilson has also not been able to continue repairing equipment during the past winter months, but anticipates he will soon be able to return to this work.

Mr. Wilson's condition has also impacted his wife, Debra. Prior to the accident, she had been pursuing her accounting degree but delayed her education as a direct result of the need for her to provide additional assistance at home and on the farm as well as additional care for her husband. Also, it was financially necessary for her to return to part-time employment following the incident. At a minimum, Ms. Wilson has lost approximately one and a half years in the labor market.

RELEVANT DATES AND TIME PERIODS

DATE OF BIRTH:	November 18, YR-55
DATE OF INJURY:	August 4, YR-5
DATE OF TRIAL:	July 30, YR-0
AGE AT INJURY:	49 years; 9 months.
LOSS PERIODS:	
PAST:	5.0 years
FUTURE:	6.7 years of remaining worklife (*Worklife Expectancies)* 23.3 years of life expectancy *(U.S. Vital Statistics)*
FAMILY DATA:	Married; one grown son from a previous marriage
EDUCATION:	High school degree
WORK HISTORY:	Farming for over 30 years; employed with Consolidated Farming for over 15 of those years

ECONOMIC FOUNDATION

In analyzing this particular case, the following documents have been reviewed:

- Income tax returns and/or W – 2 forms for the years YR-11 through YR-1;
- Interrogatories answered by Mr. and Ms. Wilson;
- Deposition of David Wilson and Statement of Debra Wilson;
- Pay stubs and benefit information from Consolidated Farming;
- Statement from Mr. George Wilson;
- Correspondence from Mr. Wilson to Mr. Weeks dated Sept. 24, YR-5;
- Depositions and medical reports from Drs. Jason, Donald, McGee, Gordon, Ogle and Towe; and
- Attorney correspondence.

In addition, specific inquiries and/or research related to this care were also performed by our office, including, a personal interview with Mr. and Ms. Wilson regarding their work histories, the operation of the farm, the changes in their lifestyle since the incident, etc.

A wealth of general economic data exists which is typically relied upon in any economic evaluation. This information includes:

- current and historical relationships between interest rates, inflation, and wage growth indices in addition to private and government agency forecast data for these economic indicators;
- state and federal labor department information regarding labor force participation rates, employment probabilities, geographic differentials, etc.;
- information on disabled workers including labor force participation, earnings, employment opportunities, unemployment rates, severity of limitations, etc.;
- age-earnings profiles and occupational mobility data;
- materials regarding employee benefit levels;
- retirement and pension information; and
- numerous documents regarding time contributions for household activities.

Academic and government citations for these data sources are located in the Appendix to this report.

TIME FRAME DEFINITIONS

The past loss time period reflects the losses incurred from the time of the incident to the time of the trial in July YR-0 (5.0 years). The amount of past net pecuniary loss is not adjusted for any probable interest earnings. No offset has been made for any monies which may have been received from other sources.

The probable future time frame commences at the time of the trial and continues through the remainder of Mr. Wilson's expected worklife or life expectancy from the time of the accident (6.7 and 23.3 years respectively), depending on the component being evaluated.

Annual loss amounts are set forth in today's dollars, but the stream of future loss amounts is discounted to reflect the probable net level of interest earnings relative to inflation and/or wage growth. In this particular evaluation of probable future loss, the discount rate used for the net present value analysis assumes that probable future average annual wage growth will be less than the probable annual interest returns on a lump-sum payment. The discount rate used for the net present value analysis of future medical care assumes that the probable future annual inflation of medical costs will be less than the relevant interest earnings on a lump-sum payment for this type of loss. See the Appendix for a more detailed explanation of discounting to net present value.

In the economic loss calculations, the following areas are analyzed:

- Earnings
- Home Services
- Medical Care Expenses

LOSS EVALUATION

EARNINGS – David O. Wilson

Mr. Wilson's average annual pre-injury wages were $60,000. Since the accident, Mr. Wilson's wages would have grown in the past period with average growth rates in earnings. His expected wages in the past period are as follows:

YR-5	$62,280
YR-4	$64,647
YR-3	$66,521
YR-2	$68,451
YR-1	$69,888
YR-0	$71,356

His future wages are based on his YR-0 expected wages of $71,356 per year. His anticipated average annual wages commencing in the future period are based on wages at Consolidated Farming or a comparable position consistent with Bureau of Census data regarding earnings of similarly situated males in YR-0 dollars.

Mr. Wilson's benefits from employment at Consolidated Farming were 20% of wages. This incorporates the value of legally required benefits, medical coverage and a pension/retirement plan or other typical benefits. In addition, the value of a company car that was available to Mr. Wilson while employed at Consolidated Farming was $500-$750 per month.

FARMING WAGES

The average annual loss associated with Mr. Wilson's decreased contribution to his farm, which recognizes the value of an extra farm laborer now needed based on $12.00 per hour for seasonal assistance of some 500 hours per year during the past period, is $6,000 per year. In the future period, the average annual loss is expected to be $7,500 based on $15.00 for some 500 hours per year, associated with hiring additional farm help in YR-0 dollars.

Included in the expenses for farming operations is the value of legally required benefits, which are 10% of money wages paid to the farm employee that Mr. Wilson must hire for the additional farm help in the past and future periods.

EQUIPMENT REPAIR WAGES

Mr. Wilson has lost $10,000 each year since the accident because Mr. Wilson was unable to do this work during the winter months as he had prior to the accident. There is no loss in the future period as Mr. Wilson is expected to be able to do this work in the future.

DISCOUNT RATE

With respect to Mr. Wilson's lost earnings at Consolidated Farming and from equipment repairs and the cost he incurs from additional farm help, the net discount rate is 2.5% in the future period.

EARNINGS – Debra Wilson

Ms. Wilson's probable delay in graduation and, therefore, delay in typical entry level wages of a college graduate will be a loss in wages of $45,000 per year over a 1.5 year period commencing at Ms. Wilson's expected pre-incident college graduation. These are the anticipated lost accounting wages which reflect the occupational opportunities available to Ms. Wilson in a rural community. This amount will be offset by monies Ms. Wilson will earn until she can return to school in YR-0 dollars.

Ms. Wilson's expected benefits associated with accounting wages are 15-20% of wages, the value of post-graduation employee benefits for full-time work within the field of accounting. This percentage incorporates the value of legally required benefits, medical coverage and/or a pension/retirement plan. Included in the offset is 10% of wages for the value of employee benefits for the waitress positions Ms. Wilson will likely have during the delay period, which incorporates the value of legally required benefits only and recognizes the part-time nature of Ms. Wilson's employment opportunities.

DISCOUNT RATE

With respect to Ms. Wilson's lost earnings due to the delay in college graduation, the net discount rate is 3.0% in the future period. This analysis does not consider any ongoing, incremental loss of earnings from the delay.

HOME SERVICES – Mr. Wilson

Mr. Wilson contributed 5 to 10 hours each week to household activities. This includes such chores as home maintenance, car maintenance, yard work, etc. per information from an interview with Mr. and Ms. Wilson and tracked to labor market studies.

Lost home services total $6,630 per year using a rate of $15 to $19 per hour, the market replacement wage over past and future periods. This rate is based on area wage rates for variety of household activities and responsibilities, adjusted for geographical location.

DISCOUNT RATE

With respect to lost home services from Mr. Wilson, the net discount rate is 1.0% in the future period. The past loss reflects the value of time, not out of-pocket expenses, while in the future period a fund of money is provided to meet these needs.

MEDICAL CARE EXPENSES – David Wilson

As of December YR-1, Mr. Wilson's past medical care expenses totaled $30,000 per year. This amount may need to be adjusted at the time of trial. His anticipated cost for lab tests and additional tests and physician visits in the future period is $4,000 per year.

DISCOUNT RATE

With respect to medical care expenses for Mr. Wilson, the net discount rate is 0.5% in the future time period.

CONCLUSION

The following chart summarizes the past and future time periods with their associated loss elements as previously discussed. Based upon the analysis presented here, an aggregate fund of $1,591,600 will compensate Mr. and Ms. Wilson for the probable past losses and also replace probable future losses.

- Drawn upon each year in the future, this fund will serve as a substitute for the probable economic losses each year.

- Thus, at the end of the probable future loss period, the fund balance would be $0. (That is, the actual purchasing power of losses replaced year by year at levels enumerated herein will be maintained.)

- To ignore the cost of living or earnings growth factor would understate the losses sustained while a failure to incorporate interest earned from funds on hand today would overstate the probable losses.

- By simultaneously considering these two magnitudes (earnings and interest factors), this economic evaluation appropriately reflects the net present values in real terms.

SUMMARY OF ECONOMIC LOSS AMOUNTS
MR. DAVID WILSON

PAST LOSSES	
EARNINGS – Mr. Wilson	$522,000
HOME SERVICES	$33,200
MEDICAL CARE EXPENSES	$150,000
TOTAL PAST LOSS	$705,200
FUTURE LOSSES	
EARNINGS – Mr. Wilson	$613,500
EARNINGS - Ms. Wilson	$44,400
HOME SERVICES	$138,000
MEDICAL CARE EXPENSES	$90,500
TOTAL NET PRESENT VALUE OF FUTURE LOSS	$886,400
TOTAL VALUE OF LOSS	**$1,591,600**

APPENDIX

Notes on the Determination of Probable Net Present Value

Selected Tables of Economic Indicators

Bibliography of General Economic Sources

JULY YR-0 UPDATE

NOTES ON THE DETERMINATION OF PROBABLE NET PRESENT VALUE

The derivation of the net present value in an appraisal of economic loss must take into account both expected inflationary earnings growth and probable interest returns. When future expenditures for products, equipment, medical care, etc. are considered, the relevant comparison is future price inflation relative to interest returns. When wage losses are considered, the relevant comparison is growth in earnings (both macroeconomic and individual) relative to interest returns. The following discussion focuses on the relationship of earnings growth versus interest returns to establish net present value. The same analysis is valid for the inflation versus interest returns relationship.

EARNINGS GROWTH

The reality of wage increases (earnings growth) is a future probability. Although earnings growth may fluctuate from year to year, the trend over the long-term is more predictable. The significance of such economic circumstances is that a continuation of the general historical pattern is, with some variation, probable into the future. By incorporating economic trends into an appraisal one is able to identify the appropriate real earnings loss to be compensated in the future. Identifying the real earnings loss is critical because economic losses involve a loss of living standards into the future, and it is this lifestyle that is sought as recovery, not an endlessly diminishing monetary value.

Notably, part of the increase in earnings growth is inflationary in nature while further growth is a result of technological advances in our economy, which improve overall (macroeconomic) productivity. A third component in earnings growth recognizes the increased productivity that accrues over the work years as an individual acquires specific experience and training.

For example, inflation growth or cost of living increases over time can be found on Table II of this Appendix. Table II indicates that, although price level increases have slowed in recent years, over the last thirty-three years the YR-2 price level is greater than four and one-half times the YR-35 level. That is, one currently needs $4.74 to purchase each dollar ($1.00) of goods and services consumed thirty-three years ago (i.e., divide the YR-2 index of 184.0 by the YR-35 index of 38.8). Thus, to maintain the same standard of living or the same basic purchasing power in YR-2 as one had in YR-35, earnings must also have a similar 4.74 fold increase.

For a variety of market reasons, hourly wage earners just barely “kept up” with inflationary increases over this same thirty-three year period. As noted on Table I-A for YR-2 vis-à-vis the base year in YR-35 produced a 4.69 fold increase (i.e. 196.6 divided by 41.9). However, over the same time frame the wages of salaried workers (indicated in Table I-B) improved by a multiple of 7.09 compared to the 4.74 inflation multiple. This information indicates that a typical thirty year old male *hourly* wage earner in YR-2 has simply maintained his standard of living in relation to inflation since YR-35 while a thirty year old male *salaried* worker in YR-2 has a substantially better standard of living than his YR-35 counterpart. Of note (and also good news) is that over the past decade, while the overall increase in inflation was approximately twenty-seven percent, the increase in the average aggregate earnings for hourly wage earners was up thirty-nine percent, resulting in a recent increase in the standard of living for these workers. Detail by year for the aggregate average hourly wage earners, salaried workers, and the inflation phenomena can be found in Tables I-A, I-B, and II, respectively.

However, the aggregate average earnings discussed above are not the only wage increases either hourly or salaried workers can expect to receive over their work years. As earlier noted, in addition to wage increases due to inflation and/or technological advances (macroeconomic factors), individual workers receive earnings increases due to their own experience, skill, and training. It is relatively common knowledge that wages tend to increase substantially faster in the early years of an individual's worklife and as the training and experience accrues, wages continue to increase but at slower rates in the latter work years. Also, conventional wisdom suggests and various government and academic data confirm that increased levels of education and training will, on average, produce not only better wage increases, but also prolonged opportunity for these wages to continue at accelerated rates. This well recognized phenomena is best captured in the "age-earnings profiles" compiled by the *Bureau of Census* and also replicated on Chart I in this Appendix.

As described above, wage increases consider numerous factors including, but not limited to, general economic conditions, industry specifics, and the special characteristics of the worker such as age, education, occupation, etc. These factors and special characteristics are important but do not invalidate the universality of inflationary earnings growth in the U.S. economy, either historically or in the future.

INTEREST EARNINGS

In addition to probable earnings growth considerations, interest earnings from a lump sum payment must be incorporated into the analysis. A sum of money available today as compensation for probable future losses has the capacity and expectation to earn additional monies. Since it is necessary that all probable future losses be summarized *in toto* today, the interest earnings available from a lump-sum payment in the present must be taken into account. (The concept of interest earnings is more precisely labeled "net" interest earnings since the yield, net of investment expenses, is the relevant measure.)

Not surprisingly, if one is required to replace $10,000 ten years from today, less than $10,000 can be set aside for this future obligation. How much less depends upon the probable net interest rate. At a five percent net interest, only 61 cents is needed now to replace each dollar ($1.00) in ten years; that is, the "present value" of $10,000 is $5,139, the remaining amount being accumulated through ten years of compound interest.

The data in Tables III and IV depict interest returns on U.S. Treasury bills and bonds. These government securities are regarded as appropriate rates to use (especially in determining monies needed in regular intervals for wages, medical needs, etc.) when discounting to present value for several reasons:

(1) They are relatively stable and reasonably prudent investments as these types of government securities reflect a predictable and reliable stream of income;

(2) They are characterized by high liquidity, being easily transformed into money needed for day-to-day living; and

(3) Management costs and the degree of difficulty in managing such an investment are minimal in comparison to investments that are more risky, less liquid, and more likely to have a volatile value.

Taxable government bonds of varying time frames or tax-free municipal bonds have appropriate applications, depending upon the nature of the economic loss.

NET PRESENT VALUE

Whereas earnings growth factors will cause probable future earnings loss values to rise in magnitude over time, the adjustment of probable future dollar quantities for interest earnings will have the opposite effect.

One approach in the determination of the probable net present value is to project the loss of an expected earnings stream by adjusting the current annual dollar loss by a projected wage growth factor and then discounting this value by an anticipated interest rate. This procedure incorporates explicit assumptions about the level of probable earnings growth as well as interest rates. As these magnitudes are tied to general economic conditions and to the fiscal and monetary policies of our federal government, they can be expected to vary, within a reasonable range, over time and across administrations. Nonetheless, using a variety of interest rates (in combination with wage and/or inflation rates) within a reasonable range will result in similar present value amounts.

The second method of analysis determines the probable differential between earnings growth and interest yields. This approach recognizes both the statistical relationship among inflation, wage increases, and interest rates plus the dynamic nature of our economy. That is, if inflation is high, wage increases tend to be larger than "average"; however, interest rates (with some lead or lag) also tend to be higher than "average."

Indeed, as anticipated from basic economic principles, an extremely high correlation between aggregate earnings growth and investment yields exists over time. Also, the percentage spread between these two economic magnitudes is relatively stable, particularly when evaluated over the worklife of a "typical" individual. Generally, what one finds is that:

(1) Historically, earnings and interest returns rise and fall together (or with a time lag) in a relatively consistent and/or predictable fashion;

(2) Interest returns are typically somewhat greater than the aggregate average earnings growth for both hourly and salaried workers, although (as expected) a smaller differential exists for the latter group;

(3) Only the macroeconomic effects of the relationship between earnings growth and interest rates are captured in the aggregate data on Tables I through IV but additional wage growth is also obtained from the individual age-earnings profile as noted on Chart I.

While over the short term, interest earnings and wages will vary year-to-year (although highly correlated), over the long term worker's growth in earnings (in a free market economy) will largely offset the interest earnings.

The Tables which follow identify some relevant historical relationships for specific economic indicators. Charts also follow illustrating some of the data from the preceding Tables. An annotated bibliography of general economic data sources is also provided. When appropriate, given the information available for a particular loss evaluation, more specific data measures and economic studies are utilized.

TABLE I-A

EARNINGS INDICES
HOURLY

Year	Index (YR-23=100)	% Change from Previous Year	Year	Index (YR-23=100)	% Change from Previous Year
YR-1	200.8	2.1%	**YR-31**	54.3	7.6%
YR-2	196.6	2.9%	**YR-32**	51.0	6.5%
YR-3	191.1	2.9%	**YR-33**	47.6	7.2%
YR-4	185.8	3.8%	**YR-34**	44.6	6.8%
YR-5	179.0	3.8%	**YR-35**	41.9	6.3%
YR-6	172.4	3.6%	**YR-36**	39.3	6.7%
YR-7	166.4	4.1%	**YR-37**	37.0	6.3%
YR-8	159.9	3.9%	**YR-38**	35.3	4.7%
YR-9	153.9	3.4%	**YR-39**	33.9	4.1%
YR-10	148.8	2.8%	**YR-40**	32.6	4.2%
YR-11	144.8	2.7%	**YR-41**	31.4	3.5%
YR-12	141.0	2.5%	**YR-42**	30.6	2.7%
YR-13	137.6	2.4%	**YR-43**	29.5	3.7%
YR-14	134.4	3.1%	**YR-44**	28.8	2.4%
YR-15	130.3	3.6%	**YR-45**	27.9	3.5%
YR-16	125.8	4.1%			
YR-17	120.8	3.3%			
YR-18	116.9	2.5%			
YR-19	114.1	2.2%			
YR-20	111.6	3.0%			
YR-21	108.3	3.7%			
YR-22	104.4	4.4%			
YR-23	100.0	5.9%			
YR-24	91.9	8.9%			
YR-25	85.0	8.1%			
YR-26	78.5	8.3%			
YR-27	72.4	8.4%			
YR-28	67.0	8.0%			
YR-29	62.5	7.3%			
YR-30	58.5	6.8%			

Source: This chart was adapted from information regarding hours and earnings in private nonagricultural industries. *Economic Report of the President*, Council of Economic Advisors.

TABLE I-B

EARNINGS INDICES
SALARY

Year	Index (YR-23=100)	% Change from Previous Year
YR-1	282.9	3.7%
YR-2	272.8	3.5%
YR-3	263.6	3.9%
YR-4	253.7	4.6%
YR-5	242.6	4.6%
YR-6	231.9	4.4%
YR-7	222.1	4.5%
YR- 8	212.6	4.3%
YR-9	203.8	4.1%
YR-10	195.8	4.0%
YR-11	188.3	4.0%
YR-12	181.0	4.3%
YR-13	173.6	4.7%
YR-14	165.8	5.0%
YR-15	157.9	5.5%
YR-16	149.6	5.4%
YR-17	142.0	5.2%
YR-18	135.0	5.2%
YR-19	128.3	5.9%
YR20	121.1	6.4%
YR-21	113.8	6.5%
YR-22	106.9	6.9%
YR-23	100.0	9.1%
YR-24	91.7	10.5%
YR-25	82.9	9.9%
YR-26	75.5	8.0%
YR-27	69.9	8.4%
YR-28	64.5	8.2%
YR-29	59.6	8.2%
YR-30	55.1	8.9%

Source: This chart was adapted from information found at www.worldatwork.org (previously American Compensation Association), various yearly editions.

TABLE II
COST OF LIVING FACTORS IN THE AMERICAN ECONOMY

Year	CPI - All Items (YR-23-to YR-21=100)	% Change from Previous Year	Medical Price Index (YR-23-to YR-21=100)	% Change from Previous Year
YR-1	188.9	2.7%	310.1	4.4%
YR-2	184.0	2.3%	297.1	4.0%
YR-3	179.9	1.6%	285.6	4.7%
YR-4	177.1	2.8%	272.8	4.6%
YR-5	172.2	3.4%	260.8	4.1%
YR-6	166.6	2.2%	250.6	3.5%
YR-7	163.0	1.6%	242.1	3.2%
YR-8	160.5	2.3%	234.6	2.8%
YR-9	156.9	3.0%	228.2	3.5%
YR-10	152.4	2.8%	220.5	4.5%
YR-11	148.2	2.6%	211.0	4.8%
YR-12	144.5	3.0%	201.4	5.9%
YR-13	140.3	3.0%	190.1	7.4%
YR-14	136.2	4.2%	177.0	8.7%
YR-15	130.7	5.4%	162.8	9.0%
YR-16	124.0	4.8%	149.3	7.7%
YR-17	118.3	4.1%	138.6	6.5%
YR-18	113.6	3.6%	130.1	6.6%
YR-19	109.6	1.9%	122.0	7.5%
YR-20	107.6	3.6%	113.5	6.3%
YR-21	103.9	4.3%	106.8	6.2%
YR-22	99.6	3.2%	100.6	8.8%
YR-23	96.5	6.2%	92.5	11.6%
YR-24	90.9	10.3%	82.9	10.7%
YR-25	82.4	13.5%	74.9	11.0%
YR-26	72.6	11.3%	67.5	9.2%
YR-27	65.2	7.6%	61.8	8.4%
YR-28	60.6	6.5%	57.0	9.6%
YR-29	56.9	5.8%	52.0	9.5%
YR-30	53.8	9.1%	47.5	12.0%
YR-31	49.3	11.0%	42.4	9.3%
YR-32	44.4	6.2%	38.8	4.0%
YR-33	41.8	3.2%	37.3	3.3%
YR-34	40.5	4.4%	36.1	6.2%
YR-35	38.8	5.7%	34.0	6.6%
YR-36	36.7	5.5%	31.9	6.7%
YR-37	34.8	4.2%	29.9	6.0%
YR-38	33.4	3.1%	28.2	7.2%
YR-39	32.4	2.9%	26.3	4.4%
YR-40	31.5	1.6%	25.2	2.4%
YR-41	31.0	1.3%	24.6	2.1%
YR-42	30.6	1.3%	24.1	2.6%
YR-43	30.2	1.0%	23.5	2.6%
YR-44	29.9	1.0%	22.9	2.7%
YR-45	29.6	1.7%	22.3	3.7%

Source: Table B-60. This chart was adapted from information regarding consumer price indexes for major expenditure classes. *Economic Report of the President*, Council of Economic Advisors.

TABLE III
YIELDS ON U.S. TREASURY SECURITIES

Year	3-Month Bills	6-Month Bills	3-Year Notes	10-Year Notes
YR-1	1.4%	1.6%	2.8%	4.3%
YR-2	1.0%	1.1%	2.1%	4.0%
YR-3	1.6%	1.7%	10.0%	4.6%
YR-4	3.5%	3.4%	4.1%	5.0%
YR-5	5.9%	5.9%	6.2%	6.0%
YR-6	4.7%	4.8%	5.5%	5.7%
YR-7	4.8%	4.9%	5.1%	5.3%
YR-8	5.1%	5.2%	6.1%	6.4%
YR-9	5.0%	5.1%	6.0%	6.4%
YR-10	5.5%	5.6%	6.3%	6.6%
YR-11	4.3%	4.7%	6.3%	7.1%
YR-12	3.0%	3.1%	4.4%	5.9%
YR-13	3.5%	3.6%	5.3%	7.0%
YR-14	5.4%	5.5%	6.8%	7.9%
YR-15	7.5%	7.5%	8.3%	8.6%
YR-16	8.1%	8.0%	8.6%	8.5%
YR-17	6.7%	6.9%	8.3%	8.9%
YR-18	5.8%	6.1%	7.7%	8.4%
YR-19	6.0%	6.0%	7.1%	7.7%
YR-20	7.5%	7.7%	9.6%	10.6%
YR-21	9.6%	9.8%	11.9%	12.4%
YR-22	8.6%	8.8%	10.5%	11.1%
YR-23	10.7%	11.1%	12.9%	13.0%
YR-24	14.0%	13.8%	14.4%	13.9%
YR-25	11.5%	11.4%	11.6%	11.5%
YR-26	10.0%	10.0%	9.7%	9.4%
YR-27	7.2%	7.6%	8.3%	8.4%
YR-28	5.3%	5.5%	6.7%	7.4%
YR-29	5.0%	5.3%	6.8%	7.6%
YR-30	5.8%	6.1%	7.5%	8.0%
YR-31	7.9%	7.9%	7.8%	7.6%
YR-32	7.0%	7.2%	7.0%	6.8%
YR-33	4.1%	4.5%	5.7%	6.2%
YR-34	4.3%	4.5%	5.7%	6.2%
YR-35	6.5%	6.6%	7.3%	7.4%
YR-36	6.7%	6.9%	7.0%	6.7%
YR-37	5.3%	5.5%	5.7%	5.7%
YR-38	4.3%	4.6%	5.0%	5.1%
YR-39	4.9%	5.1%	5.2%	4.9%
YR-40	4.0%	4.1%	4.2%	4.3%
YR-41	3.5%	3.7%	4.0%	4.2%
YR-42	3.2%	3.3%	3.7%	4.0%
YR-43	2.8%	2.9%	3.5%	4.0%
YR-44	2.4%	2.6%	3.5%	3.9%
YR-45	2.9%	3.2%	4.0%	4.1%

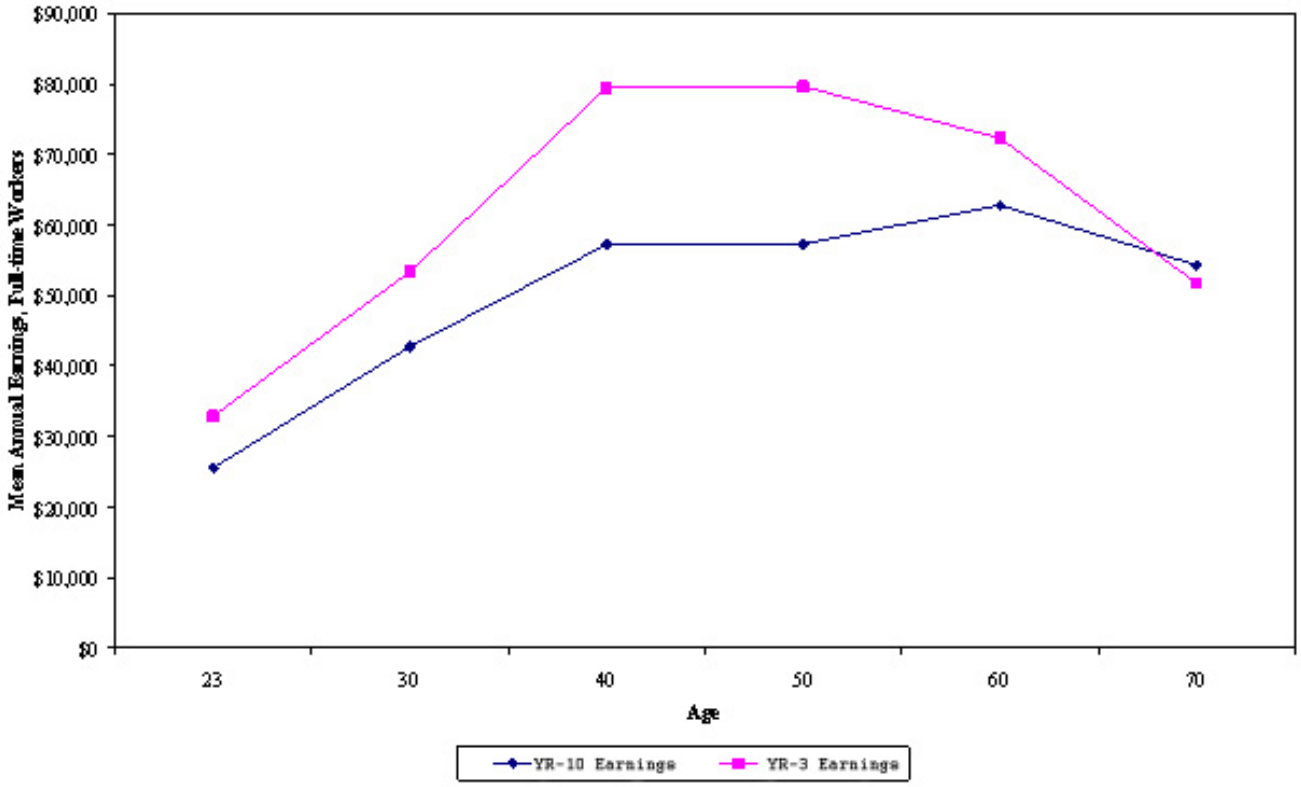
Source: Table B-73. – This chart was adapted from information regarding bond yields and interest rates. *Economic Report of the President*, Council of Economic Advisors.

TABLE IV
YIELDS ON 30-YEAR U.S. GOVERNMENT AND HIGH GRADE MUNICIPAL BONDS

Year	U.S. Bonds	Municipal Bonds
YR-1	n/a	4.6%
YR-2	n/a	4.7%
YR-3	n/a	5.1%
YR-4	5.5%	5.2%
YR-5	5.9%	5.8%
YR-6	5.9%	5.4%
YR-7	5.6%	5.1%
YR-8	6.6%	5.6%
YR-9	6.7%	5.8%
YR-10	6.9%	6.0%
YR-11	7.4%	6.2%
YR-12	6.6%	5.6%
YR-13	7.7%	5.4%
YR-14	8.1%	6.9%
YR-15	8.6%	7.3%
YR-16	8.5%	7.2%
YR-17	9.0%	7.8%
YR-18	8.6%	7.7%
YR-19	7.8%	7.4%
YR-20	10.8%	9.2%
YR-21	12.4%	10.2%
YR-22	11.2%	9.5%
YR-23	12.8%	11.6%
YR-24	13.4%	11.2%
YR-25	11.3%	8.5%
YR-26	8.7%	6.4%
YR-27	7.9%	5.9%
YR-28	7.0%	5.6%
YR-29	6.8%	6.5%
YR-30	7.0%	6.9%
YR-31	7.0%	6.1%
YR-32	6.4%	5.2%
YR-33	5.6%	5.3%
YR-34	5.7%	5.7%
YR-35	6.6%	6.5%
YR-36	6.1%	5.8%
YR-37	5.3%	4.5%
YR-38	4.9%	4.0%
YR-39	4.7%	3.8%
YR-40	4.2%	3.3%
YR-41	4.2%	3.2%
YR-42	4.0%	3.2%
YR-43	4.0%	3.2%
YR-44	3.9%	3.5%
YR-45	4.0%	3.7%

Source: Table B-73. – This chart was adapted from information regarding bond yields and interest rates. *Economic Report of the President*, Council of Economic Advisors.

CHART I
AGE-EARNINGS PROFILE ANALYSIS
(MALES WITH BACHELOR'S DEGREE)



BIBLIOGRAPHY OF
GENERAL ECONOMIC SOURCES

Federal, state and local governments plus professional and trade associations, private agencies and academics compile and publish a wide variety of information which can be useful in an economic analysis. Although not exhaustive, the following list of government and private agencies and their publications is comprehensive and indicative of the sources which are generally referred to when performing an economic appraisal of loss. Of note, voluminous academic textbooks and/or handbooks covering an array of economic principles, as well as additional background, training and experience, have not been detailed in this bibliography.

BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

The Board of Governors compiles data on various financial and business statistics. Included are yields on securities, interest rates, price indices, and GNP. The ***Federal Reserve Bulletin*** is published monthly and the ***Federal Reserve Statistical Release of Selected Interest Rates*** is now available via their website (listed at end).

COUNCIL OF ECONOMIC ADVISORS

The Council compiles statistics including consumer and producer prices by major expenditure, productivity and wage by major industry sector, employment and unemployment figures, bond yields and interest rates. Publications include the ***Economic Report of the President*** and ***Economic Indicators***.

FEDERAL RESERVE BANK OF ST. LOUIS

The Bank collects data on the financial outlook of the economy. This includes such items as yields on securities, interest rates, general price levels, GNP and monetary components. Publications include ***U.S. Financial Data***, ***Monetary Trends***, and ***National Economic Trends***.

U.S. CHAMBER OF COMMERCE, ECONOMIC POLICY DIVISION

The Chamber's annual publication, ***Employee Benefits***, is an extensive survey of fringe benefits packages by type of benefit, industry sector, size of firm, geographic location, etc.

U.S. DEPARTMENT OF AGRICULTURE

The Consumer and Food Economics Research Division collects information relating to the economic aspects of family living, including such topics as home services, personal consumption, and cost of children. Publications issued quarterly include ***Family Economics Review*** now known as ***Family Economics and Nutrition Review***.

U.S. DEPARTMENT OF COMMERCE

The Bureau of Census provides summary statistics on the social, political and economic organization of the United States as well as disseminating a number of special studies with statistical information by education, age, sex, occupation, labor force participation, work disability, etc. Among its publications are the ***Statistical Abstract of the United States*** and ***Current Population Reports: Selected Studies*** including ***Earnings by Occupation and Education, Labor Force Statistics and Other Characteristics of Persons with a Work Disability*** and ***Money Income of Households, Families, and Persons in the United States***. The Bureau of Census also provides data on earnings for workers with impairments/disabilities (as these terms are defined in labor economics) through the following sources: ***Survey of Income and Program Participation (SIPP),*** the ***Decennial Census of the Population*** and the ***Current Population Survey (CPS)***. The Bureau of Economic Analysis reviews and presents in its publications various economic time series data useful to business analysts and forecasters as well as information on general business conditions. Publications include the ***Business Conditions Digest*** and the ***Survey of Current Business***.

U.S. DEPARTMENT OF EDUCATION

The information published by the Office of Educational Research and Improvement includes statistics on graduates, teachers, finances, educational characteristics of the labor force, fields of study, earnings by educational attainment, etc. Among its publications are the ***Digest of Education Statistics***, ***Projections of Education Statistics***, ***Education Indicators, The Condition of Education, College Costs; Basic Student Charges at Two-Year and Four-Year Institutions*** (Survey Report), ***Special Demographic Analysis; Education in the United States, High School and Beyond Tabulations, Educational Attainment in the United States*** (various years), and ***School Enrollment - Social and Economic Characteristics of Students*** (various years).

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Included in the Department's publications, ***Vital and Health Statistics of the United States and U.S. Decennial Life Tables***, are information regarding life expectancy by age, sex, race, and labor force participation. Another publication, ***Health United States***, provides statistical information regarding health status and determinants, utilization of health resources, health care resources and health care expenditures. In addition to their own publications, the U.S. Department of Health and Human Services contracts out various projects such as a study entitled ***A Labor Force Profile of Persons With Disabilities*** prepared by Mathematica Policy Research, Inc. and Systemetrics/McGraw Hill. Under this department, the Social Security Administration has also published the ***Survey of Disability and Work***. This survey presents information regarding the demographic characteristics of the disabled, the presence of activity limitations and

regarding the demographic characteristics of the disabled, the presence of activity limitations and mobility issues, chronic health conditions resulting in disability, labor force status and economic status.

U.S. DEPARTMENT OF LABOR

This agency, through the Bureau of Labor Statistics, collects and distributes data and statistics on labor force participation, work life expectancies, work patterns, income, budgets by household type, price indices, etc. Publications include the ***Handbook of Labor Statistics***, ***Occupational Outlook Handbook***, ***Employment and Earnings***, ***Employment and Wages***, ***National Survey of Professional Administrative, Technical, and Clerical Pay, Area Wage Surveys***, ***Occupational Injuries and Illnesses in the United States by Industry***, ***Employee Benefits in Medium and Large Firms***, ***Monthly Labor Review***, ***Employee Benefits Survey: An MLR Reader***, ***Current Wage Developments***, ***CPI Detailed Report***, and ***Consumer Expenditure Survey***.

EMPLOYMENT/OCCUPATIONAL RESOURCES

Supplementing the economic information available on labor market trends and characteristics is specific occupational information that can be found in publications issued by various professional and trade associations. Among these private organizations are American Medical Association, Commission on Professionals in Science & Technology, American Dental Association, and American Compensation Association. Likewise, wage information specific to occupation can be found in the Bureau of Labor Statistics state specific employment and wage estimates. Also, details regarding wages, benefits and other specific information for various employers are outlined in publications such as ***Federal Employees Almanac, Railroad Retirement and Survivor Benefits*** and ***Uniformed Services Almanac*** (as well as for Reserve Forces, National Guard and Retired Military).

ADDITIONAL BACKGROUND MATERIALS

In addition to federal government sources, specific state and local government data also exist, as do studies on a wide range of topics from private sources. State and local labor market data is available through government offices such as the Department of Labor as well as private organizations like the Chamber of Commerce. For the state of Colorado, sources include the ***Occupational Supply & Demand Report*** and ***Occupational Employment Statistics***, both issued by the Colorado Department of Labor & Employment. Wage and benefit information in Colorado's municipalities and communities is available in the ***Benchmark Employee Compensation Report*** produced by the Colorado Municipal League (CML). Similar data is available for other regions and states. Comparative cost of living data for urban areas is available quarterly from the American Chamber of Commerce Researchers Association (ACCRA).

Studies and surveys on a wide range of topics can be found through private sources such as the Employee Benefit Research Institute (EBRI), the International Center for the Disabled, The Menninger Foundation, Global Insight, The RAND Corporation, and the Commission on Professionals in Science and Technology.

Moreover, much informative, quantitative and qualitative academic research can be found in and is reviewed from such journals as the ***Journal of Human Resources***, ***Journal of Labor Economics, Journal of Law and Economics, Economic Inquiry***, ***Southern Economic Journal***, ***American Economic Review, Journal of Risk and Insurance***, ***Journal of Business***, ***Journal of the Political Economy, Journal of Public Economics, Journal of Forensic Economics, Review of Social Economy, Empirical Economics, Journal of Socio-Economics, Social Security Bulletin, Population and Development Review, Demography, Industrial and Labor Relations Review, Applied Economics, Oxford Bulletin of Economics and Statistics, Review of Economics and Statistics, American Journal of Economics and Sociology, Quarterly Review of Economics and Finance, Journal of Risk and Uncertainty, Review of Income and Wealth***, among others.

More detailed data and analyses regarding home services can be found in the academic and government literature and surveys. These data and surveys are included in publications such as ***Monthly Labor Review***, ***Journal of Human Resources*** and ***Family Economics Review*** as well as specific academic articles authored by W.H. Gauger and K.E. Walker, K.E. Walker and M.E. Woods, M.V. Leonesio, H. Paul, T. Van der Lippe and J.J. Siegers, F. Stafford and G. Duncan, M. Minton and J. Bloch, J. Peskin, among others. Specifically, studies such as ***The Dollar Value of a Day*** published by Expectancy Data and ***The Dollar Value of Household Work*** authored by W. Keith Bryant, Cathleen D. Zick, and Hyoshin Kim, contain data measuring the value of time usage for home services and associated replacement costs. ***The Dollar Value of a Day* (*DVD*)** utilizes the National Human Activity Pattern Survey (NHAPS) time-diary studied as published by the U.S. Environmental Protection Agency.

Personal consumption information has been obtained from various editions of the ***Consumer Expenditure Survey*** from the Bureau of Labor Statistics as well as from publications such as ***Family Economics Review***, ***Monthly Labor Review*** and ***Economic Report of the President***. In addition, various academic and research articles evaluating this phenomenon are represented in articles authored by E. Cheit, J. Burke and H. Rosen, R. Gieseman and J. Rogers, E. Jacobs and S. Shipp, and others.

Worklife expectancies can be found in various issues of the ***Journal of Legal Economics*** and ***Life and Worklife Expectancies*** by Hugh Richards.

National forecasting information is obtained from a number of sources such as ***Short-Term Outlook*** and ***Long-Term Outlook*** published by Global Insight, ***The Economic and Budget Outlook*** issued by the Congressional Budget Office (CBO), and various documents obtained through the General Accounting Office (GAO).

Local forecasting information for the State of Colorado is presented in the ***Colorado Economic Perspective*** issued by the Office of State Planning and Budgeting as well as in ***Focus Colorado: Economic & Revenue Forecast*** which is a Colorado Legislative Council Staff Report. Other states have comparable information.

Financial statistics, personal income and tax data are available quarterly through the ***SOI Bulletin*** issued by the Department of the Treasury, Internal Revenue Service. Also, financial instruments and yield information are provided through various sources including the ***Stocks, Bonds, Bills and Inflation Yearbook*** published by Ibbotson Associates. Sources for information regarding businesses' financial ratios, discounting, etc. include, but are not limited to, ***Valuing a Business*** and ***Valuing Small Business and Professional Practices***, both authored by Shannon

Pratt, ***Robert Morris Associates' (RMA's) Annual Statement Studies, The Almanac of Business and Industrial Financial Ratios, Business Statistics of the United States***, ***Guide to Forecasts and Projections*** authored by Pallais and Holton***, Guide to Business Valuations*** authored by Fishman, Pratt, et al. and ***Valuation-Measuring and Managing the Value of Companies*** authored by Copeland, Koller and Murrin. Information regarding the valuation of a business in a specific industry can be found in books such as ***Valuation of a Medical Practice*** authored by Tinsley, Sides and Anderson. Other more specific textbooks that focus on valuing damages specifically in litigation matters involving businesses can be found in a book authored by P. Gaughan titled ***Measuring Commercial Damages***. A text that focuses specifically on valuing lost earnings and household services in litigation matters involving personal injury and wrongful death is ***Determining Economic Damages*** by Gerald D. Martin and Ted Vavoulis.

Finally, a variety of academic textbooks in the economic, finance and general business offer important theoretical and empirical information necessary to understand the dynamics of our economy. This literature provides the foundation and the basic underpinnings for an economic appraisal and include various ***Principles of Economics*** and more advanced ***Micro/Macroeconomic*** textbooks authored by Samuelson, Lipsey and Steiner, Baumol and Blinder, Ekelund and Tollison, Ferguson, Henderson and Quandt, Mansfield, and Hirshlefer; various ***Managerial Economics*** textbooks by Brigham, Pappas and Brigham, Maurice and Smithson, and Rooney; ***Financial Theory and Corporate Policy*** and ***Managerial Finance*** both authored by Copeland and Weston; ***Financial Institutions*** by Edmister; and ***Fundamentals of Financial Management*** by Brigham.

Also, a sampling of labor economic textbooks which focus more specifically on worker issues include ***The Economics of Work and Pay*** by Hammermash and Rees, ***Contemporary Labor Economics*** by McConnell and Brue, ***Handbook of Labor Economics*** by Ashenfelter and Layard, Editors, ***Longitudinal Analysis of Labor Market Data*** by Heckman and Singer, to name but a few.

WEBSITE RESOURCES

Many agency publications that were previously available only in hardcopy are now available online. Frequently used sites include:

Bureau of Labor Statistics	http://www.stats.bls.gov
Bureau of the Census	http://www.census.gov
Congressional Budget Office	http://www.cbo.gov
Federal Reserve Board	http://www.federalreserve.gov
Federal Reserve Bank	http://www.stls.frb.org
Internal Revenue Service	http://www.irs.gov
National Center for Education Statistics	http://www.nces.ed.gov
Social Security Administration	http://www.ssa.gov
US Bureau of Economic Analysis	http://www.bea.gov/
US Chamber of Commerce	http://www.uschamber.org
US Department of Commerce	http://www.doc.gov
US Department of Education	http://www.ed.gov
US Department of Labor	http://www.dol.gov
Employee Benefit Research Institute	http://www.ebri.org

For state government Websites http://www.state.**.us

(Replace ** with the two-letter state code, e.g., for California: http://www.state.ca.us)

Journal Article

Weed Science:

PRINCIPLES AND PRACTICES

GLENN C. KLINGMAN

Eli Lilly and Company, Greenfield, Indiana
[Formerly Professor, North Carolina State University]

FLOYD M. ASHTON

Professor of Botany
University of California at Davis
Davis, California

With the editorial assistance of

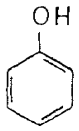
LYMAN J. NOORDHOFF

Communications Specialist, Extension Service
United States Department of Agriculture
Washington, D. C.

A WILEY-INTERSCIENCE PUBLICATION

JOHN WILEY & SONS, New York • London • Sydney • Toro

15 Phenols

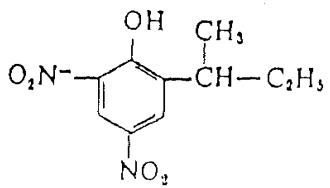


Phenol is the monohydroxy (—OH) derivative of benzene. Herbicides of this class now registered for crop use in the United States have two nitro ($—NO_2$) groups on the ring in the number 4 and number 6 positions. These are dinitrophenols or simply dinitros.

Historically, PCP (pentachlorophenol) was used as a herbicide in certain crops, but it is not registered now for this use in the United States. While it can be used as a preharvest desiccant in small-seeded legume crops grown for seed, it is largely used as a wood preservative.

Substituted phenolic herbicides are contact herbicides. Some have been used for more than 40 years. The sodium salt of DNOC (4,6-dinitro-*o*-cresol) was first used to remove broadleaf weeds from small grain in France about 1933. Soon after, it was introduced into the United States and promptly became the major material for annual broadleaf weed control in cereal crops, flax, and peas. However, it is not now registered for these uses in the United States. It is presently used as a plant growth regulator for blossom thinning in apples.

DINOSEB



dinoseb

Dinoseb is the common name for 2-*sec*-butyl-4,6-dinitrophenol. It is also often called DNBP. It has several trade names. The phenol form is usually formulated as an emulsifiable concentrate; it is also soluble in oil. It may also be formulated as water-soluble salts; the most common are the ammonium, triethanolamine, and a mixture of ethanol and isopropanolamine salts.

Dinoseb is a dark-brown solid or a dark-orange liquid, depending on temperature. As the phenol, it has a water solubility of 52 ppm, but the salts are quite soluble in water.

Toxicity to Humans and Animals

Dinoseb and its salts are dangerous poisons if taken internally, if inhaled as dusts, or if considerable quantities are absorbed through the skin. Therefore, avoid prolonged breathing of the spray drift or dusts, and avoid wearing contaminated clothing or shoes. If your skin is contaminated, wash it immediately with soap and water. Symptoms of poisoning are excessive fatigue, sweating, thirst, and fever. If these develop, send for a physician.

With normal precautions, the chemical can be applied routinely with little or no hazard to the applicators. Daily bathing and change of clothing is recommended whether the applicator thinks he is contaminated or not.

Residues on foliage normally constitute little or no hazard to livestock. In an unpublished study, a milk cow was given 1.7 g of chemical/kg body weight/day for 3 days with no ill effects. Dinoseb did not appear in the milk. If there is question, keep livestock away from sprayed foliage until a rain has removed much of the herbicide.

The acute oral LD_{50} for rats ranges from 5 to 60 mg/kg. The maximum amount tolerated in the diet for a 6-month period was 100 ppm. It is considered to be quite toxic.

Fish are sensitive to dinoseb; 1.0 ppm killed trout and sea lamprey in 14 hr, and bluegills in 5 hr (1).

Uses

Dinoseb is very toxic to growing plants, so it is used as a general contact herbicide. It is so toxic to all leaves that it lacks the selectivity of its salt derivatives. Dinoseb is valuable where mowing is impractical; for example, along fencerows, ditchbanks, and roadsides. It kills most annual weeds and removes the tops from perennial weeds. Underground parts of perennial plants are not killed except by repeated treatments. Thus, dinoseb can be used in dormant alfalfa to kill annual weeds.

TOXICOLOGICAL STUDIES ON LABORATORY ANIMALS OF CERTAIN ALKYLDINITROPHENOLS USED IN AGRICULTURE*

H. C. Spencer, V. K. Rowe, E. M. Adams and D. D. Irish

Biochemical Research Laboratory, The Dow Chemical Company, Midland, Michigan

THE dinitrophenols are used extensively in agriculture for the control of insects, fungi and weeds.

The older literature pertaining to the use of the dinitrophenols as insecticides has been reviewed by Kagy and Richardson (1), who point out that a preparation containing the potassium salt of dinitro-o-cresol was marketed as early as 1892. Since that time the dinitrophenols have been used extensively in dormant sprays for the control of mites, aphids, scale insects, and other pests in overwintering stages. During the last ten years 2-cyclohexyl-4,6-dinitrophenol and its compound with dicyclohexylamine have gained wide acceptance as insecticides; and especially as acaricides for use in the greenhouse, field and orchard.

The dinitrophenols, particularly dinitro-o-cresol and its derivatives, are used as eradicant fungicides for the control of fungi which are pathogenic to a number of plant species.

Dinitro-o-cresol, 2-sec-butyl-4,6-dinitrophenol, and their salts are used extensively in weed control. These materials may be applied as selective weed killers in field crops and pastures, or as contact herbicides in such locations as roadsides and right-of-ways.

The widespread use of the dinitrophenols in the agricultural field has led, naturally, to the question of the problems that may be encountered in their handling and use. The answer to this question depends, to a large extent, upon the physiological effects produced by these materials.

In the case of 2,4-dinitrophenol, there have been many reports dealing with its effect upon laboratory animals and man. This extensive literature has been reviewed by Horner (2) with special emphasis upon the role of 2,4-dinitrophenol in the production of cataracts in man. On the other hand, relatively little information is available on the toxicity of the other dinitrophenols. The report by Ambrose (3) on dinitro-o-cresol and that by Hrenoff and Leake (4) on 2-cyclohexyl-4,6-dinitrophenol essentially cover the work that has been published on these materials.

The present experimental work was undertaken in order to obtain toxicological information which would be useful in evaluating the actual hazards associated with the use of the dinitrophenols, and in formulating safe handling procedures.

*Received for publication August 21, 1947.

Compounds Investigated

The chemical and physical properties of the compounds used in this toxicological study are listed in Table 1. The solubility determinations were made by adding an excess of the material to the solvent and stirring for several hours at 25°C. The excess solid was then filtered off and the amount dissolved was determined by titration of the nitro groups with titanium chloride.

Skin Irritation and Absorption—Rabbits and Guinea Pigs

Rabbits

The effect of each of the dinitrophenols upon the skin was determined on white rabbits by a method previously described (5). The materials were all tested as 3 per cent solutions in 95 per cent ethanol. In some instances, other concentrations and vehicles were used. Heat was used when necessary to dissolve the test material. Routinely, 20 applications were made to the ear and 20 applications were bandaged onto the shaven abdomen over a period of four weeks. The absorption of lethal quantities of the test material or the development of marked skin irritation interrupted this routine in some cases.

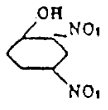
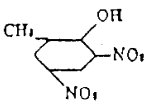
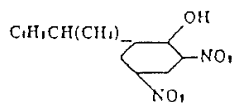
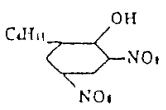
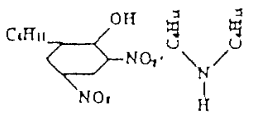
2,4-Dinitrophenol. A 3 per cent alcoholic solution of 2,4-dinitrophenol produced no irritation on the ear and only a very slight irritation on the abdomen, characterized by mild hyperemia, edema, and exfoliation. There was no indication that toxic quantities of 2,4-dinitrophenol were absorbed through the skin under the conditions of this test.

Dormant spray oil containing 4 per cent of 2,4-dinitrophenol was no more irritating to the skin than the oil alone, which produced marked irritation when bandaged onto the abdomen for two or three days. Lethal quantities of 2,4-dinitrophenol were not absorbed through the abdominal skin from three applications in the oil.

4,6-Dinitro-o-cresol. Seven applications of a 3

TABLE 1

CHEMICAL AND PHYSICAL PROPERTIES OF COMPOUNDS INVESTIGATED

PROPERTY	COMPOUNDS				
Name*	2,4-Dinitrophenol	4,6-Dinitro-o-cresol	2-sec-Butyl 4,6-dinitrophenol	2-Cycloheryl-4,6-dinitrophenol	2-Cycloheryl-4,6-dinitrophenol compound with dicycloherylamine
Synonym	4,6-Dinitrophenol	2,4-Dinitro-o-cresol	2,4-Dinitro-o-sec-butylphenol	2,4-Dinitro-o-cycloheryl-phenol	Dicycloherylamine salt of 2,4-dinitro-o-cycloherylphenol
Molecular Formula	$C_6H_4O_5N_2$	$C_7H_6O_5N_2$	$C_{10}H_{12}O_5N_2$	$C_{12}H_{14}O_5N_2$	$C_{12}H_{27}O_5N_3$
Structural Formula					
Formula Weight	184.04	198.13	240.21	266.25	447.56
M.P., °C.	113.2–113.9	86.0–86.9	37.9–39.3	104.1–105.7	191.5–195.8
N Found, %	14.87	13.95	11.55	10.08	9.26
N Theoretical, %	15.22	14.14	11.66	10.52	9.39
Purity of Compd., %					
From N det'n.	97.7	98.7	99.1	95.8	98.6
By titration**	98.9	98.7	97.7	99.6	97.2
Crystal Form	orthorhombic	triclinic	monoclinic	monoclinic	triclinic
Appearance	yellow crystals	yellow crystals	dark amber crystals	yellow crystals	orange crystals
Solubility in grams/100 grams at 23°C					
Water	0.0597	0.075	0.0734	0.072	0.0515
95% Ethanol	3.66	3.69	23.46	1.36	1.76
Oil***	1.67	5.98	8.77	1.84	0.00

* According to Chemical Abstracts.

** Titration of nitro groups with titanium chloride.

*** Oil commonly used in Dormant Sprays.

per cent alcoholic solution of 4,6-dinitro-o-cresol resulted in death from absorption through the skin; but caused no irritation on the ear and only slight irritation of the abdominal skin.

A 5 per cent solution in olive oil was also tested and found to be similar to the alcoholic solution in irritating properties; however, the amount of 4,6-dinitro-o-cresol absorbed from the olive oil solution during the course of 20 applications was insufficient to cause death.

A 4 per cent solution of 4,6-dinitro-o-cresol in Dormant spray oil was no more irritating than the oil alone; although in the case of three different rabbits, one application of this Dormant spray oil solution bandaged onto the shaven abdomen killed the animal within twenty-four hours.

2-sec-Butyl-4,6-dinitrophenol. A 3 per cent alcoholic solution of 2-sec-butyl-4,6-dinitrophenol failed to cause any significant irritation when repeatedly applied to the rabbit ear. However, when it was bandaged onto the shaven abdomen of 3 different rabbits, death occurred after 1, 3 and 8 exposures, respectively. No irritation of the abdominal skin was observed in any instance.

A 10 per cent solution of 2-sec-butyl-4,6-dinitrophenol in butylcarbitol acetate was applied to three rabbits. In each case death occurred within twenty-four hours without evidence of any irritation to the ear or abdominal skin.

2-Cyclohexyl-4,6-dinitrophenol. Alcohol containing 2-cyclohexyl-4,6-dinitrophenol in a concentration of 3 per cent produced no irritation on the ear, but caused a moderate irritation on the abdomen, characterized by moderate hyperemia and exfoliation, and some denaturation. This irritation was severe enough to warrant the termination of the experiment after 7 applications.

A 5 per cent solution of 2-cyclohexyl-4,6-dinitrophenol in olive oil produced only slight irritation of the ear, as shown by mild hyperemia and exfoliation, and a slightly greater response on the abdomen with some blistering as well as hyperemia and exfoliation.

Dormant spray oil containing 4 per cent of the test material appeared to be only slightly more irritating than the oil alone. Lethal quantities of 2-cyclohexyl-4,6-dinitrophenol were not absorbed from 2 applications of the Dormant spray oil solution, 7 applications of the alcoholic solution, or 20 applications of the olive oil solution, bandaged onto the shaven abdomen.

2-Cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine. A 3 per cent solution of 2-cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine in 1:4 acetone-alcohol (acetone used to effect complete solubility) failed to cause any appreciable irritation when applied repeatedly to the ear or when bandaged repeatedly to the shaven abdomen.

Tested in a like manner, a 20 per cent solution of the material in olive oil produced no irritation. Lethal quantities of 2-cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine were not absorbed from either of these solutions during the course of the experiments.

TABLE 2

SUMMARY OF TOXICITY FROM SKIN ABSORPTION FOLLOWING SINGLE APPLICATION—GUINEA PIGS

COMPOUND	"SURVIVAL DOSE"*	"LETHAL DOSE"**
	g./kg.	g./kg.
2-sec-Butyl-4,6-dinitrophenol	0.1	0.5
4,6-Dinitro-o-cresol	0.2	0.5
2,4-Dinitrophenol	0.2	0.7
2-Cyclohexyl-4,6-dinitrophenol	1.0 or more	>1.0
2-Cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine	1.0 or more	>1.0

* Largest dose survived by all animals treated.

** Smallest dose causing death of all animals treated.

Guinea pigs

Guinea pigs of both sexes were used to determine the toxicity of the dinitrophenols from absorption through the intact skin. The animals used in this work were of heterogeneous stock procured from a commercial supplier and maintained on Purina Rabbit Chow (complete ration), alfalfa hay, and cabbage. A single dose of one of the dinitrophenols in alcoholic solution was applied to the clipped abdomen of each experimental animal. Each guinea pig was restrained on an animal board in such a manner that the treated area could be kept wet with ethanol during the four-hour period following the application of the test material in order to facilitate its absorption. At the end of this period, the surviving animals were removed from the boards, bandaged so as to prevent oral ingestion, caged, and observed until it was certain that they had fully recovered.

The results of this study on 108 guinea pigs are summarized in Table 2 and shown in detail in Table 3.

Summary of Skin Irritation and Absorption

These experiments on rabbits have shown that the dinitrophenols investigated are not significantly irritating to the skin. Even the most irritating one of the group, 2-cyclohexyl-4,6-dinitrophenol, required prolonged exposure to cause appreciable irritation. None of the materials caused any epithelial hyperplasia or follicular changes.

In the skin irritation tests on rabbits it was apparent that some of these materials, particularly, 2-sec-butyl-4,6-dinitrophenol and 4,6-dinitro-o-cresol, were readily absorbed through the intact skin in quantities sufficient to cause death.

from the stock colony in this laboratory, although some were purchased from the Breeding and Laboratory Institute, Brooklyn.

Aliquots of olive oil solutions of the materials were emulsified with 5–10 per cent gum arabic solution and administered by means of a stomach tube (8FS 16" all rubber catheter). The volume of oil given to each rat was always less than 3 ml. and was usually of the order of 1 ml. All of the rats that survived were observed until it was certain that they had fully recovered (usually about two weeks). Deaths that resulted from the administration of the dinitrophenols are believed to

TABLE 3

MORTALITY RESULTING FROM SINGLE APPLICATION TO ABDOMINAL SKIN—GUINEA PIGS

QUANTITY APPLIED TO SKIN	COMPOUNDS (APPLIED IN ALCOHOLIC SOLUTIONS)									
	2,4-Dinitrophenol		4,6-Dinitro-o-cresol		2-sec-Butyl-4,6-dinitrophenol		2-Cyclohexyl-4,6-dinitrophenol		2-Cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine	
	No. treated	No. died	No. treated	No. died	No. treated	No. died	No. treated	No. died	No. treated	No. died
g./kg.										
0.1	5	0	5	0	5	0	—	—	—	—
0.15	—	—	—	—	5	1	—	—	—	—
0.2	5	0	5	0	5	4	—	—	—	—
0.3	5	1	5	1	5	5	—	—	—	—
0.4	5	1	5	3	5	4	—	—	—	—
0.5	5	2	5	5	5	5	—	—	—	—
0.6	—	—	—	—	5	5	—	—	—	—
0.7	5	5	—	—	—	—	—	—	—	—
1.0	5	5	2	2	1	1	5	0	5	0
Totals....	35		27		36		5		5	

In order to obtain a better estimation of the relative toxicity of these dinitrophenols from skin absorption, the quantitative tests on guinea pigs were carried out. These experiments have demonstrated that the following compounds, listed according to decreasing toxicity, can readily be absorbed through the intact skin in lethal amounts: 2-sec-butyl-4,6-dinitrophenol; 4,6-dinitro-o-cresol; and 2,4-dinitrophenol. On the other hand, neither 2-cyclohexyl-4,6-dinitrophenol nor its compound with dicyclohexylamine are absorbed through the skin to an appreciable extent.

ORAL ADMINISTRATION—SINGLE DOSE BY STOMACH TUBE—RATS

The toxicity of the dinitrophenols when given in single oral doses was determined on young mature white rats of both sexes. Most of the animals were

be due chiefly to their pyretic effect; as a rule, death occurred an hour or two after the feeding or not at all. The detailed results obtained on the 674 rats used in this study are given in Table 5 and are summarized in Table 4.

It is evident that all of the dinitrophenols investigated are rapidly acting materials of a fairly high order of acute oral toxicity. However, the toxicity of 2-cyclohexyl-4,6-dinitrophenol or its compound with dicyclohexylamine is definitely lower than that of 2-sec-butyl-4,6-dinitrophenol or 4,6-dinitro-o-cresol.

ORAL ADMINISTRATION IN THE DIET FOR SIX MONTHS—RATS

Experimental Procedure

The modified Sherman diet (6), which has been used successfully for several years in this labora-

tory as the stock ration for rats, served as the control and basic diet in all of the experiments.

TABLE 4

SUMMARY OF ACUTE ORAL TOXICITY—RATS

COMPOUND	"SURVIVAL" DOSE*	"LETHAL" DOSE**
	g./kg.	g./kg.
2-sec-Butyl-4,6-dinitrophenol	0.005	0.060
4,6-Dinitro-o-cresol	0.010	0.050
2,4-Dinitrophenol	0.027	0.100
2-Cyclohexyl-4,6-dinitrophenol	0.030	0.180
2-Cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine	0.060	0.600

* Largest dose survived by all animals fed.

** Smallest dose causing death of all animals fed.

The following ingredients were used in the preparation of this stock diet:

Whole wheat, freshly ground	55% by weight
Dried whole milk	25% by weight
Dried meat residue (or dried extracted liver)	12% by weight
Dried brewer's yeast	5% by weight
Calcium carbonate	1% by weight
Iodized table salt	2% by weight

For several years dried meat residue was used in the stock diet, however, when this product was no longer available, dried extracted liver was substituted (March, 1944) and found to be satisfactory.

The experimental diets (see Table 6) were prepared by thoroughly mixing the dinitrophenols with the stock diet on a per cent by weight basis. The test material was added to the diet either directly or by means of a flour concentrate. In either case thorough mixing was obtained by the use of a mechanical mixer, and the actual concentration of the test material in the diet checked by chemical analysis. Each flour concentrate was prepared by adding wheat flour to an alcoholic solution of the test material to form a thick paste

TABLE 5

MORTALITY RESULTING FROM ADMINISTRATION OF SINGLE ORAL DOSE—RATS

SINGLE ORAL DOSE	COMPOUNDS (GIVEN IN OLIVE OIL EMULSIFIED IN GUM ARABIC)									
	2,4-Dinitrophenol		4,6-Dinitro-o-cresol		2-sec-Butyl-4,6-dinitrophenol		2-Cyclohexyl-4,6-dinitrophenol		2-Cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine	
	No. fed	No. died	No. fed	No. died	No. fed	No. died	No. fed	No. died	No. fed	No. died
g./kg.										
0.005	—	—	—	—	20	0	—	—	—	—
0.010	9	0	20	0	20	1	—	—	—	—
0.020	20	0	20	3	10	1	—	—	—	—
0.023	10	0	—	—	10	2	—	—	—	—
0.025	10	0	—	—	—	—	—	—	—	—
0.027	10	0	—	—	10	0	—	—	—	—
0.030	30	11	20	9	10	4	10	0	—	—
0.040	20	18	20	15	10	5	10	1	—	—
0.050	20	17	20	20	10	7	10	3	—	—
0.060	20	19	—	—	20	20	10	5	10	0
0.070	30	15	—	—	—	—	25	13	—	—
0.080	40	18	—	—	—	—	20	12	—	—
0.100	20	20	—	—	—	—	40	22	5	1
0.120	—	—	—	—	—	—	20	14	—	—
0.140	—	—	—	—	—	—	10	7	—	—
0.160	—	—	—	—	—	—	10	8	—	—
0.180	—	—	—	—	—	—	10	10	—	—
0.200	—	—	—	—	—	—	10	10	—	—
0.400	—	—	—	—	—	—	—	—	5	3
0.600	—	—	—	—	—	—	—	—	10	10
Totals	239		100		120		185		30	

TABLE 6

EXPERIMENTS IN WHICH MALE RATS RECEIVED DIETS CONTAINING DINITROPHENOLS

COMPOUND IN DIET[a]		SOURCE OF RATS	DATE STARTED ON DIET	NO. OF RATS STARTED	SURVIVAL FOR ENTIRE EXPTL. PERIOD	LENGTH OF EXPTL. PERIOD	NO. OF RATS EXAMINED AT END OF EXPT.				
Name	Conc. (wt. %)						Hematology	Bone marrow counts	Organ weights	Blood urea-N	Histopathology
					per cent	*days*					
2,4-Dinitrophenol	0.00	B—L[c]	5-22-45	20	70	179	10**	7	14	14	7
	0.01	B—L	"	15	80	178			12	12	8
	0.02	B—L	"	15	80	179			12	12	8
	0.05	B—L	"	15	66	179	9**	6	10	9	9
	0.10	B—L	"	15	93	179	14		14	14	13
	0.20	B—L	"	10	60	24			6	6	6
4,6-Dinitro-o-cresol	0.00	B—L	3-23-45	20	80	182	10**	8	16	16	8
	0.002*	B—L	"	20	90	179			18	17	10
	0.005*	B—L	"	20	100	182			20	20	10
	0.01*	B—L	"	20	90	182	10**	8	18	18	9
	0.02*	B—L	"	20	80	181			16	16	12
	0.05*	B—L	"	10	90	182	9		9	9	9
	0.05	B—L	3-31-45	12	42	77			5	5	5
	0.10	B—L	7-9-45	10	40	10			4	4	4
	0.10*	B—L	7-9-45	10	50	10			5	5	5
2-sec-Butyl-4,6-dinitrophenol	0.00	B—L	3-2-45	30	70	189	10**	9	21	21	21
	0.005*	B—L	"	20	90	189			18	17	17
	0.01*	B—L	"	20	80	189	10**	8	16	15	15
	0.02*	B—L	"	20	85	189	8	8	17	16	16
	0.05*	B—L	"	10	60	21			6	6	6
2-Cyclohexyl-4,6-dinitrophenol	0.00[b]	Dow	8-18-43	20	70	195	10***	14	14		6
	0.02	Dow	"	20	95	194	10***		19		9
	0.05	Dow	"	20	65	194	10**	12	13		7
	0.10	Dow	"	20	55	195			11		11
2-Cyclohexyl-4,6-dinitrophenol compd. with dicylcohexylamine	0.00[b]	Dow	"	20	70	195	10***	14	14		6
	0.05	Dow	"	20	65	195	10***		13		6
	0.10	Dow	"	20	80	194	10**	15	16		9
	0.20	Dow	"	20	60	196			12		12
Totals.....				472			Approx. 600 exams.	95	355	252	258

[a] Compound added directly to the control diet unless otherwise indicated.
[b] One control group for both compounds.
[c] Breeding and Laboratory Institute, Brooklyn.
* Flour concentrate containing compound added to the control diet.
** Examined bimonthly during experimental period.
*** Examined monthly during experimental period.

which was then dried, ground, passed through an 80-mesh sieve, and analyzed. The use of these concentrates facilitated the accurate addition of small quantities of the test materials to the basic diet.

The diets containing the dinitrophenols were

made up from freshly prepared stock diet when needed. No diet preparations over a month old were used during the course of these experiments. The rats were fed from stainless-steel hoppers which were weighed and refilled three times a week.

White male rats from the stock colony in this laboratory ("Dow") were used in the experiments on 2-cyclohexyl-4,6-dinitrophenol and its compound with dicyclohexylamine. These rats were the progeny of animals obtained from the Wistar Institute in 1938. Since sufficient "Dow" animals were not available, white male rats were purchased from the Breeding and Laboratory Institute, Brooklyn, ("B and L") for the work on the other dinitrophenols.

The "Dow" rats were maintained on the stock diet from the time of weaning until about two months of age when they were divided according to body weights into well matched groups and started on the experimental diets. The rats from the Breeding and Laboratory Institute were received when about twenty-five to thirty days old, although the exact ages were not known, maintained for three to four weeks on the stock diet, and then divided according to body weights into matched groups and started on the experimental diets.

Five rats were caged together, the "Dow" rats in solid bottom cages with wood shavings and sawdust as litter, and the "B and L" rats in wire bottom cages. The animals had free access to food and water at all times. In addition, each rat was given approximately 3 grams of cabbage twice weekly.

The general design of the experiments is presented in Table 6. The following information for each experimental diet is given: concentration of the test material in the diet, method of adding test material to the diet, source of the rats used, date started, number of rats started in each group, length of experimental period, and survival.

The experiments with "Dow" rats on 2-cyclohexyl-4, 6-dinitrophenol and its compound with dicyclohexylamine were started at the same time using only one group of controls; while the experiments with "B and L" rats on 2,4-dinitrophenol, 4,6-dinitro-o-cresol, and 2-sec-butyl-4,6-dinitrophenol were each started separately, making it necessary to use 3 groups of controls.

All of the rats were weighed twice a week throughout the experimental period. Records were kept of the body weight, general appearance, and estimated average daily food consumption of each animal. Animals that died were examined for gross pathological lesions.

During the course of the experiments, periodic hematological examinations were made on several groups of animals as indicated in Table 6. The following determinations were made routinely: erythrocyte count, hemoglobin concentration, total leucocyte count and differential count.

At the end of each experiment all of the surviving rats were starved overnight, weighed, killed by decapitation, and examined. The liver, kidneys, heart, and testes from each rat were weighed; and tissues from representative animals in each group were saved for histopathological studies. Hematoxylin and eosin stained sections of the following organs were prepared: lung, heart, liver, kidney, spleen, adrenal, pancreas, testis, stomach, and bone marrow. The number of animals examined is given in Table 6.

The concentration of urea-N in the blood was determined at the time of autopsy by the diacetyl monoxime procedure (7) on the rats that received 2,4-dinitrophenol, 4,6-dinitro-o-cresol and 2-sec-butyl-4,6-dinitrophenol.

Bone marrow counts were made on many of the rats which had been examined periodically for hematological changes (see Table 6). The number of nucleated cells per cu. mm. of bone marrow was estimated by the method described by Farrar (8) using a red-blood-cell diluting pipette and 1 per cent acetic acid as the diluting fluid. The total cell count was determined in a similar manner using Hayem's solution (9).

Experimental Results

Growth curves for each group of rats on the diets containing the dinitrophenols and on the controls are given in Figure 1. The length of time that each experimental diet was fed and the survival on each diet are given in Table 6. The average final body weights (after overnight starvation) and the average organ weights of the rats in each group that survived for a period of six months are presented in Table 7, together with the standard error of the mean (S.E.) in each case. The t-test (10) was used in comparing the mean values obtained on the experimental groups with those of the controls; probability values (P) of 0.05 or less indicating a significant difference.

No evidence of corneal opacity, cataract formation, or other pathological changes were found in

the eyes of the rats receiving any of the dinitrophenols included in these studies. The hair of all of the animals on the experimental diets was stained, the intensity of the staining being approximately proportional to the concentration of the test material in the diet. This staining probably accordance with the practice followed in this laboratory of immediately killing every animal showing definite signs of pulmonary or ear infection. In these six-month experiments there was no indication that the mortality rate was appreciably increased by the dinitrophenols in the diets.

TABLE 7

BODY WEIGHTS AND ORGAN WEIGHTS OF MALE RATS THAT SURVIVED FOR SIX MONTHS ON DIETS CONTAINING DINITROPHENOLS

COMPOUND IN DIET		NO. OF RATS	BODY WEIGHT (G.)	LIVER (G.)	KIDNEYS (G.)	HEART (G.)	TESTES (G.)
Name	Concn., (wt. %)		Mean ± S.E.[a]	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.
2,4-Dinitrophenol	0.00	14	314 ± 7	7.86 ± 0.21	2.18 ± 0.05	1.08 ± 0.02	3.18 ± 0.08
	0.01	12	306 ± 7	8.13 ± 0.11	2.36 ± 0.04**	1.10 ± 0.02	3.04 ± 0.17
	0.02	12	314 ± 8	8.31 ± 0.27	2.37 ± 0.08*	1.07 ± 0.03	3.38 ± 0.13
	0.05	9	286 ± 7*	7.89 ± 0.32	2.39 ± 0.12*	1.03 ± 0.02	3.02 ± 0.17
	0.10	14	269 ± 5**	8.08 ± 0.24	2.38 ± 0.07*	1.01 ± 0.02*	3.15 ± 0.12
4,6-Dinitro-o-cresol	0.00	16	300 ± 8	7.78 ± 0.27	2.16 ± 0.09	1.05 ± 0.03	2.85 ± 0.12
	0.002	18	292 ± 8	7.08 ± 0.28	2.00 ± 0.09	1.02 ± 0.03	2.77 ± 0.08
	0.005	20	293 ± 8	7.23 ± 0.25	1.99 ± 0.05	1.00 ± 0.03	2.74 ± 0.09
	0.01	18	304 ± 8	7.55 ± 0.28	2.01 ± 0.06	1.01 ± 0.02	2.58 ± 0.15
	0.02	16	277 ± 7*	6.86 ± 0.22*	1.82 ± 0.05**	0.94 ± 0.03*	2.61 ± 0.07
	0.05	9	247 ± 7**	7.14 ± 0.19	2.09 ± 0.07	0.96 ± 0.04	2.49 ± 0.16
2-sec-Butyl-4,6-dinitrophenol	0.00	21	278 ± 4	7.13 ± 0.14	1.90 ± 0.05	0.95 ± 0.01	2.59 ± 0.06
	0.005	18	286 ± 5	6.83 ± 0.12	1.86 ± 0.04	0.95 ± 0.02	2.69 ± 0.07
	0.01	16	281 ± 5	7.47 ± 0.23	1.90 ± 0.07	0.96 ± 0.03	2.76 ± 0.10
	0.02	17	266 ± 6	7.85 ± 0.24**	2.06 ± 0.07	0.96 ± 0.03	2.67 ± 0.08
2-Cyclohexyl-4,6-dinitrophenol	0.00[b]	14	341 ± 10	9.16 ± 0.42	2.13 ± 0.06	1.01 ± 0.03	2.57 ± 0.09
	0.02	19	322 ± 5	8.88 ± 0.21	2.24 ± 0.06	1.06 ± 0.02	2.59 ± 0.09
	0.05	13	322 ± 12	9.11 ± 0.35	2.22 ± 0.08	1.05 ± 0.03	2.62 ± 0.09
	0.10	11	291 ± 14**	8.97 ± 0.40	1.98 ± 0.08	0.90 ± 0.03*	2.40 ± 0.09
2-Cyclohexyl-4,6-dinitrophenol compd. with dicyclohexylamine	0.00[b]	14	341 ± 10	9.16 ± 0.42	2.13 ± 0.06	1.01 ± 0.03	2.57 ± 0.09
	0.05	13	316 ± 8	9.19 ± 0.33	2.18 ± 0.07	0.98 ± 0.03	2.57 ± 0.08
	0.10	16	314 ± 9*	9.16 ± 0.32	2.29 ± 0.07	1.06 ± 0.02	2.53 ± 0.11
	0.20	12	289 ± 8**	8.75 ± 0.25	2.10 ± 0.05	0.96 ± 0.03	2.43 ± 0.20

[a] S.E. = Standard Error of the Mean.
[b] One control group for both compounds.
* P = 0.05 – 0.01 (as determined by the t-test (10)).
** P = < 0.01

came from contact with the food and apparently did no harm to the animals.

In all of the experiments which lasted for six months, the survival was essentially the same in all groups of rats, controls as well as those on the diets containing the dinitrophenols (Table 6). Most of the deaths, that occurred during the course of these experiments, were shown by autopsy to be due to pulmonary infection. Other rats were sacrificed in

The daily food intake of the control rats and of the rats in the experimental groups that grew equally as well as the controls was found to be from 10 to 20 grams per rat. It may be calculated that these rats, weighing from 200 to 350 grams, ingested quantities of the dinitrophenols of the order of 0.002–0.00054, 0.005–0.00135, 0.01–0.0027, 0.02–0.0054, 0.05–0.0135, 0.10–0.027, and 0.20–0.054 g./kg./day when maintained on diets con-

taining 0.002, 0.005, 0.01, 0.02, 0.05, 0.10, and 0.20 per cent of the test materials, respectively.

No doubt there was considerable individual variation in the quantity ingested depending upon the body weight and food intake of each rat. During the first few weeks on the experimental diets the young rats actually received greater quantities of the dinitrophenols on a g./kg./day basis than later when they were approaching maturity.

The animals that made poor weight gains usually showed an obvious dislike for the experimental diet, ate rather sparingly, and wasted a great deal of the food by pawing and scratching at the hopper; in these cases it was impossible to obtain an accurate estimation of the food consumption.

The hematological examinations which were made during the course of these experiments are indicated in Table 6. In every case, the erythrocyte counts, hemoglobin concentrations, leucocyte counts, and differential counts obtained on the animals receiving the dinitrophenols agreed satisfactorily with those obtained at the same time on their own controls. Similarly, there was satisfactory agreement between the bone marrow counts obtained at autopsy on the rats that had been maintained for six months on diets containing the dinitrophenols and the values obtained on their own controls. Thus, there was no indication that the feeding of diets containing 2,4-dinitrophenol, 4,6-dinitro-o-cresol, 2-sec-butyl-4,6-dinitrophenol, 2-cyclohexyl-4,6-dinitrophenol, or its compound with dicyclohexylamine at the concentrations shown in Table 6 for a period of six months produced any change in the bone marrow or blood picture of male rats. For the sake of clarity, further discussion of the experimental results is given separately for each of the dinitrophenols included in this investigation.

2,4-Dinitrophenol. Rats in the group of 10 animals on the diet containing 0.20 per cent 2,4-dinitrophenol lost weight rapidly and four of them died after seven, twelve, sixteen, and twenty-one days, respectively. The six survivors were killed and examined after twenty-four days on the diet, at which time they were very thin and weak. Gross examination of each animal revealed marked emaciation, an empty gastrointestinal tract, a slightly enlarged, dark spleen and small testes. Microscopic examination showed slight congestion and cloudy swelling of the liver, very slight parenchymatous degeneration of the epithelium of the renal tubules, slight congestion and hemosiderosis of the spleen, and testicular atrophy. No significant pathological changes were observed in the lung, heart, adrenal, pancreas, or stomach. The concentration of urea-N in the blood of these animals averaged 31.7 mg. per cent. It is difficult to distinguish clearly between the ill effects produced in these animals by dinitrophenol and those due to decreased food consumption.

The growth curve of the group of rats that received the diet containing 0.1 per cent 2,4-dinitrophenol fell 10 to 15 per cent below that of the controls throughout the experimental period of six months (Figure 1). The difference between the average final body weight of these animals and that of their controls was highly significant ($P = (<0.001)$). During the course of the experiment these animals showed no discernible ill effects other than slight emaciation. At autopsy, the only changes noted in the experimental group as compared with the controls was a slight depletion of the body fat, a very slight increase in the average weight of the kidneys and a very slight decrease in the weight of the heart (Table 7). Two of the 14 animals examined gave blood urea-N values of 32.8 and 36.6 mg. per cent; the other animals in this group had an average blood urea-N of 21.6 as compared with 19.4 mg. per cent for the controls. No appreciable changes were found upon microscopic examination of sections of the lung, liver, kidney, heart, spleen, adrenal, pancreas, testis, stomach, and bone marrow from these animals.

The growth curve of the group of rats that received the diet containing 0.05 per cent 2,4-dinitrophenol fell 5 to 10 per cent below that of the controls throughout the six-month experimental period (Figure 1). The difference between the average final body weight of these animals and that of their own controls was quite significant ($P = 0.01$). At autopsy the only changes observed in the experimental animals as compared with the controls was a very slight depletion of body fat, and a very slight increase in the average weight of the kidneys (Table 7). Blood urea-N values of 38.2 and 44.8 mg. per cent were found in two of the nine experimental animals. The other rats in this group had an average blood urea-N of 19.5 as compared with 19.4 mg. per cent for the controls. No significant pathological changes were found upon microscopic examination of the tissues.

In the case of the groups that received the diets containing 0.02 and 0.01 per cent 2,4-dinitrophenol, the growth curves were essentially the same as that of the controls throughout the six-month experimental period (Figure 1). During the course of these experiments no discernible ill effects were noted in these animals; and at autopsy the only change observed in the experimental groups as compared with the controls was a very slight increase in the average weight of the kidneys.

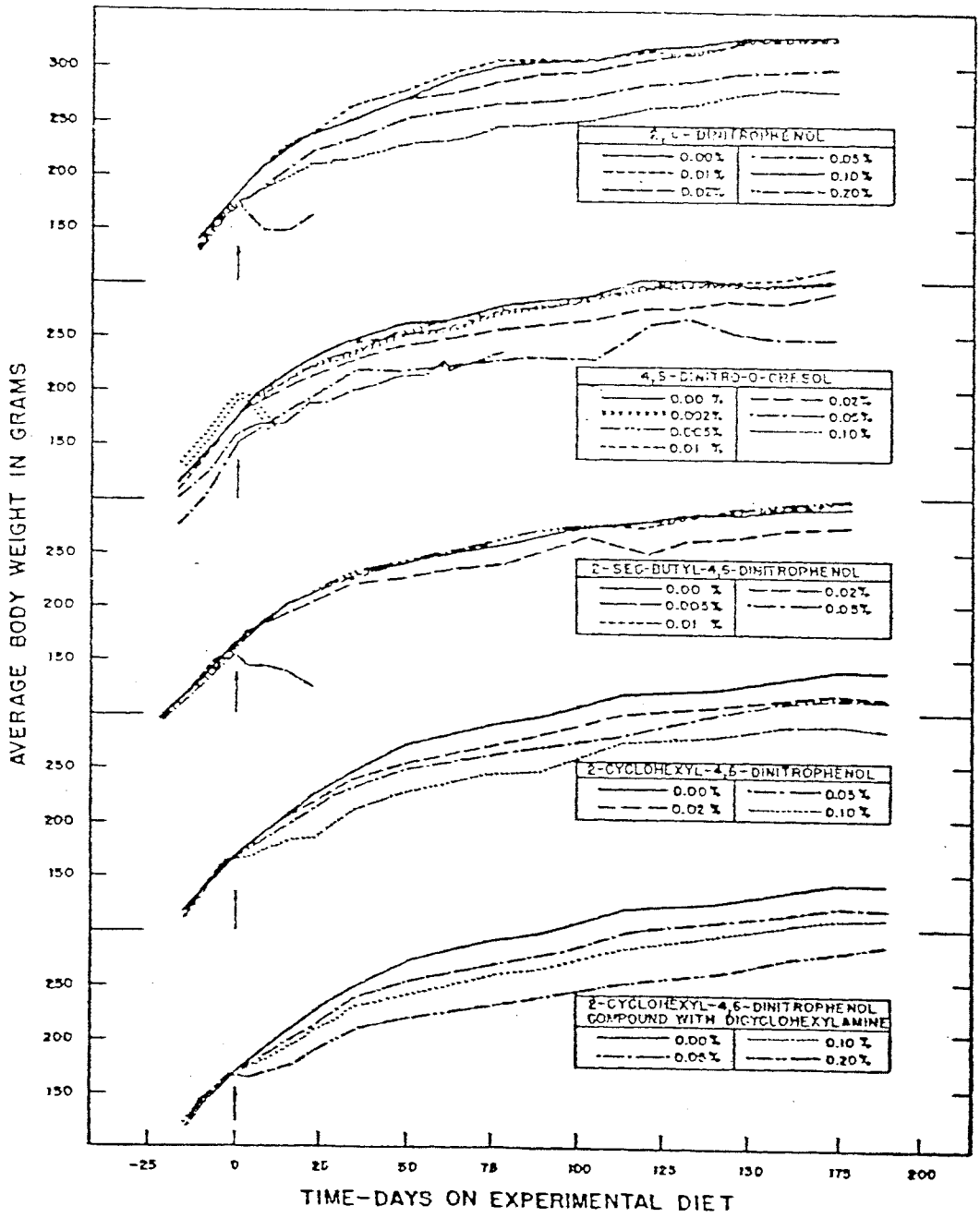


FIG. 1. Growth curves of male rats on diets containing dinitrophenols.

The average blood urea-N was 22.8 and 18.2 mg. per cent for the groups on the 0.02 and 0.01 per cent diets, respectively, as compared with 19.4 mg. per cent for the controls. No pathological changes were found upon microscopic examination of sections of the lung, liver, kidney, heart, spleen, adrenal, pancreas, and testis from these animals.

4,6-Dinitro-o-cresol. The two groups of rats on the diets containing 0.10 per cent 4,6-dinitro-o-cresol, one prepared from the flour concentrate and the other by direct mixing, lost weight rapidly (Figure 1), and appeared weak, hungry, thin and unkempt. The surviving rats were killed on the tenth day of the experiment, since about half of the rats in each group had died by this time (Table 6). Gross examination of each animal revealed marked emaciation, an empty gastrointestinal tract, and a slightly enlarged dark spleen. The average blood urea-N concentration in these rats was 44.4 mg. per cent. Microscopic examination showed cloudy swelling of the liver, very slight degenerative changes in the renal tubules, and slight congestion of the spleen. No appreciable changes were observed in the lungs, heart, adrenals, pancreas or testes. In an experiment such as this, it is difficult to differentiate between the effects produced by the test material and those due to decreased food intake.

Both groups of rats on the diets containing 0.05 per cent 4,6-dinitro-o-cresol made poor weight gains (Figure 1) and appeared hungry, thin and unkempt throughout the course of the experiment. The surviving rats on the diet prepared by direct mixing with 4,6-dinitro-o-cresol were killed and examined after seventy-seven days (Table 6). No appreciable change in the organ weights was noted in these animals. Two of the five rats gave blood urea-N values of 34.4 and 35.0 mg. per cent, the other three an average value of 24.4 per cent. Congestion and hemosiderosis of the spleen was noted in three animals. No appreciable changes were observed upon microscopic examination of the lung, heart, kidney, liver, adrenal, pancreas, testis and stomach. The group receiving the diet prepared from the flour concentrate were allowed to continue on the experiment until the end of the six-month period. At autopsy depletion of the body fat was observed, but no gross changes were evident in the viscera. The average weights of the liver, kidneys, heart, and testes for the experimental animals were essentially the same as those for the controls even though the average body weight of the experimental group was much lower than that of the controls (Table 7). Four of the nine experimental animals showed an average blood urea-N of 30.4 mg. per cent, the other 5 an average of 21.9 mg. per cent. No significant changes were observed upon microscopic examination of the tissues from these animals.

The growth curve of the group of rats on the diet containing 0.02 per cent 4,6-dinitro-o-cresol fell 7 to 9 per cent below that of the controls throughout the experimental period of six months (Figure 1). This depression in growth is probably significant, since a comparison, by means of the t-test (10), of the body weights of the experimental animals with those of the controls at frequent intervals during the 6-month period yielded P values of 0.05 or less in most instances. The general appearance of these animals was good during the course of the experiment and at autopsy there were no evident ill effects; although the average organ weights in the case of the liver, kidneys, and heart were slightly lower than those for the controls (Table 7). The average blood urea-N in this group was 16.1 as compared with 15.8 mg. per cent for the controls. No pathological changes were observed upon microscopic examination of the tissues from these animals.

In the case of the groups that received the diets containing 0.01, 0.005, and 0.002 per cent 4,6-dinitro-o-cresol, the growth curves were essentially superimposed on that of the controls throughout the six-month experimental period (Figure 1). No ill effects were observed in these animals during the course of the experiment or at autopsy. The organ weights obtained on these experimental animals compared favorably with those of the controls (Table 6). The average blood urea-N concentration was 14.0, 17.8 and 18.1 mg. per cent for the rats on the 0.01, 0.005, and 0.002 per cent diets, respectively, as compared with 15.8 mg. per cent for the controls. No histopathological changes were found upon examination of the tissues from these animals.

2-sec-Butyl-4,6-dinitrophenol. The group of 10 rats on the diet containing 0.05 per cent 2-sec-butyl-4,6-dinitrophenol lost weight rapidly and four of the animals died after five, ten, and thirteen days, respectively. The six survivors were killed and examined after twenty-one days on the diet. Examination of these animals showed marked emaciation, an empty gastrointestinal tract and an average blood urea-N concentration of 55.0 mg. per

cent. Microscopic examination of their tissues revealed slight degenerative changes in the renal tubules, and slight cloudy swelling of the liver, but no appreciable changes in the lung, heart, spleen, adrenal, pancreas, or testis. Here again, it is difficult to distinguish between the effects due to the test material and those associated with inanition.

The growth curve of the group of rats on the diet containing 0.02 per cent 2-sec-butyl-4,6-dinitrophenol fell 3 to 8 per cent below that of the controls during the experimental period of six months (Figure 1). This depression in growth is probably significant since a comparison of the body weights of the experimental rats with those of the controls at frequent intervals during the course of the experiment yielded P values slightly below 0.05 in most cases. No discernible ill effects were observed in these animals, either during the course of the experiment or at autopsy. The average blood urea-N was 20.3 as compared with 17.5 mg. per cent for the controls. The organ weights did not vary appreciably from that of the controls except for a slight increase in the weight of the liver (Table 7). Microscopic examination of the tissues from these animals failed to reveal any appreciable changes as compared with the controls.

The growth curves of the groups of rats that received the diets containing 0.01 and 0.005 per cent 2-sec-butyl-4,6-dinitrophenol were superimposed on that of the controls throughout the six-month experimental period (Figure 1). These animals showed no evidence of ill effects either during the course of the experiment or at autopsy. The average blood urea-N concentration in the animals on the 0.01 and 0.005 per cent diets were 20.9 and 17.3 mg. per cent, respectively, as compared with 17.5 mg. per cent for the controls. The organ weights of the experimental animals compared favorably with those of the controls (Table 7); and no histopathological changes were found upon examination of their tissues.

2-Cyclohexyl-4,6-dinitrophenol. The growth curve of the group of rats on the diet containing 0.10 per cent 2-cyclohexyl-4,6-dinitrophenol fell 10 to 15 per cent below that of the controls throughout the six-month experimental period (Figure 1). This depression in growth is quite significant as shown by frequent comparisons of body weights during the course of the experiment which consistently yielded P values much below 0.05. The general appearance of these animals was good and at autopsy there were no evident ill effects other than a slight loss in body fat. The organ weights of the experimental animals agreed well with those of the controls except for heart weights which were slightly lower (Table 7). Slight cloudy swelling of the liver was the only change observed upon microscopic examination of the tissues.

In the case of the groups of rats on the diets containing 0.05 and 0.02 per cent 2-cyclohexyl-4,6-dinitrophenol the growth curves fell 3 to 10 per cent below that of the controls throughout the experimental period (Figure 1). It is very doubtful that this slight depression in growth is significant, since analyses of the body weights at frequent intervals during the course of the experiment yielded values of P below 0.05 in only a few instances; in no case was a P value of less that 0.014 encountered. The organ weights obtained on these animals compared favorably with those of the controls (Table 7). No histopathological changes were found upon examination of the tissues from these animals.

2-Cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine. The group of rats receiving the diet containing 0.20 per cent 2-cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine showed a definite depression in growth throughout the experimental period (Figure 1); their final average body weight falling 15 per cent below that of the controls ($P = <0.001$). Except for slight emaciation, these experimental animals showed no evident ill effects, either during the course of the experiment or at autopsy. Their organ weights compared favorably with those of the controls (Table 7), and no histopathological changes were observed other than slight cloudy swelling of the liver.

The growth curves of the groups of rats on the 0.10 and 0.05 per cent diets fell 5 to 9 and 7 to 11 per cent respectively, below that of the controls during the experimental period of six months (Figure 1). The significance of this depression in growth is questionable since comparisons at frequent intervals of the body weights of the rats on the 0.05 per cent diet with those of the controls gave values of P slightly above 0.05 in most instances; while similar studies on the group receiving the 0.10 per cent diet yielded P values only slightly below 0.05 in most cases, with an occasional value above 0.05. No discernible ill effects were apparent in these experimental animals either during the course of the experiment or from organ weight and

histopathological studies conducted at its termination.

Summary of Feeding Experiments with Rats

Male rats maintained for six months on diets containing 0.01 per cent 2-sec-butyl-4,6-dinitrophenol, 0.01 per cent 4,6-dinitro-o-cresol, 0.02 per cent 2,4-dinitrophenol, 0.05 per cent 2-cyclohexyl-4,6-dinitrophenol, and 0.05 per cent 2-cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine showed no appreciable ill effects as determined by frequent gross observations, growth curves, periodic blood counts, analyses for blood urea-N, organ weights, and histopathological examinations.

Effects that may be attributed to the action of the dinitrophenols as metabolic stimulants were observed in rats that received diets containing greater quantities of these materials. Thus, depression in body weight, chiefly at the expense of body fat, was the characteristic finding rather than appreciable organic injury. No cataracts were produced in any of the rats receiving the dinitrophenols, nor were there any changes in the bone marrow or blood picture.

In the case of each of the dinitrophenols investigated, it is evident that there is very little summation of toxic effects upon prolonged ingestion, as judged by a comparison of the quantity that caused death after a single oral dose with the quantity that produced no appreciable ill effects when administered daily in the diet for a period of six months.

Oral Administration in the Diet for Short Time—Ducklings

In view of the unfortunate human experience with 2,4-dinitrophenol, there have been many attempts to produce cataracts in laboratory animals by the administration of this material. However, all of these were unsuccessful until Robbins (11) found that cataracts formed very quickly in ducklings or chicks following the feeding of a diet containing the sodium salt of 2,4-dinitrophenol.

In order to obtain comparative information concerning the production of cataracts by 2,4-dinitrophenol, 4,6-dinitro-o-cresol, 2-sec-butyl-4,6-dinitrophenol, and 2-cyclohexyl-4,6-dinitrophenol, the following experimental work was undertaken.

Experimental Procedure

Five-day old white Pekin ducklings were purchased from a commercial hatchery, maintained on Purina Duck Startena for about a week, and then started on diets prepared by thoroughly mixing definite quantities of the dinitrophenols with the Startena. The 8 to 10 ducklings in each of the experimental groups were examined frequently for body weight changes, observable ill effects, and particularly cataract formation.

Diets containing the following concentrations of the dinitrophenols were used: 0.25 per cent sodium salt of 2,4-dinitrophenol; 0.25 per cent 4,6-dinitro-o-cresol; 0.25, 0.10, and 0.03 per cent 2-sec-butyl-4,6-dinitrophenol; and 0.25 and 0.10 per cent 2-cyclohexyl-4,6-dinitrophenol.

Experimental Results

The per cent mortality in each experimental group and the incidence of cataracts are tabulated in Table 8.

Within twenty-four hours all of the ducklings receiving the diet containing 0.25 per cent sodium salt of 2,4-dinitrophenol showed bilateral cataracts. This concentration was sufficient to cause considerable retardation in growth and even a few deaths within the experimental period of thirty-five days. Since the appearance of the cataracts and the changes occurring in the eye during the course of the experiment were similar to those reported by Robbins (11), a detailed description is unnecessary.

Similarly, cataracts were produced within twenty-four hours in the ducklings on the diet containing 0.25 per cent 4,6-dinitro-o-cresol. This concentration proved rapidly fatal to the birds.

The ducklings on the diet containing 0.25 per cent 2-sec-butyl-4,6-dinitrophenol died within three days without showing cataracts. Those on the 0.10 per cent diet died within four days with the appearance of cataracts in one animal on the third day. Even at the level of 0.03 per cent in the diet, 2-sec-butyl-4,6-dinitrophenol was not well tolerated, 50 per cent of the ducklings dying within five days; nevertheless cataracts were observed in one bird on the fifth day and in another on the eighth, when the experimental birds were accidentally killed.

No cataracts were observed in the ducklings that received diets containing 2-cyclohexyl-4,6-dinitrophenol. The birds on the diet containing 0.25 per cent of the material died within four days; while

of the ten ducklings that received the 0.10 per cent diet one died on the second day, one on the third, two on the fourth, two on the fifth, two on the ninth, and one on the thirty-eighth, at which time the surviving bird was killed.

Summary of Feeding Experiments with Ducklings

The production of cataracts in ducklings by the administration of the sodium salt of 2,4-dinitrophenol, first reported by Robbins (11), has been substantiated. Furthermore, it has been demonstrated that cataracts can be produced in this species as readily by 4,6-dinitro-o-cresol as by 2,4-dinitrophenol, and only slightly less readily by 2-sec-butyl-4,6-dinitrophenol. On the other hand, cataracts were not produced in ducklings by the administration of 2-cyclohexyl-4,6-dinitrophenol in the diet for as long as thirty-eight days.

TABLE 8

PER CENT MORTALITY AND INCIDENCE OF CATARACTS IN YOUNG DUCKLINGS ON DIETS CONTAINING DINITROPHENOLS

NO. OF DAYS ON DIET	CONTROL DIET		SODIUM SALT OF DINITROPHENOL		4,6-DINITRO-O-CRESOL		2-SEC-BUTYL-4,6-DINITROPHENOL						2-CYCLOHEXYL-4,6-DINITROPHENOL			
	0.00%		0.25%		0.25%		0.25%		0.10%		0.03%		0.25%		0.10%	
	M	C	M	C	M	C	M	C	M	C	M	C	M	C	M	C
1	0	0	0	100	56	100	56	0	0	0	0	0	11	0	0	0
2	0	0	0	100	100		56	0	63	0	20	0	11	0	10	0
3	0	0	0	100			100		88	100	40	0	56	0	20	0
4	0	0	0	100					100		50	0	100	0	40	0
5	0	0	0	100							50	20			60	0
6	0	0	10	100							50	20			60	0
7	0	0	10	100							50	20			60	0
8	0	0	10	100							50**	40			60	0
9	0	0	10	100											60	0
10	0	0	10	100											80	0
15	0	0	10	100											80	0
18	0*	0	30	100											80	0
25			30	100											80	0
30			30	100											80	0
35			40*	100											80	0
38															90*	0

M—Per cent mortality.
C—Per cent of living ducklings with cataracts.
* All surviving ducklings killed.
**Surviving ducklings accidentally killed.

DISCUSSION OF PRACTICAL HANDLING PROBLEMS

The following discussion of the health problems associated with the handling and use of the dinitrophenols is based upon information obtained from experimental work on animals and from extensive field experience in the agricultural use of these materials.

Physiological Action

The predominant physiological action of this class of compounds is that of a metabolic stimulant. This action is the same whether the material is absorbed through the skin or is absorbed following inhalation or oral ingestion. This characteristic physiological effect makes it possible to use the increase in basal metabolic rate as an indication of absorption following exposure. Increased body temperature, profuse sweating, and nausea may also be observed in some cases. A serious effect attributed to 2,4-dinitrophenol following its clinical use was the production of cataracts in some individuals.

Skin Contact

Contact with the dinitrophenols incident to their use in agriculture does not present a significant problem from skin irritation. The rare individual

who is hypersensitive to this class of compounds should not work with these materials.

Neither 2-cyclohexyl-4,6-dinitrophenol nor its compound with dicyclohexylamine are absorbed through the skin to an appreciable extent and, consequently, there is no significant problem of skin absorption associated with the handling and use of these materials.

On the other hand, both 4,6-dinitro-o-cresol and 2-sec-butyl-4,6-dinitrophenol are very readily absorbed through the skin and, therefore, present many problems in safe handling. Strict precautions must be observed in order to avoid contact of the skin with liquid concentrates (greater than 5 per cent) of 4,6-dinitro-o-cresol, 2-sec-butyl-4,6-dinitrophenol, or their salts. Should some of the concentrate come in contact with the skin, it must be removed immediately by very thorough washing of the contaminated area with soap and water. Clothing contaminated with the liquid concentrate must be removed immediately and washed before it is worn again. In some cases, it may be necessary to wear suitable protective clothing in order to avoid skin contact with liquid concentrates of these materials.

The low concentrations (usually less that 1 per cent) of 4,6-dinitro-o-cresol and 2-sec-butyl-4,6-dinitrophenol that are commonly found in diluted sprays ready for field use, should not present a significant handling problem from skin absorption; nevertheless, it is advisable to avoid excessive contamination of the clothing and prolonged wetting of the skin with sprays containing these materials.

Appreciable skin absorption should not result from contact with dusts or dry mixes containing the dinitrophenols, except in the case of preparations containing very high concentrations (above 30 per cent) of 4,6-dinitro-o-cresol, 2-sec-butyl-4,6-dinitrophenol, or their salts. In the handling of such preparations reasonable care should be taken to avoid unnecessary skin contact.

It should be remembered that the staining of the skin by a dinitrophenol compound gives no indication of the quantity absorbed or of the actual hazard involved, but merely shows that there has been some contact with the material.

Inhalation

The systemic toxicity of the dinitrophenols is sufficiently high that any one of them, under certain conditions, may present a health hazard from the inhalation of dusts or sprays. Nevertheless, the practical handling problems presented by preparations containing either 2-cyclohexyl-4,6-dinitrophenol or its compound with dicyclohexylamine are much less serious than those encountered with preparations containing 4,6-dinitro-o-cresol or 2-sec-butyl-4,6-dinitrophenol.

The inhalation of either liquid or dry mix concentrates (greater than 5 per cent) of any of these compounds should be avoided. In some cases suitable respirators may be necessary to afford adequate protection. The low concentrations of the dinitrophenols commonly found in preparations ready for field use should not present a significant problem, although reasonable care should be taken to avoid the breathing of excessive amounts of the dust or spray.

Ingestion

The oral intake of toxic quantities of the dinitrophenols should not present a significant practical handling problem. Persons handling these materials should exercise reasonable care to avoid the contamination of food or anything else that may be taken into the mouth. Care should be taken to wash well before eating.

Disposal of Wastes

The improper disposal of the sludge or residue left after a spraying operation may lead to serious consequences. The ingestion of these wastes by cattle or other livestock must be prevented by adequate safeguards. The careless dumping of such wastes in ponds, streams, or irrigation ditches may be deleterious to aquatic life as well as contaminate the water for other uses.

Residues on Fruits and Vegetables

During the many years that dusts and sprays containing dinitrophenols have been used, no significant health problems have arisen from residues remaining on fruits and vegetables. Under the usual conditions of use, there is ample time for the removal of the residue from the fruit before harvest by volatilization and by the leaching action of rain. In addition, the experimental results reported in this paper indicate clearly that a much greater margin of safety is provided by the use of 2-cyclohexyl-4,6-dinitrophenol or its compound with dicyclohexylamine than by 4,6-dinitro-o-cresol or 2-sec-butyl-4,6-dinitrophenol.

Foliage Treated with Weed-killers

Field experience with the selective weed-killers containing dinitrophenols has shown that when these sprays are used as recommended, livestock may be pastured upon recently treated foliage without evident ill effects. On the other hand, foliage that has been heavily or excessively sprayed with either selective or contact weed-killers may be dangerous; livestock should be kept away from even small areas treated in such a manner.

Summary and Conclusions

Studies on rabbits have shown that none of the dinitrophenols investigated are appreciably irritating to the skin.

Experiments on rabbits and guinea pigs have demonstrated that the following compounds, listed according to decreasing toxicity, can readily be absorbed through the skin in lethal amounts: 2-sec-butyl-4,6-dinitrophenol, 4,6-dinitro-o-cresol, and 2,4-dinitrophenol. On the other hand, neither 2-cyclohexyl-4,6-dinitrophenol nor its compound with dicyclohexylamine is absorbed through the skin to an appreciable extent.

It has been determined by experimental work on rats that all of the dinitrophenols investigated are rapidly acting materials of a fairly high order of acute oral toxicity. The following values for "Survival Dose" and "Lethal Dose," respectively, were obtained for each of the compounds: 2-sec-butyl-4,6-dinitrophenol, 0.005 and 0.060 g./kg.; 4,6-dinitro-o-cresol, 0.010 and 0.050 g./kg.; 2,4-dinitrophenol, 0.027 and 0.100 g./kg.; 2-cyclohexyl-4,6-dinitrophenol, 0.030 and 0.180 g./kg.; and 2-cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine, 0.060 and 0.600 g./kg.

Male rats maintained for six months on diets containing 0.01 per cent 2-sec-butyl-4,6-dinitrophenol, 0.01 per cent 4,6-dinitro-o-cresol, 0.02 per cent 2,4-dinitrophenol, 0.05 per cent 2-cyclohexyl-4,6-dinitrophenol, and 0.05 per cent 2-cyclohexyl-4,6-dinitrophenol compound with dicyclohexylamine exhibited no appreciable ill effects as determined by gross observations, growth curves, periodic blood counts, analyses for blood urea-N, organ weights, and histopathological examinations. Higher concentrations in the diet produced effects that may be attributed to the action of these materials as metabolic stimulants.

In the case of each of the dinitrophenols studied, there is very little summation of toxic effects upon prolonged ingestion, as indicated by a comparison of the quantity that caused death after a single oral dose with the quantity that produced no appreciable ill effects when administered daily in the diet for a period of six months.

Cataracts were readily produced in ducklings by the administration of 2,4-dinitrophenol, 4,6-dinitro-o-cresol, or 2-sec-butyl-4,6-dinitrophenol in the diet; but not by 2-cyclohexyl-4,6-dinitrophenol when fed for as long as thirty-eight days.

A discussion is given of the practical handling problems associated with the use of the dinitrophenols, based upon information obtained from experimental work on animals and from extensive field experience in agriculture. Consideration is given to the health problems that may arise from skin contact, inhalation, or ingestion.

References

(1) Kagy, J. F. and Richardson, C. H.: Ovicidal and scalicidal properties of solutions of dinitro-o-cyclohexylphenol in petroleum oil. J. Econ. Ent., *29:* 52–61, 1936.

(2) Horner, W. D.: Dinitrophenol and its relation to formation of cataract. Arch. Ophth. (Chicago), *27:* 1097–1121, 1942.

(3) Ambrose, A. M.: Some toxicological and pharmacological studies on 3,5-dinitro-o-cresol. J. Pharm. and Exptl. Ther., *76:* 245–51, 1942.

(4) Hrenoff, A. K., and Leake, C. D.: Toxicological studies on 2,4-dinitro-6-cyclohexyl-phenol, a new insecticide. Univ. Calif. Pub. in Pharm., *1:* 151–160, 1939.

(5) Adams, E. M., Irish, D. D., Spencer, H. C., and Rowe, V. K.: The response of rabbit skin to compounds reported to have caused acneform dermatitis. Indust. Med., *10:* Ind. Hyg. Sec., *2:* 1–4, 1941.

(6) Hawk, P. B., and Bergeim, O.: Practical physiological chemistry, Tenth ed., p. 692. P. Blakiston's Son and Co., Inc., Philadelphia, Pa., 1931.

(7) Barker, S. B.: The direct colorimetric determination of urea in blood and urine. J. Biol. Chem., *152:* 453–463, 1944.

(8) Farrar, G. E., Jr.: The concentration of nucleated cells in the bone marrow of the albino rat. Am. J. Physiol., *117:* 662–4, 1936.

(9) Kracke, R. R.: Diseases of the blood, 2nd ed., pp. 655–656. J. B. Lippincott Co., Philadelphia, Pa., 1941.

(10) Fisher, R. A.: Statistical methods for research workers. Oliver and Boyd, London 1938.

(11) Robbins, B. H.: Dinitrophenol cataracts: Production in an experimental animal. J. Pharm. and Expt. Ther., *80:* 264–267, 1944.

Updated 5.31.07 (Years changed to YR-0 format). Updated 12.12 with new facts. Updated 4.13 by CHC.

Updated 11.24.14 by RGL Forensics