IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF PENNSYLVANIA
HARRISBURG DIVISION

TAMMY KITZMILLER, et al.,	:	CASE NO.
Plaintiffs	:	4:04-CV-02688
vs.	:	
DOVER SCHOOL DISTRICT,	:	Harrisburg, PA
Defendant	:	3 November 2005
.....	:	1:00 p.m.

TRANSCRIPT OF CIVIL BENCH TRIAL PROCEEDINGS
TRIAL DAY 21, AFTERNOON SESSION
BEFORE THE HONORABLE JOHN E. JONES, III
UNITED STATES DISTRICT JUDGE

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I N D E X
Kitzmiller vs. Dover Schools
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PROCEEDINGS

DEFENSE WITNESSES

P R O C E E D I N G S

THE COURT: Be seated, please. All right, good afternoon to everyone. We have the first witness then of the afternoon.

MR. MUISE: Your Honor, I know there was a discussion during the lunch break over the exhibits, and if we perhaps maybe could move for those admissions, I believe there's no objections on any of the exhibits.

THE COURT: Do you want to do them now? All right, sure.

MR. MUISE: So it might be worthwhile to get that housekeeping measure taken care of.

THE COURT: All right, I'll just read the numbers and not describe them if you think there's no objection, and you can for the sake of speed, D-4, D-5, D-7, D-9, D-10, D-19, actually these are all defendant's, 20, 21, 24, 25, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 54, 164, 284, 286, 287, 85, 86, 100, 116. What did I miss on the defendant's exhibits?

MR. MUISE: I believe that's the complete list. I don't think Mr. Gillen reviewed --

THE COURT: Say again? I'm sorry.

MR. MUISE: Yes, I believe that was the complete list, Your Honor. That's all the exhibits.

MR. ROTHSCHILD: Your Honor, you said 285, and I didn't have that on my list. So --

THE COURT: No, if I said it I misspoke. 284 and 286. If I said that I misspoke.

MR. ROTHSCHILD: And then I thought there was an Exhibit 50, and I don't remember what it is, but I have that on my list.

THE COURT: What is D-50? Why don't we check?

MR. ROTHSCHILD: D-50 is --

COURTROOM DEPUTY: It's already in. It's already in.

MR. ROTHSCHILD: My mistake. Thank you.

THE COURT: You got to get up pretty early to keep up with Liz, Mr. Rothschild.

MR. ROTHSCHILD: 5:20 this morning, Your Honor.

THE COURT: Anything else? Any objections?

MR. MUISE: That's it, Your Honor.

MR. ROTHSCHILD: No objection.

THE COURT: All right, they're all admitted the. Cross, P-817, P-91, and P-179. Any

additional exhibits that I've missed? And are you moving for those, or are you moving those in I should say.

MR. ROTHSCHILD: Those we are moving in, and if you could just give me just one moment, I believe that's everything.

(Brief pause.)

MR. ROTHSCHILD: That's it, Your Honor.

THE COURT: All right. No objection? All right, then they're admitted as well. All right. Having covered that, we're ready.

MR. MUISE: Thank you, Your Honor. Defendants call Dr. Scott Minnich.

(Dr. Scott Minnich was called to testify and was sworn by the courtroom deputy.)

COURTROOM DEPUTY: State your name, and spell it for the record, please.

THE WITNESS: My name is Scott A. Minnich. S-C-O-T-T, middle initial A, M-I-N-N-I-C-H.

DIRECT EXAMINATION BY MR. MUISE:

Q. Good afternoon, Dr. Minnich.

A. Good afternoon.

Q. Your Honor, may I approach?

THE COURT: You may.

(Brief pause.)

Q. Dr. Minnich, I've just provided you with two binders. One of them is a black binder marked as exhibits, which have some of the exhibits that we'll be using for the course of your testimony to assist you in your reference. In the blue binder is a copy of the demonstrative exhibits that we'll be using through the course of your testimony again to assist you from the witness stand. Sir, where do you reside?

A. In Moscow, Idaho.

Q. And, sir, I'd ask you if you could please open up that exhibit binder, the black binder if you could, to Exhibit 201-A, as in Alpha. It should be under Tab 1?

A. Got it.

Q. Is that a copy of your curriculum vitae, sir?

A. It is. It's an abbreviated form for a grant that was submitted.

Q. I want to, I want you to refer to it as we go through some of your background and qualifications to give expert opinions in this case. Sir, what is your profession?

A. I'm an associate professor at the

University of Idaho in microbiology.

Q. Are you a tenured professor?

A. I am.

Q. And you said you teach at the University of Idaho?

A. Correct.

Q. How long have you taught there?

A. Since 1989.

Q. Where else have you taught?

A. I was at Tulane for a year previous to that.

Q. And what subjects have you taught at the University of Idaho?

A. General microbiology for undergraduate majors. Food microbiology, molecular genetic techniques. I currently teach a 600 level course, six credit course in infectious disease for first year medical students.

Q. And what other subjects do you presently teach?

A. Infectious disease and general microbiology.

Q. You've been teaching science at the college and graduate level for approximately eighteen years, is that correct?

A. Correct.

Q. You said you're a microbiologist. Could you explain for us what it is that you do as a microbiologist?

A. Well, the primary focus is microorganisms, in my particular case pathogenic organisms or infectious disease agents. All the biological sciences, you know, the disciplines have kind of bled together. So we do molecular biology, biochemistry, and are even doing a little bit of cell biology, but primarily molecular genetics is my bread and butter.

Q. And how would that different at all with say a biochemist?

A. Again, you know, those are somewhat artificial distinctions. I mean, we're more focused at genetic programming of organisms and how they respond to their environment, biochemists may be looking at specific, you know, organelles or suborganelles and how they're assembled, and we do a little bit of that as well.

Q. How would a microbiologist then differ from a cell biologist?

A. A cell biologist is looking at more global

effects, you know, cell responses, involves generally a lot of microscopy, and we don't do a lot of that.

Q. And I know during the course of your testimony we're going to be using some difficult scientific terms and so forth, so I would ask if you could, we need to speak slowly and loud and clearly so our court reporter here can do his best job taking all this down, okay?

A. I'll do my best.

Q. What is the name of the department that you teach in at the University of Idaho?

A. My department is microbiology, molecular biology, and biochemistry.

Q. Does that department then include all three of those disciplines that we discussed, cell biologists, biochemists, and microbiologists?

A. Correct.

Q. Now, sir, in your work and in your profession do you conduct experiments?

A. I do.

Q. What is the focus of your experimental work?

A. Right now we're focused on I'd say the discipline of host parasite interactions.

So we work on bacterial infectious agents and how they adapt during the infectious process.

Q. Does that focus on the bacterial flagellum and the type three secretory systems?

A. It is. We've worked on that for the last ten years in terms of these are two systems that in our organism the genus Yersinia have opposing regulations. So outside the host the cells build a flagellum. Once they inspect a mammalian host, flagellum biosynthesis is turned off and you turn on the weapons systems that these organisms have. So we've used those two aspects kind of as opposing markers to follow regulatory events.

Q. So the focus of your experimental work, I assume also the focus of your research, and that would include the bacterial flagellum and the type three secretory systems?

A. Correct.

Q. Sir, do you incorporate intelligent design into your experimental and research work?

A. I think the principles of intelligent design are what we would call reverse engineering would be, you know, a very prominent part of what we do.

Q. And we're going to get into a little bit more detail about that later in your testimony. Sir, I want to talk about your education. What degrees do you hold and where did you get them from?

A. I have an undergraduate degree, a BS in bacteriology and public health from Washington State University.

Q. What year was that, sir?

A. Good question. 1975.

Q. If you want to look at your CV to help refresh --

A. Okay.

Q. Okay, go ahead.

A. I obtained a masters degree in microbiology from the University of Idaho, and a Ph.D. from Iowa State University in 1981 in microbiology.

Q. Now, when you got your Ph.D. in microbiology, what was the dissertation that you wrote?

A. My research dissertation was on the development of a rapid immunoassay for the detection of salmonella. So it was really the first application of enzyme immunoassays, which are kind of a standard diagnostic procedure now,

to detecting salmonella.

Q. Would you give us a thumbnail sketch of what this was about?

A. Yeah, it's an antibody based assay, and our goal was to make something that was very rapid. So the problem that we had, you know, particularly in the food industry that it could take up to a week using conventional microbiological techniques to verify, detect and verify that salmonella was present. This was a rapid screening procedure that reduced that time period to about 24 to 36 hours. So for the food industry there was, you know, incredible savings in terms of warehousing costs before food is released. The FDA has zero tolerance with respect to salmonella in foods. So the test was developed as a prototype as a graduate student, and then through the next four years it was commercialized and applied to the food industry. Variants of that procedure are still used today.

Q. You got to see your work go from the inception of an idea through the experimental all the way to the commercialization of the idea?

A. Correct.

Q. Did this work also include work on the bacterial flagellum?

A. It did, because the antibodies we were using were directed against the flagellar filament, which is distinctive for the salmonella. We had to have an assay that incorporated the detection of over 2,400 different what we call serotypes, or variants, of salmonella.

Q. Sir, do you belong to any professional memberships?

A. I do. I'm a member of the American Association for the Advancement of Science and the American Society for Microbiology.

Q. I want to talk about some of you, we have listed here positions and honors. That's how you have it listed in your CV. You were on a sabbatical from October of 2003 to May of 2004, is that correct?

A. That's correct.

Q. And for what purpose?

A. I was a subject matter expert for the Defense Intelligence Agency in Iraq. So I served with the Iraq Survey Group looking for

weapons of mass destruction.

36 Q. What was the purpose of the need for a microbiologist to be part of this survey group?

A. Well, that was the focus of the Iraq Survey Group based on the intelligence that Iraq had reestablished both their chemical and biological weapons, or their nuclear, but we weren't part of that aspect, but their programs. So our job was to travel around the country and look for these materials.

37 Q. How were you selected for that position?

A. I had a phone call in September of 2003, actually August of 2003, asking if I had any students in my laboratory that had military experience. In part because we're registered with the Center of Disease Control to work with select agents, and that requires now with the new regulations after 9/11 that everybody in my laboratory has FBI clearance, and so I think we were on a checklist of people that worked with organisms that were of concern and, you know, my remark was no, I didn't have any students that fit that category, but in subsequent conversations, you know, I was intrigued by the idea, and volunteered.

Q. And why did you volunteer?
A. I volunteered because I grew up in a military family. Both my father and father-in-law are West Pointers, and it's an area that I'm very interested in. Obviously, I mean, it's work that we do, and it was an opportunity to do field work and serve my country at the same time.
Q. Sir, you said you've been teaching at the University of Idaho since 1989 in microbiology, correct?
A. Right.
Q. Is that correct?
A. That's correct.
Q. You also were a post-doctoral fellow at Princeton University from 1984 to 1987, is that correct?
A. That's correct.
Q. Could you tell us what that was?
A. This was after my doctorate, working in a laboratory, the primary focus was developmental regulation of flagellum biosynthesis, and one of the model organisms for this system, caulobacter crescentus.
Q. So during this period of research you

worked on flagellar biosynthesis, is that correct?

A. That's correct.

44 Q. And you also were a post-doctoral fellow at Purdue University from 1981 to 1983, is that correct?

A. That's correct.

45 Q. And what did you do there?

A. There I was working in a molecular genetics laboratory. The project focused on cloning and studying the regulation of a toxin made by bacillus thuringiensis. So that sounds kind of esoteric, but this is the BT toxin that was put into plants by Monsanto. So really the first application of genetic engineering in agricultural crops. So we cloned the gene, studied its regulation, we handed it over to Monsanto, it was modified, put into maize, soybeans, you name it, cotton.

46 Q. Now, when you were at Purdue University doing this work did you also engage in any collaborative efforts with other faculty at Purdue University?

A. Yes. There was an individual in the food science department, Dr. Swaminathan, that had

worked on for years on salmonella detection. We knew each other's work, so we started collaborating. And I actually took my graduate work ideas that he had as well and took our assay to the next level. So it was a very profitable interaction. Dr. Swaminathan I think is just retiring this year as branch chief for enteric disease at the Center for Disease Control.

47 Q. During that collaborative effort did you work on the bacterial flagellum?

A. We did. Again this was the focus of what we called the antigen that we were trying to detect.

48 Q. Now, you've published articles in peer reviewed science journals, is that correct?

A. I have.

49 Q. Approximately how many?

A. 25 to 30. I'm missing a few on here, but --

50 Q. And what are some of the journals that you've published in?

A. Proceedings of the National Academy of Science, Journal of Molecular Biology, and Molecular and Microbiology, and Journal of

Bacteriology, which are really the primary journals for what I work on. Applied Environmental, there are a few others.

51 Q. Has there been a focus of your peer reviewed science journal articles?

A. Over the last ten years we've focused on flagellum biosynthesis and type three secretory system regulation and pathogenic organisms.

52 Q. And again this is the focus of your experimental work?

A. Correct.

53 Q. Through your experiments, your research, and your writings have you become familiar with the scientific evidence as it relates to Darwin's theory of evolution?

A. I have.

54 Q. Would it be fair to say that your focus is principally on the molecular level?

A. Correct.

55 Q. So you're a fellow with The Discovery Institute, is that correct?

A. I am.

56 Q. And what does that mean?

A. My name is on one of their web pages listed as a fellow. So it's more of a networking

opportunity, you know, for people that are interested in this area of intelligent design.

57 Q. Are you an employee of The Discovery Institute?

A. No. No, I'm not.

58 Q. Do they have any control over the work that you do?

A. None whatsoever.

59 Q. Do they direct your work?

A. No.

60 Q. So is it fair to say that you're not on The Discover Institute payroll?

A. I'm not.

61 Q. Has anyone ever accused you of that?

A. Yeah, there was an incident in 2003 in May when Robert Pennock was invited to give a seminar --

MR. HARVEY: Objection. Relevance, hearsay.

MR. MUISE: Your Honor, we'll all say we've been hearing a lot of testimony today, or throughout the course of this trial, vilifying Discovery Institute, you know, talking about this grand agenda. Some of it's been expressed by their experts. I'm going through his qualifications and I'm just demonstrating that

a lot these accusations aren't true, that these are independent scientists who are working on this for scientific reasons.

THE COURT: But he's not being offered to defend The Discovery Institute.

MR. MUISE: That's correct, Your Honor, but the fact is in terms of his, in terms of his background and qualifications, I mean this is how they've been really vilifying these individuals --

THE COURT: I say again, I understand that, and in another time and in another place he might be competent to talk about how as a fellow The Discovery Institute ran into some difficulties, but for today I think it's stipulated, his credentials are stipulated to, and now we're going to get sidetracked on why his bona fides as a fellow at The Discovery Institute were called into question, and I just don't think that's relevant. I understand, it is not central or necessarily important to me that we engage in an independent debate on The Discovery Institute. It's just not helpful to me, and I'll tell you that. So why don't we proceed. I'll sustain the objection.

BY MR. MUISE:

62 Q. Sir, you're an advocate for intelligent design?

A. I am.

63 Q. Is Darwin's theory of evolution inconsistent with your private religious beliefs?

A. No.

64 Q. Do you have a religious equipment to intelligent design?

A. I don't.

65 Q. Why did you get involved with intelligent design?

A. I read Mike Behe's book soon after it was published, and of course he uses the bacterial flagellum as a paradigm for, you know, his term irreducible complexity, and I had arrived at some of these same conclusions. So it intrigued me, there was a friend I had in the physics department that was interested in these questions as well. So I think together we started looking into these questions and what intelligent design was and what it claimed, and so it kind of blossomed from there.

66 Q. So how long have you been involved with

or associated with intelligent design?

A. Probably since about 1997, `98, or so.

67 Q. Have you ever been involved with creationism or creation science?

A. No.

68 Q. Why not?

A. You know, I'm old enough that I was around during those debates, and I never participated because I don't agree with the approach. I don't think you mix religion with your science. I don't think you use Genesis as a filter of how you interpret your scientific data, you know, empirical evidence.

69 Q. So what is your commitment then to intelligent design?

A. I think it fits. I think it's a good paradigm. We can discuss that as we go through some of the slides, but it's consistent with the empirical evidence and standard scientific reasoning that we employ.

70 Q. Do you perceive efforts on the part of opponents of intelligent design to equate intelligent design with creationism?

A. I think there is. You know, often times when it's mentioned in the press it's referred

to as intelligent design creationism, anti-evolutionism, you know, these types of terms are often equated, and I think that's a misrepresentation.

71 Q. Sir, is there unanimity amongst biologists regarding all aspects of Darwin's theory of evolution?

A. No, there isn't.

72 Q. Is intelligent design different in that respect?

A. No. There's a broad spectrum of people in terms of, you know, how they interpret the data.

73 Q. Does intelligent design continue to develop?

A. Yes. I mean, it's I think developed quite a bit since my involvement, and maybe if you trace it back to the early 90's.

74 Q. Now, sir, you testified that you authored numerous peer reviewed articles, many in scientific journals, and I believe you testified the one area in which you published the most was on the topics of molecular biology and in the past ten years specifically the bacterial flagellum and the type three secretory system. Is that fair?

A. Correct.

75 Q. Have you authored any articles appearing in peer reviewed science journals that make intelligent design arguments?

A. Not directly.

76 Q. You say not directly. Are there articles that provide support for intelligent design arguments that you've published?

A. I think so. I think all of them do. I think they're, you know, dissecting intricate components of subcellular organelles that support the general contention of irreducible complexity and design.

77 Q. I want to ask you if you agree with this testimony that was provided by Dr. Miller. He testified that, "It is a standard scientific practice for scientists to point to the scientific literature, to point to observations and experiments that have been done by other people in other laboratories, have been peer reviewed, have been published, and to cite to that evidence, cite to those data, and to cite to those experiments in their arguments." Do you agree with that?

A. I agree with that. That's standard

practice in scientific, you know, endeavors.

78 Q. And is that what intelligent design is doing?

A. Yes.

79 Q. This is something that scientists do routinely?

A. Oh, yes. It's critical.

80 Q. I want to ask you if you also agree with Dr. Miller that the question is not whether you or any other scientists have done experiments in your own laboratories that have produced evidence for a particular claim, the question is whether or not the inference that you or other scientists drawing your analysis from that data are supported. Do you agree with that?

A. I do. I think, you know, that's part of the scientific endeavor. I mean, either you're doing your own experiments and the data that you generate you try to fit into the general knowledge that's available, whether it's consistent or inconsistent, and you can look at other people's data through this published and view it perhaps from a different perspective and come up with a new interpretation. And

that's standard. I think Watson and Crick are examples of that in terms of doing minimal experiments, but at the same time taking information from various sources and melding it into an explanatory model, and so that can be profitable.

81 Q. Explain for us what you -- you mentioned Crick and Watson. What are you referring to?

A. Well, the fact that, you know, they really didn't do any wet lab experiments. They took Shordhop's work from Columbia University, Rosalyn Franklin's x-ray crystallography data coordinate in terms of the structure of nucleotides and built models and came up with a double helical structure, so --

82 Q. And those are the two that received the Nobel prize for --

A. Right.

83 Q. -- developing the architecture I guess of the double helix, DNA?

A. Right, solving instruction.

84 Q. Now, is this method, this process, is this what intelligent design advocates are engaged in?

A. Well, I don't want to equate it with, you

know, in terms of something that is critical as a double helix, but at the same time we're looking at across the landscape of empirical data and asking the question does it fit with the Darwinian mechanism of mutation and natural selection to generate, you know, the deep diversity of life.

85 Q. Now, you testified previously that you though do experiments that you believe supports intelligent design?

A. I do. I do.

86 Q. Are there peer reviewed articles that make arguments for aspects of intelligent design that you're aware of?

A. I think there are around ten of them now that are in the literature that address this, I'm not sure of an exact number, but within the last couple of years.

87 Q. Do you perceive a bias against publishing intelligent design articles in science journals?

A. I think there's --

MR. HARVEY: Objection, Your Honor. Speculation.

MR. MUISE: I'm asking for his perception, Your Honor.

THE COURT: I think it's a fair question. I'll overrule the objection. You can answer.

THE WITNESS: I think that's on public record, there's a paper published by a journal from the Smithsonian Institute last summer by Stephen Meyer. Brixter and Berg was the editor, and I think it was a --

MR. HARVEY: Your Honor, objection. Hearsay. He has no firsthand knowledge of it.

THE COURT: Well, the question was a yes or no question. The answer was yes. That was accepted. The objection was overruled on that basis. If he gets into the particulars he may be getting into hearsay.

MR. MUISE: But he testified as to perception. If he has an understanding, he said it's a public record. I mean, you're saying that --

THE COURT: A newspaper article is not a public record, and you've certainly argued vigorously in this case that it's not, and we've spent a lot of time on that. Mr. Muise. You want to tell me now it's a public record? We can spare a lot of argument tomorrow if it

is.

MR. MUISE: Your Honor, I mean, a public record not in the sense of I think the term that you're using with the hearsay.

THE COURT: No, it's not in the way that I'm using it. It's the way that we've argued it. Don't insult my intelligence. It's not. The objection is sustained.

MR. MUISE: I understand, Your Honor. And I certainly did not intend to convey any message that I was --

THE COURT: I understand that. Let's keep going. Proceed.

BY MR. MUISE:

88 Q. Sir, you authored an article entitled Genetic Analysis of Coordinate Flagella in Type Three Regulatory Circuits and pathogenic Bacteria, correct?

A. I did.

89 Q. And was this article published?

A. It was published in the proceedings of a meeting in 2004.

90 Q. And who was it published by?

A. The Wessex Institute. It's an institute of higher education in the U.K.

Q. It's not a religious organization?

A. No.

Q. This article was part of a conference, is that correct?

A. That's right. It was a conference titled "Design In Nature II" that was held in Rhodes, Greece in July of that year.

Q. And what was this conference about?

A. The conference I think would fit under the broad category of a new area in science called biomimetics where engineers, architects are brought together with biologists to, as a mechanism of cross fertilization. Engineers are recognizing that biological systems have solved some pretty difficult problems, and so there's a lot in terms of nanotechnology structural analysis that can be gleaned from biological systems.

Q. Do you consider this article to be an intelligent design article?

A. Primarily it's a review of our work looking at coordinate regulation in type three systems, but there's a section where I address intelligence aspects of it.

Q. Who attended this conference? I believe

you said there were engineers and scientists?
A. Biologists, engineers, design engineers, aircraft engineers, architects.
96 Q. Was this a creationists conference?
A. No.
97 Q. Now, this article that was published by the Wessex Institute, was it peer reviewed?
A. There was, you had to submit the paper before it would be accepted or before you could provide or present it at the conference. So I actually wrote that when I was in Baghdad, communicated it by e-mail, and it was peer reviewed, I'm not sure what the peer review is, it's not as rigorous as, you know, a primary journal article, but there is that process.
98 Q. Could you just briefly explain for us what this article is about? We're going to be talking about it in more detail later in your testimony, but if you could just give us sort of a thumbnail sketch?
A. Well, it looks at the work that we've been involved with why bacteria repress motility in a mammalian host environment and how they activate type three secretion systems and why these systems are segregated. It also addressed

the question that had come up in these debates on intelligent design that the type three secretory system represented a structural intermediate for the flagellum, and Ken Miller has published on this. And so there were arguments against that position in particular.

99 Q. Did this conference demonstrate the utility of intelligence design as a scientific theory?

A. I think so, in terms of our approach and what we found out.

100 Q. How so?

A. Well, again the types of the questions we asked looking for reasons why these two systems would be regulated in an opposing manner, the reverse engineering techniques that proved profitable. We also, although I don't want to bore everybody with the details, but in part to me the most interesting aspect is that one of the organism we work with, yersinia pestis, which causes the bubonic plague, so this is an organism that's estimated to have killed two hundred million people in recorded history, activates its virulence genes by temperature.

So we were interested in terms of what's the thermostat, how does the cell sense

temperature and how does it shut genes off and turn others on, and it turned out through a genetic approach mutational analysis that the trigger, from one sense you can look at this almost as kind of dissecting the trigger of a nuclear weapon in terms of its potential effect, turned out to be DNA itself, which was a surprise to us.

It told us that the DNA molecule is just not a reservoir for digital information, but the three-dimensional structure that it can conform to under different environments imparts information as well, and that was a surprising observation and I think we did that by reverse engineering and looking at temperature parameters of DNA molecules.

101 Q. Sir, are you familiar with the book Of Pandas and People?

A. I am.

102 Q. Did you contribute to any portions of this book?

A. I did not.

103 Q. Are you aware of any prior drafts of this book?

A. No.

104 Q. I take it then you didn't contribute to any prior drafts of the Pandas book?
A. I didn't.
105 Q. Sir, is it your understanding that this book Pandas is part of the controversy in this lawsuit?
A. I'm aware of that.
106 Q. What is your understanding of how this book will be used at the Dover High School?
A. It's mentioned in a short statement read to students before the, to biology students, 9th grade biology students, and it's also on deposit or reserve or in the library as, you know, a reference in the library.
107 Q. Now, this book was published in 1993, correct?
A. That's correct.
108 Q. Would you recommend that it be used as the primary text for a biology class?
A. No, I would not.
109 Q. Why not?
A. Well, it's not a primary biology text, and I think that's stated in the introduction.
110 Q. And the other reason?
A. Well, it's outdated as well. It's an old

book. I mean, in the course of biology ten years is light years now in terms of our progression.

111 Q. Would you recommend that it be used in the manner that Dover High School is using it?

A. I do.

112 Q. Do you have experience with this book being used in a biology course at the high school level?

A. I do. I had children that attended private school in Moscow, Idaho. Being a scientist they asked me to review their biology curriculum. They had, you know, a curriculum that I thought was inadequate. I recommended that they use Miller and Levine, which I think is the same book that's being used in Dover, and supplement it with Pandas and People.

113 Q. What year was this?

A. I'm not sure exactly. I'd say `95 or `96.

114 Q. Are they still using the Pandas book?

A. They still have it. In fact, I got a copy from them.

115 Q. Why did you recommend Pandas as a supplement?

A. It addresses some of the aspects of

Darwinian evolution from a different perspective in terms of the fossil record, in term of other interpretations of homology, molecular aspects. There was I think in this book a brief introduction to, although not stated, but irreducible complexity, the blood clotting system, that Mike Behe contributed.

116 Q. Did you think it was beneficial for the students to have exposure to this book?

A. Yes. I think any time you expose students to, you know, different interpretations it's good. It promotes critical thinking.

117 Q. Have you subsequently had any experience with these students from this school since recommending this curriculum change?

A. Two of the students came through our department and have since graduated, and they were excellent students. Both of them I think had published peer reviewed papers by the time they had finished their undergraduate degrees, which is an outstanding achievement for undergraduates.

118 Q. Do you have any way of assessing their critical thinking skills compared with other students?

MR. HARVEY: Objection, Your Honor. Beyond the scope of the expert report. I have not objected for a few questions here, figuring a little latitude is appropriate, but it's clearly not the area with which he's been proffered and the content of his expert report.

THE COURT: Mr. Muise?

MR. MUISE: I'm going to move on, Your Honor. I think what it's establishing is obviously with regard to his expertise from the perspective of science education. I haven't proffered him obviously yet as an expert.

THE COURT: Well, just the critical skills of the students who would have, along with his own child --

MR. MUISE: I'm sorry, Your Honor?

THE COURT: Whose critical skills are we talk about?

MR. MUISE: The students'.

THE COURT: The students in his own child's class?

MR. MUISE: No, these are students who have gone through this biology course where the curriculum included Pandas as part of the

supplemental books, and --

THE COURT: That would appear to be beyond the scope of this report. I think you can probably concede that point.

MR. MUISE: Well, in the report he specifically talks about Pandas being a good book and it promotes good science education.

THE COURT: If I recall the testimony correctly, correct me if I'm wrong, sir, this is a school that your child attends and they use Pandas as an ancillary resource?

THE WITNESS: Right. I mean, my children have since graduated, but --

THE COURT: But when they were there they used it?

THE WITNESS: They did, right.

THE COURT: I don't know what basis he could judge -- well, I do know the basis he could judge, but it does appear to go outside the report, Mr. Muise. Unless you can, if you can point me to something in the report, and it's a long report, if there's something in there that you want to hang your hat on, I'll listen.

MR. MUISE: Well, it's not just the report.

He was asked about these same questions during his previous deposition, and on his report he said, "I read and am familiar with the text of Pandas, it's a good text, it critically analyzes various aspects of Darwin's theory, it asks critical questions in terms of the evidence and mechanism required to drive evolution. Such questions are essential for the advancement of science, makings students aware of the controversy in the science community, it's good to students and it's good to science."

COURT REPORTER: Mr. Muise? Mr. Muise?

THE COURT: Yes, we have lots of time. Slow your cadence down if you could.

MR. MUISE: Your Honor, I mean I can, I think I've got through the testimony of the part that I wanted to and I can move on to the next --

THE COURT: Well, that may be a fair question once we get out of the -- we're still on qualifications, are we not?

MR. MUISE: We are.

THE COURT: All right. Why don't you -- I'll reserve judgment. If you want to come back around and lay a foundation for that question

on your examination, I'll hear any objection Mr. Harvey has at that time. So why don't we move on. I'll sustain it, but with needs to reassert it, I think there's maybe a foundational problem with the question, too, but that wouldn't stop you necessarily from asking it under different circumstances.

BY MR. MUISE:

119 Q. Dr. Minnich, do you think that schools should teach students the theory of evolution?

A. Absolutely.

120 Q. Why?

A. It's critical. I mean, it's critical to biology to have a firm foundation in evolution.

121 Q. By advocating intelligent design is it your goal to not have the theory of evolution taught in a biology class?

A. Not at all.

122 Q. Has that ever been your goal?

A. No.

123 Q. At this point do you believe that intelligent design should be fully integrated into a science curriculum?

A. I don't.

124 Q. Why not?

A. Well, you've got an old textbook and you lack the standards for teachers and assessment for students.

125 Q. You think it's appropriate to supplement the science curriculum by making the students aware of intelligent design as Dover has done in this case?

A. Yes, I think it's advantageous.

126 Q. There's one last area on your CV I want to address, and that's the research support.

A. Correct.

127 Q. What is significant about research support for a scientist?

A. Well, to be successful and to do experiments you've got to have extramural support and, you know, it's to be likened to running a small business within a research community. You know, I have to pay my graduate students, technicians, pay for supplies, animal care, and there's overhead associated with it as well. So funding is very important.

128 Q. Have you been awarded any significant grants?

A. Well, right now we have an NIH grant for five years for, with myself and two

collaborators, for 1.8 million dollars.

129 Q. And what is significant about NIH grants?

A. Well, I mean for infectious disease that's the primary source for funding. It's competitive.

130 Q. Now, the research that you're being funded by NIH, does that include research on the flagellum and the type three secretory system?

A. It does.

MR. MUISE: Your Honor, may it please the court, I tender Dr. Scott Minnich as an expert in microbiology, evolution, intelligent design, and science education.

MR. HARVEY: Your Honor, I don't believe this expert was proffered previously in science education, and I'm not aware of that. His reference in the expert report to Pandas and People being good science, and his general statement about it being good to make students aware of the controversy, but there's no reference to an expert in science education.

MR. MUISE: Your Honor, I mean we stipulated to the qualifications of the matters that were covered in the expert report. He testified that using Pandas, making students aware of

intelligent design, was good for science education. He's been teaching science for eighteen years at the college level.

THE COURT: Did you have a, and I may have known this and forgotten it, but was there a written stipulation as to the expert or just simply an understanding?

MR. MUISE: There's a written stipulation I believe, I don't have a copy in front me, but I believe it says effective of the matters that were covered in the expert reports, that their experts would testify as to the matters addressed in the expert reports.

MR. HARVEY: Your Honor, addressing the defendant's pretrial memorandum, it says will testify, it says questions, in other words critical questions in terms of the evidence and mechanism required to drive evolution are essential to the advancement of science and that making students aware of the controversy in the science community is good for students and is good for science.

THE COURT: Well, we're having a bench trial, and your objection is that he's being offered on science education. But it seems to

me that the real objection gets to potential testimony that would be outside of his report, isn't it?

MR. HARVEY: That's correct, Your Honor. And I don't believe he has been qualified in the area of teaching at the high school level for example.

THE COURT: Well, I understand that, and that may go to a specific objection, but so we don't waste time on this, which becomes at some point a semantical argument, I'll take a precise objection as it goes to his testimony on that point, but I'm going to overrule your objection at this point and allow him to testify on that basis. I think that's the better course rather than to try to split hairs at this point as to what he's qualified to testify, what area he's qualify to testify. And you have his report. If you have an objection as to an individual question or an area that Mr. Muise gets into, I'll hear your objection on that, all right? So we accept him for the purposes and qualifications as set forth by Mr. Muise, and Mr. Muise, you may proceed with your examination.

BY MR. MUISE:

Q. Thank you, Your Honor. Dr. Minnich, I want to first review with you the opinions you intend to offer in this case before we get to the basis for these opinions. Sir, do you have an opinion as to whether intelligent design is science?

A. I do.

Q. What is that opinion?

A. It is.

Q. Do you have an opinion as to whether intelligent design makes testable scientific claims?

A. I do.

Q. And what is that opinion?

A. It does.

Q. Do you have an opinion as to whether intelligent design causes a causative argument for design?

A. I do.

Q. What is that opinion?

A. It does.

Q. Do you have an opinion as to whether intelligent design requires the action of a supernatural creator?

A. I do.

Q. What is that opinion?
A. It does not.
Q. Do you have an opinion as to whether intelligent design is creationism?
A. I do.
Q. What is that opinion?
A. It is not.
Q. Do you have an opinion as to whether intelligent design is a religious belief?
A. I do.
Q. And what is that opinion?
A. It is not.
Q. Do you have an opinion as to whether Darwin's theory of evolution is a fact?
A. I do.
Q. And what is that opinion?
A. It is not.
Q. Do you have an opinion as to whether there are gaps and problems with Darwin's theory of evolution?
A. I do.
Q. Sir, what is that opinion?
A. There are such gaps.
Q. Do you have an opinion as to whether making students aware that Darwin's theory is not a

fact promotes good science education?

A. I do.

148 Q. And what is that opinion?

A. I think it does. It does.

149 Q. Do you have an opinion as to whether making students aware of the existence of gaps and problems with Darwin's theory of evolution promotes good science education?

A. I do.

150 Q. And what is that opinion?

A. It does, definitely.

151 Q. Do you have an opinion as to whether making students aware of intelligent design promotes good science education?

A. I do.

152 Q. And what is that opinion?

A. It does.

153 Q. Sir, do you have an opinion as to whether providing students with the opportunity to review the book Of Pandas and People promotes good science education?

A. It does.

154 Q. Do you have an opinion on that?

A. I do, and it does.

155 Q. Thank you. Sir, I want to talk now about

the, turn now to the nature of the intelligent design argument, and I believe you have provide some demonstratives to assist in your testimony here, is that correct?

A. That's correct.

156 Q. Sir, what is intelligent design?

A. We have summarized here in the first slide. I'll just read it, "Intelligent design is a scientific theory, and it holds that the deep complexity and clearly evident design in organisms is the result of an intelligent agent or cause. Given that even the simplest cells are comprised of nanomachines that currently defy our own intelligent capability to produce, yet have the general features of many machines we have made on a larger scale, intelligent design theory is simply an inference to the best explanation as to the origin of the design." If I could just summarize this perhaps in a more simpler form?

157 Q. Yes.

A. All biologists recognize design in nature. So I think the question boils down to whether or not it's real design or apparent design, as some people hold. Thirty years ago we didn't know

about molecular machines and this concept of irreducible complexity, which we'll talk more about. We didn't know the sophistication of the information storage system in nucleic acids of RNA and DNA that have been likened to digital code that surpasses anything that a software engineer at Microsoft at this point can produce. Certainly Darwin didn't know about this.

So we don't have a Darwinian mechanism to explain these things in terms of natural selection and mutation or variation. On the positive side, because these are similar to machines that we have made in a macro scale, we know what it takes to make them. We know digital information storage systems that we can infer design, looking at the empirical evidence, and maybe a uniformitarian aspect of cause and effect in the world that we live in, when we find these things they're the product of intelligence.

So we're looking at the empirical evidence. We find irreducible complex systems. When we find these in any other context they're the product of intelligence, we infer by standard scientific inference or reasoning that these

systems are also the product of intelligence, and we leave it at that.

158 Q. Is intelligent design based on any religious beliefs or convictions?

A. No. Again, it's looking at the public evidence or the empirical evidence.

159 Q. And if you could just summarize the intelligent design argument, I know you have an exhibit to assist you.

A. Yes, we'll just go this, we infer design when we see parts that appear to be arranged for a purpose. The strength of the inference is quantitative. The more parts that are arranged, the more intricately they interact, the stronger our confidence is for design. The appearance of design in aspects of biology is overwhelming by the community's own admission. Since nothing other than intelligence cause has been demonstrated to be able to yield such a strong appearance of design, Darwinian claims notwithstanding, the conclusion that design seen in life is real design is rationally justified.

160 Q. Does intelligent design make a causative argument for design?

A. Again it does. I mean, there's a negative

aspect in the sense that for any of these systems that we'll talk about we don't have a Darwinian mechanism to explain them. The positive side is we do know where such systems originate from our own experience of cause and effect.

161 Q. The purposeful arrangement of parts?

A. The purposeful arrangement of parts in molecular machines that have the appearance of machines that we make that are the product of intelligent design engineers.

162 Q. Now, does the book Pandas make this point?

A. It talks about, and there's a quote here, the ordering of independent pieces into a coherent whole to accomplish a purpose which is beyond any single component of the system is characteristic of intelligence. So this is kind of a prestatement I think before the coining of the term irreducible complexity.

163 Q. And the quote you read was from page 144, is that correct?

A. Correct.

164 Q. And that's Defendant's Exhibit 220. Sir, is intelligent design science?

A. It is. Again just to restate, it's looking

at the empirical evidence, the public evidence.

Q. And from this empirical evidence it makes inferences, is that correct?

A. Right, using standard scientific reasoning of cause and effect we see machines that in every aspect look like machines that engineers produce. We don't have a Darwinian mechanism to explain these things in terms of the intermediates. So we can infer that these are the product of intelligence.

Q. Sir, can you give us an example of design at the molecular level?

A. Yeah, I've got a couple of slides, you know, this is I'm sure has been hammered to some degree already, but this is a bacterial flagellum. This is a system that I work on.

THE COURT: We've seen that.

A. I know.

Q. You're going to see a little bit more of it, Your Honor.

A. I kind of feel like Zsa Zsa's fifth husband, you know? As the old adage goes, you know, I know what to do but I just can't make it exciting. I'll try.

THE COURT: Any further questions,

Mr. Muise?

MR. MUISE: He's doing fine right now, Your Honor.

THE COURT: For our last witness we get stand-up. You may proceed.

A. All right, this is out of a standard biochemistry textbook that's used for the advanced graduate, or undergraduate and graduate students, Voet and Voet, but it's a cartoon of bacterial flagellum from a grand negative organism, and this is what we refer to as the parts. I mean, we've got a drive shift here, this is the hook protein, or the U joint, it spins. This is the propeller, or the filament. We've got bushings, we've got a stator and a rotor. This thing self assembles from the inside out in a programmed manner. Most of my research has focused on the genetic programming of when to make these things, and also on the assembly of the filaments. But it's a true rotary engine. The size of is about 45 nanometers. So forty-five billionths of a meter in size.

168 Q. You specialize your focus and research on the flagellum, is that correct?

A. That's correct.

169 Q. And you've done experiments on flagellum?

A. I have.

170 Q. And have written peer reviewed articles about it?

A. Yes.

171 Q. Now, as your prior testimony intimated there's been a good deal of focus on the bacterial flagellum. I guess we could probably call this the bacterial flagellum trial. Why the focus on this particular organelle?

A. Well, I think it's, I mean it's just a logical thing, because of all the molecular machines that we know about in biological systems, we know more about the bacterial flagellum than any. I mean, this was first discovered in E. coli and salmonella, which are really the gold standard for doing molecular genetics, and teasing apart these types of machines.

This in terms of organelle development synthesis, we know an incredible amount about it. It's also been a primary model system starting in the early days for signal transduction, a field of biology in terms of

how an organism reads its environment and makes appropriate decisions in terms of, you know, in this case directional flow. So it has served us very well in terms of working out simple signal transduction systems which have paid off an astonishing coin as we've applied the same principles of their study to higher organisms. So in essence this is a system that will maker or break, you know, intelligent design, because it's the one we know the most about.

172 Q. So it's a system that we have a lot of data available, correct?

A. Correct.

173 Q. And it's a well defined system?

A. It's well defined. I mean, we know all the genes involved, we know a lot about its assembly, but there's still questions about how the motor actually works, some of the biophysics, but other than that I think of any molecular machine this one is the most well understood and most defined.

174 Q. Sir, would it be fair to say that this is not just an organelle that intelligent design proponents have randomly selected to use for their arguments?

A. No, no, not at all.

175 Q. Is it fair to say that if you were going to find support for your arguments or support against your arguments, this would probably be the organelle that you would have to address in the literature?

A. Sure.

176 Q. Now, Dr. Behe and you just covered some of the components of the bacterial flagellum, and they appeared to be identified or named in using names that we sort of recognize as part of engines and as part of machines. Are those labels that scientists actually apply to these components?

A. Right. I mean, again this is out of a textbook, and you know, some may say that well, if you draw something to look like a machine it becomes a machine, but this is a true rotary engine, and by definition it's got to have a rotor and stator and drive shaft and U joint for propulsion. It's an amazing engine I don't think just to me, but, you know, the people, those of us that work on it are fascinated by it.

In E. coli these things will rotate at

about 17,000 RPM's on average, although there's some marine vibrios where these engines have been blocked at 100,000 RPM's. It's essentially a massless engine, so it can reverse direction in less than a quarter turn of the rotor. So, you know, it's got two gears, forward and reverse, water cooled, battery powered. It's a fascinating system.

177 Q. Now, the conclusion that something was designed, does that require knowledge of the designer?

A. No. Absolutely not.

178 Q. Why not?

A. Well, I mean, we can infer design, but the science isn't going to tell us anything about the designer unless it's, you know, signed on one of these components, and we haven't found that yet.

179 Q. So is it accurate for people to claim or to represent that intelligent design holds that the designer is God?

A. No, absolutely not.

180 Q. Has science answered this question, the source of design --

A. No.

Q. -- in your view?
A. No.
Q. Now, we're going to, we'll be returning to the bacterial flagellum a little bit later. I put up here a quote that I believe we heard already once in this trial from Theodosius Dobzhansky, did I pronounce that right?
A. Correct, Russian evolutionist.
Q. It says, "Nothing in biology makes sense outside the light of Evolution." Do you agree with this quote?
A. I don't. Not to belittle the importance of evolution, but this hasn't been my experience.
Q. Why?
A. Well, let's go to the next slide, and I've got a couple of quotes that I picked from my expert report. This is from a review by Carl Woese, it was published last year. He talks about this aspect, if could read it, "Molecular biology's success over the last century has come solely from looking at certain ones of the problems biology poses (the gene and the nature of the cell) and looking at them from a purely reductionist point of view," and this is part of Carl's point, you know, he disagrees with

reductionism.

"It's produced an astounding harvest." So a reductionist approach to biology has been astounding. "The other problems, evolution and the nature of biological form, molecular biology chose to ignore, either failing outright to recognize them or dismissing them as inconsequential as historical accidents, fundamentally inexplicable, and irrelevant to our understanding of biology. Now, this should be cause for pause."

So here you have, you know, Carl Woese really saying that there's this period in the last fifty years when molecular biology has kind of reigned that we've ignored the question of evolution, and this is a period I think where we've had the greatest increase in our understanding of biological systems I'd say probably over the whole millennium beforehand.

185 Q. And who is Carl Woese?

A. He's a professor at the University of Illinois, a prominent evolutionary biologist. I have utmost respect for him.

186 Q. He's not an intelligent design advocate?

A. No, no.

187 Q. And if you'd just note, this is, it's listed here as Defendant's Exhibit 251, if you can just confirm that that's the exhibit that you're referring to, and it should be in your exhibit binder under Tab 5.

A. Yes, that's correct.

188 Q. And that's the article A New Biology For A New Century?

A. Correct.

189 Q. I believe you have some additional demonstratives to make this point?

A. Yes. The next slide, this is a paper published in Cell in 2000. So Cell I think is most prestigious journal for biologists to publish in. Primary research articles of some length. It won't go into the nature of science. Simon Conway Morris is a paleontologist at Cambridge University. This is the introduction to his paper which is a review titled Evolution: Bringing Molecules Into the Fold. "When discussing organic evolution the only point of agreement seems to be: `It happened.' Given, therefore, this history and the most recent and spectacular advances in microbiology, it may seem curmudgeonly, if not perverse, to even hint

that our understanding of evolutionary processes and mechanisms is incomplete. Yet, this review has exactly that intention."

So again this is one of the most prominent paleontologists, worked on the Burgess shale, Cambrian explosion, remarking that molecular biology had spectacular advances and, you know, I think with this knowledge, and going back and addressing fundamental questions in terms of evolution is justified. When you consider that statement, you know, the only consensus seems to be that it happened. Beyond that, you know, mechanisms, our understanding of mechanisms, processes, are incomplete.

190 Q. In this article, I believe it's marked as Defendant's Exhibit 255, and it's Tab 9 in your exhibit binder, can you verify that for us, sir?

A. That's correct.

191 Q. I'll move to the next exhibit, which is a paper by Lenski, et al., and I believe it's marked as Defendant's Exhibit 252, which will be under Tab 6 in the exhibit binder that you have. Are you familiar with this paper and its findings?

A. I am.

192 Q. What does this paper purport to conclude?
A. Well, if you go to -- well, this is a paper addressing evolutionary origin of complex features, really looking at the infusion of new genetic information in organisms and trying to look at, you know, the mechanism of that.
193 Q. Now, Professor Pennock is one of the co-authors of this paper, is that correct?
A. That's correct.
194 Q. And he's an expert who testified for plaintiffs, and he appeared rather giddy about the results that they achieved in this paper. Do you share his enthusiasm?
A. I like the paper, and I like the quotes. The thing that I hesitate when I bring this up first you all is, and I'll show you in the next slide, but this is out of Richard Lenski's lab, and they've been doing experiments over the last twenty years, long-term evolutionary of E. coli and hemostats or fermenters, looking at changes over, up to 40,000 generations, and --
195 Q. These are on living --
A. Living, on escherichia coli, again our standard model for these type of studies, and this in less than 20,000 generations they see

the infusion of new information, but this is a mathematical model. These are virtual organisms. So I think there's a limitation, which I mentioned in my expert report.

196 Q. How do the results of these digital organisms compare with Lenski's results with living organisms?

A. Well, again you see change at a faster pace than the real experiment, so I think it's somewhat backward, I'm not a computer scientist, I don't understand the software, so there's limitation there as well and I'm the first to admit it, but as I read this paper it seems like there's a targeted logical program that these organisms can adapt to by mutation, much like viruses in your computer systems. So that's what they're measuring this change to.

197 Q. You picked a particular quote from this paper I guess to emphasize your points regarding that quote from Dobzhansky, is that correct, on this next line?

A. Right. That, and also the fact that students are often confronted with the absolute statement that Darwinism is fact, or if not evolution is fact and, you know, this is from

the introduction of this paper that was, you know, in Nature. From the outset Darwin realized that organs of extreme perfection and complication, such as the eye, posed a difficulty to his theory." I mean, this is the argument of design.

"Such features are much too complex to appear de novo, and he reasoned that they must evolve by incremental transitions through many intermediate states, sometimes undergoing changes in function." This is variation in natural selection. "Now, there exists substantial evidence concerning the evolution of complex features that supports Darwin's general model. Nonetheless, it's difficult to provide a complete account of the origin of any complex feature, owing to the extinction of intermediate forms, imperfection of the fossil record, and incomplete knowledge of the genetic and developmental mechanisms that produced such features."

So in summary, if you go to the next slide, there's this admission in this paper, in Simon Conway Morris's paper, Woese addresses these facts as well, that we lack intermediate

structures, we lack fossils, we don't have an adequate knowledge of how natural selection can introduce novel genetic information. That's the point of this paper with virtual organisms and mathematical and computer simulation, and then from my own experience going back to Dobzhansky's quote, "Nothing in biology makes sense outside the light of information," I have my own experience as well that I would like to --

198 Q. Please tell us your experience with regard to that quote that nothing makes sense in biology in light of evolution.

A. In my entire academic training as an undergraduate or graduate student or as a post-doc at Purdue and Princeton University, I never once took a formal course in evolution. In fact, when I requested it as a graduate student, you know, to include it on my graduate student study plan, it was refused by my committee with a, you know, you don't have time to do it, it's not necessary.

So that has been my experience as a biologist and a practicing, you know, experimental biologist, I've never been

required to take a single course in evolution. My exposure formally was in my undergraduate 100 and 200 level introductory biology classes were we got basic evolution, you know, Haeckel's embryos, peppered moths, founder effect. So the basis tenets were there, but in terms of really looking at this in detail, I haven't.

Now, this isn't unique to me. When I, in my department of molecular biology, microbiology, and biochemistry there's only one other faculty member, although we've had three or four that have joined the department in the last year, so I can't say that absolutely, but since my tenure there in 1989 one person has took an actual course in evolution as a graduate student. So I find this amazing that, you know, we're doing hard-core molecular biology, and this was never part of our training.

I'm the only person and one other faculty member that have read Darwin, which again, you know, I think is a problem. I would like to correct that. I think it should be required that all students in biology read Darwin's Origin of the Species and be required to take a rigorous course at some level, preferably

early on in their undergraduate degree careers, in evolution, because, you know, I find this ironic situation that although I've never been required to take this material, you know, in my training, the point now where I'm questioning its importance in my discipline, you know, has been quite an amazing experience.

199 Q. How so has it been quite an amazing experience?

A. Well, it's difficult to say. I mean, it's almost like you're a heretic in the camp. I mean, I'll put it like that.

200 Q. So to sort of summarize through some of these quotes from prominent evolutionary biologists and from your own experience, we had the greatest advances in biology perhaps in this last half century, and it's been primarily at the molecular level, is that fair to say?

A. Correct. I mean, molecular biology is focusing primarily on E. coli first and then extrapolating what we learn there to more difficult systems, eukaryotic systems, yeah, it's been an incredible period.

201 Q. Yet evolution has been practically

inconsequential in the development of this information that we've gathered?

A. Carl Woese states that in his paper. I mean, some people considered it inconsequential. It was ignored, a historical accident.

MR. MUISE: Your Honor, I'm going to start moving into another area. I don't know if this may be a time to break.

THE COURT: Yeah, why don't we, I think that makes good sense. Why don't we break here for about twenty minutes, and we'll resume with the witness's testimony after that intermission, and we will return after the break. Thank you.

(Recess taken at 2:14 p.m. Proceedings resumed at 2:36 p.m.)

THE COURT: Be seated, please. You may resume.

BY MR. MUISE:

202 Q. Thank you, Your Honor. Dr. Minnich, when you were defining intelligent design earlier in your testimony you noted the "deep complexity and clearly evident design in organisms." Do other scientists recognize this complexity in evidence of design?

A. Yes. All biologists see design in nature,

and this is really part of this central question, is it real design or apparent design, and how do we differentiate between the two. This is a cover of Cell again, this is our premier journal. From a review issue, once a year they run a review issue, this is from 1999 I believe.

203 Q. I believe it's 1998.

A. `98, okay, I can't remember, but macromolecular machines, this dealt with the machines of life, and I think the cover really sums it up. Across the landscape of biological systems we find these incredible macromolecular machines.

204 Q. And they dedicated an entire issue?

A. Exactly. The entire issue is looking at specific machines in the cell that we knew a lot about.

205 Q. And just I guess for purposes of the record this cover can also be found as Exhibit 203-C, Charlie. I believe another slide from an article that appeared in there in this particular journal, this issue, from Bruce Alberts, is that correct?

A. Correct. Bruce Alberts at the time was

National Academy of Science president. He's an evolutionist, so you know, I don't want to misinterpret his position on any of this, but it's an interesting article titled The Cell as a Collection of Protein Machines: Preparing the Next Generation of Molecular Biologists. Some of the things that he notes, the complexity of the cell's macromolecular machines was not anticipated."

In the introduction of this article he states as a graduate student in the 1960's they looked at the, you know, cells that they were working on, E. coli at the time, as really a bag of enzymes operating on the second order of kinetics, or diffusion kinetics, "Our current view of the cell is vastly different." In fact, he says, "We've always underestimated the cell in this review." More complex than the view of the cell when Dr. Alberts was a graduate student, okay, so I covered that.

Dr. Alberts advocates in this article incorporating the principles of design engineering into biology curricula for this next generation of molecular biologists as a means to dissect the interactions of

macromolecular machines now identified in even the simplest cells. The point being that for us to get to the next level of understanding at the cellular and subcellular level, how all these molecular machines not only function independently in and of themselves, but how they're coordinately regulated as a consortium machines to carry out the cell's duty will be the job more of the design engineer or a systems analyst. These are true factories.

So I find it incredible. In fact, in the acknowledgments he acknowledges Jonathan Albert, I don't know the relationship, for the information in terms of how design engineers approach these types of problems. We're going to need this, you know, the age of cloning and sequencing is over, to get to the next step. We're going to incorporate design engineering.

206 Q. And again this article is marked as Defendant's Exhibit 253, and I just want to verify if you look under Tab, I believe it's Tab 7 in your exhibit binder if you would, in the black binder, if you'd verify this as the article you're referring to?

A. Correct.

207 Q. I believe you have another section from this issue of the journal that you want to use to emphasize your points?

A. Right. Can I just read one quote out of this article, because again it's important to understand that Bruce Alberts is an evolutionist. In fact, he's co-author of the book on how to teach evolution at the secondary level, published by the National Academy. But on the first page of this article at the bottom, why do we call --

208 Q. I'm sorry, you're referring to Exhibit 253?

A. Correct, 253, on the first page. "Why do we call the large protein assemblies that underlie cell function protein machines? Precisely because like the machines invented by humans to deal efficiently with the macroscopic world, these protein assemblies contain highly coordinated moving parts. Within each protein assembly intermolecular collisions are not only restricted to a small set of possibilities, but retain, reaction C depends on reaction B, which in turn depends on reaction A, just as it would in the machine of our common experience." So emphasizing that this is almost a definition of

purposely ordered parts that you find in Pandas and People or it might be a used definition of irreducible complexity, highly ordered parts that perform a function.

209 Q. And you have another demonstrative aid?

A. Right.

210 Q. I guess another excerpt from this journal itself, right?

A. Correct. I think this is what I just read, isn't it? Oh, no, this is actually from the table of contents for this issue. "Again, like machines invented by humans to deal efficiently with the macroscopic world, protein assemblies contain highly coordinated moving parts. Reviewed in this issue of cell are the protein machines that control replication, transcription, splicing, nucleocytoplasmic transport, protein synthesis, protein assembly, protein degradation, and protein translocation, the machines that underlie the workings of all living things."

Across the landscape again these are the machines that are performing every function in the cell. Highly sophisticated machines, many of which when we dissect them have all the

hallmarks of machines that design engineers have made in our macro world. So again the inference, you know, we have the question the appearance of design, is it real or just apparent? We don't have a Darwinian mechanism to explain the appearance of these in a step-wise manner. At the same time we do know from our common experience, you know, cause and effect in the world, that when we find these types of machines, they're the product of intelligence, and these surpass anything that yet, you know, that we can make ourselves. It's an inference, it's a logical inference.

211 Q. I believe we have another slide with our friend, the bacterial flagellum.

A. Right. Again this is my machine, and David DeRosier at Brandeis University has done an incredible amount of work on this. In a review article in Cell in 1998 he wrote, "More so than other motors, the flagellum resembles a machine designed by a human," all right? So there's question of design. As biologists we all recognize it. It's a true rotary engine.

212 Q. Is that an understatement by Dr. DeRosier?

A. Yeah, I guess you would have to say,

because we have yet engineered a machine that can self assemble and function, you know, actually have its own software written that can call up and decide when and how many of these to make, where to put them, etc. So it's incredible, I mean, when you look at the parameters of this machine.

213 Q. And this, and again for reference purposes this is from Defendant's Exhibit 274, and if you can just look in your exhibit binder, I believe it's Tab 11, is this the article from which you're quoting from?

A. Correct. That's correct.

214 Q. Now, you indicated these living organelles are described as machines by you and by these scientists. Are they in fact machines?

A. They are. I mean, again they have all the components of a rotary engine. Rotor, stator, U joints, bushings, drive shaft, that's how they're described, and by definition a rotary engine has to have these components, regardless of the scale. I want to point out, too, you know, just for the record that we didn't know these things existed twenty or thirty years ago this was the surprise.

Again emphasizing what Bruce Alberts says, our conception of the cell has changed radically in the last twenty to thirty years. In terms of how we view the cell he says that we've always underestimated it, I have another quote here by some colleagues, but I think it's perfectly legitimate to go back and ask is natural selection mutation sufficient to prove or to build this type of sophisticated machinery.

215 Q. But the bacterial flagellum isn't the only machine in a cell, correct?

A. No, no.

216 Q. And I believe you have some additional exhibits to point out some other machines?

A. Yeah, I've included another rotary engine, the ATPase we find in prokaryotic and eukaryotic cells. This is a description of the torque generated in the transfer of this energy to ATP synthesis. ATP is the energy currency of a cell, is generated by oxidation reduction reactions in the cell, and essentially what you do is you push protons across a membrane, much like you would collect water behind a dam, and then you bleed through ATPase, which acts as a

turbine. For every third of a turn, or 120 degree turn of this rotor, you generate essentially one adenine triphosphate molecule.

The point being here I think is this group conceded all, makes this point in their article in Cell that if one ATP consumed for 120 degrees is one of, one may anticipate from the make of this motor the efficiency of our ATPase is nearly 100 percent, far superior to a Honda V-6. This is a direct quote out of this article. So it's approaching 100 percent efficiency in these machines that are being produced by the random events and selection of Darwinian mechanism.

217 Q. I believe you have a schematic here of ATP?

A. Yes, this is a cartoon, again it's a rotary engine like the flagellar, it's a much smaller scale, but you can see that you've got a stator here and a rotor with arem ATP is generated as this turbine turns around up here.

218 Q. Are engineers studying these machines?

A. Right, I think that's -- the fascinating thing to me, and this is in part why I participated in this conference in Rhodes in biomimetics is that engineers and architects have recognized that biology, systems in biology

have solved some pretty complex problems, and when you consider nanotechnology, the application of this, computer applications, pharmaceutical applications, engineers are coming to biologists to learn about these systems and how they may, you know, practically apply them. So when you consider the bacterial flagellum, the speed at which it rotates, the fact that it can, you know, reverse direction in less than a turn, I mean that's like any time you have a machine that can stop and start, it's the equivalent in machine language of a one and zero. I mean, you can have that application in terms of designing computers that are biologically based.

219 Q. Have you been asked to give presentations to engineers about these molecular machines?

A. I have in my university, the University of Idaho, I've given one talk to the physics department just based on the bacterial flagellum as a nanomachine. They're interested in the fluid dynamics of the system and how it operates at this scale, and also to, I believe it was a mechanical engineering department.

220 Q. And I believe you have a few other examples

of design in nature?

A. Yeah. So the other thing that I think caught us by surprise is the sophistication of the information storage system of the cell. DNA and RNA are really information systems that store digital information just like our computers do. This is out of a textbook, this is a genetic code that was solved in the 1960's by Caron at Harvard and Nirenberg at the NIH, and essentially you have as we all know from basic biology there are four nucleotides that make up genetic information, and there are twenty amino acids. It's combination of three of these letters that determine each amino acid if this translation is occurring between nucleotide language to protein language.

So for instance U in the first position, we call this the five prime positions, the center position U, and U in the third position codes for phenylalamine. UUC also codes for phenylalamine. With four digits there are 64 combination. So we have 64 three letter codons. Now, when this was determined in the 60's, so this is really the Rosetta Stone of genetics, when this was determined in the 60's there was

an intuitive recognition that there seemed to be a bias in the code for amino acids that if you had a point mutation, for instance if you have UUU and you changed this last U to a C, you get the same amino acids.

So there's redundancy. UCU or UCC, UCA, UCG all code for a series. You either get the same amino acid or a similar amino acid in terms of its chemical properties. So that was intuitively obvious. Now, if this is a product of arbitrary chance and necessity, to quote Minot, then there's no reason that this code is chosen over any other. Francis Crick referred to this as a frozen accident. Carl Woese in his paper "Owed to the Code" states that the genetic code has not evolved.

Now, with computer analysis we can actually look at all of the random codes that can be generated. There are millions of codes that can be generated with the parameters of twenty amino acids and four nucleotide bases, and ask is there a bias, is there a better code to minimize the effect of point mutations, because that's really what we're seeing in this code, and it turns that the natural code according to

this author Hays when this has been analyzed against millions of other arbitrary codes is optimized to minimize the effects of point mutations, okay, the very thing required to drive evolution.

We have a code that from the get go is optimized to minimize the effects of point mutation. Now, that to me, and my colleagues, too, when we've discussed this causes them to pause. I mean, people just stop and get reflective. That to me has a signature of design on it, okay, that you have a, this is a sophisticated, this is the most sophisticated information storage system that we know of. It's true digital code we've got, it codes for algorithms.

Now we're talking about the cell working on fuzzy logic, which is non-linear, which is much more complicated than we considered in the past, and if this is a product of undirected chance and necessity, I find that difficult, you know, that nothing that Microsoft and Bill Gates's engineers yet have come close to producing an information storage system like this. That's what we're talking about in terms of design and

looking back. We didn't know about this system fifty years ago I mean, when the code was broken in the 60's. Certainly Darwin didn't know about it.

So you have this most sophisticated information storage system coupled with macromolecular machines that are also highly sophisticated, with ordered parts that we by definition call are irreducibly complex, it's appropriate to go back and ask is a Darwinian mechanism sufficient to account for the appearance of these.

221 Q. You said that the DNA has been shown to resist point mutations, is that correct?

A. It's not that it resists it, but if you have a point mutation, which is common either in replication or just exposure to the environment, perhaps mutagens or UV, light that you can get a mutation in one of these codons, you know, to convert a U to a C, or what we call a transition or a transversion mutation, and often you'll get either the same amino acid or an amino acid that's related in terms of its chemical properties so that you don't disruption of that protein that's produced with that

mutational event. Now, it doesn't eliminate it completely, but there is, we recognize that there is this bias. This is optimized to negate the effect of point mutation.

222 Q. So it's optimized to negate point mutations which are necessary for that selection to function?

A. Right. That's one of the driving forces obviously of evolution.

223 Q. Dr. Minnich, why isn't this just the argument from incredulity?

A. I mean, that's -- Dawkins makes that argument that because I can't imagine a mechanism that would produce this that I suffer from incredulity, and I'm, darn it, you know, we are trained to be skeptics. We are trained to look at things through, you know, a very narrow lens. We're to be our own worst critics, and it seems like in any other practice of science that's how we operate, except when it comes to an explanation of the origin of these systems, and then we're accused of being, you know, suffering from incredulity because we can't imagine how these came about.

We don't have the intermediates. Again

for any biochemical pathway we don't have the phylogenetic history for any biochemical pathway or subcellular organelle. Yet as a scientist I am supposed to accept this without blinking that this is a product of a Darwinian mechanism, and I'm sorry, these are highly sophisticated systems, and I know from experience that when you see a machine, a rotary engine, in any other contest, you would assume that there's an engineer around, and those are the arguments that we're making.

224 Q. I believe you have another example, you described the sliding clamp. Could you describe this?

A. This is DNA polymerase on the right, so this is the copying mechanism for DNA replication. What I find interesting, actually this was a paper that was given to me by a colleague who we disagree with in terms, but he thought I'd be interested in it. The clamp protein here, which forms this donut around this double helix of DNA, in eukaryotic organisms or higher organisms there's a dimer. We call it in yeast PCNA protein.

In E. coli we also have a clamp protein,

this is a prokaryotic, a more primitive organism, it's a trimer. It's a beta subunit of E. coli polymerase. Now, if we compare the protein sequences that form this structure between E. coli and yeast, we wouldn't pick them up as being similar in a computer search. Now, this is, all organisms are required to replicate their DNA. You would think that this would be a highly conserved process by definition if prokaryotics eventually evolved eukaryotes from some common ancestor, but what we find is a protein that has almost an exact superimposable structure, one on the other, forming the same function, but completely different amino acid sequences.

This is a remarkable example of convergence, and there are many examples of this coming out now at the molecular, and as we'll talk about Simon Conway Morris says even at the organismal level. We can't, at present we don't understand the properties of protein folding, so we couldn't make a protein to form this structure as a base for the assembly of the other components of DNA polymerase. Yet we find in nature that this has happened twice for the

same function, the same structure, but a different amino acid sequence. I mean, that's an incredible finding.

225 Q. Is that what you mean by convergence?

A. Convergent, right.

226 Q. I believe you have another example, a gated portal. Could you explain what this is?

A. The gated portal, so this is looking from the nucleus of a eukaryotic organism, and I don't think it shows up with that well on this slide, but this is a portal, or actually a gate, so you have to have traffic material from the nucleus to the outside, from the outside back into the nucleus.

These are proteins of nucleic acids, and we have these gate systems or turnstiles, and we find that there's a very sophisticated postal system in the cell that components of the cell will have, you know, a molecular zip coding that will direct them, first of all allow them to go through this portal, and then afterwards direct them to their location wherever they're required in the cell. That whole postal system of zip coding, how, you know, a protein made of a cytoplasm is directed to the membrane or to

endoplasmic verticulum is an incredible area of research and interest as well, and --

227 Q. So this is an informational transport system, is that --

A. Correct, correct. So there's, you know, this is a cross section of that. So here would be the nuclear membrane and the components that have been defined by mutational analysis that dictate what can come through or what can go back through the nucleus. So proteins synthesized in the cytoplasm and in the ruthear have to come back through if they're regulatory proteins and interact with DNA. So there's a very important regulatory system in terms of recognizing these proteins and directing them to their locales.

228 Q. Dr. Minnich, it appears from your testimony and sometimes from the prior quotes you have from other scientists that our understanding of the complexity of life has, especially at the molecular level, has probably advanced exponentially in the last half century. Is that fair to say?

A. Oh, for sure. For sure.

229 Q. Dr. Alberts acknowledged that in the

article that you cited to, is that correct?

A. Right.

230 Q. Are there other scientists as well that make that observation?

A. Right, I have a quote from the journal Bacteriology, you know, from Richard Losick at Harvard and Lucy Shapiro who works on an organism that I used to work with. I know Lucy, but --

231 Q. Where is she now?

A. She's at Stanford. She's department chair in developmental biology at Stanford, Changing Views on the Nature of the Bacterial Cell from Biochemistry to Cytology. She would be a contemporary of Bruce Alberts having gone through I think graduate training in the 60's. So these people that are kind of reaching retirement age are starting to reflect back on their careers I think during the most fruitful research period in the history of biology, and these are not uncommon statements.

So let me read what these two individuals say, "How profoundly our view of the bacterial cell has changed since we first started our lifelong fascination with life's smallest

creatures." They're both microbiologists. "Who would have imagined that bacteria have proteins that assemble into rings, that cluster at the poles of cells, that localize delocalize as a function of the cell cycle, or that bounce off the ends of the cell with a periodicity of tens of seconds.

"Who would have suspected that the origins replication move to the poles of cells, that the machinery for replicating DNA is stationary, and that it is the chromosome that moves through the chromosome duplicating factory, or that plasmas would jump from the cell center or the cell quarter points following their replication." The point I just want to make is that our view of the cell, even the simplest cell, has changed profoundly, and we are, there are scientists that have come through are, you know, awe struck in terms of the beauty and complexity of the systems that we're studying.

232 Q. How is this relevant or implicate intelligent design?

A. Again the molecular machines that we find that I work on were not anticipated, they weren't predicted. They have the appearance

of machines that engineers make. I'm going to hammer this point home, but I think it's critical to understand that we don't have a Darwinian mechanism for the step-by-step intermediates to get there or build these machines, and we know from definitional work on these machines that they're irreducibly complex, and we'll go over that in the next section. But again you take away one component, you trash the machine. That's how you study them. That's how we figure out what the parts are in each individual system that, you know, is our pleasure to work on.

233 Q. I believe we have one last quote which I believe we've seen already in this trial.

A. Right, from Mr. Dawkins and The Blind Watchmaker. "Biology is the study of complicated things that give the appearance of having been designed for a purpose." As biologists we all see the design, and you can be like Richard Dawkins and argue that it's only apparent design. If there is a natural mechanism, a Darwinian mechanism, a variation on the mutation that can produce it, I'm more reserved, I guess more conservative and say,

you know, to me it's real design, and it's a scientific argument.

234 Q. And I believe you've prepared a summary?

A. Okay. Our view of the cell is vastly different from when Darwin's theory was first proposed, let alone our view over forty years ago. The cell is now recognized as being orders of magnitude more complex and sophisticated than Darwin envisaged. While our understanding of the complexity of the cell has increased by orders of magnitude, the mechanism to generate the complexity, mutation and natural selection, has remained constant, although there's some new avenues of research that I find very exciting in this last part. It's reasonable to revisit the question, again it's reasonable to revisit the question as to whether natural selection is sufficiently up to the task of design engineering this recognized sophistication we find in even the simplest of cells.

235 Q. Do other scientists who are not intelligent design advocates recognize the lack of an adequate Darwinian explanation for this complexity in evident design?

A. I have a quote from Carl Woese in that

paper that was cited earlier alluding to this fact, and I don't think I'm taking this out of context. "The creation of the enormous amount of and degree of novelty needed to bring forth modern cells is by no means a matter of waving the usual wand of variation and selection. What was there, what proteins were there to vary in the beginning? Did all proteins evolve from one aboriginal protein to begin with? Hardly likely.

"Evolution's rule, to which there are fortunately a few exceptions," which he doesn't give, "is that you can't get there from here. Our experience with variation and selection in the modern context does not begin to prepare us for understanding what happened when cellular evolution was in its very early rough and tumble phases of spewing forth novelty." All right, so Carl Woese is saying essentially in these early stages of evolution, whatever parameters were at work are not present today, which again, I mean, bears on the question of doing the science.

I mean, there were conditions by admission perhaps that we can't reproduce. You know, we've got to recognize that, and I think it's

important for students to recognize that, but maybe the important thing here, evolution's rule to which there are fortunately a few exceptions is you can't get there from here. It means we can't, we don't have the intermediates to account from how we got from the simple to the complex.

236 Q. And this article you're quoting from, if you can again refer to your exhibit binder, Defendant's Exhibit 251, and it should be I believe at Tab 5, is that the article you're referring to?

A. I'll check. That's correct.

237 Q. I just need to backtrack because I don't believe we identified the exhibit number for the article from Losick and Shapiro that you referred to previously, and I believe it's at Defendant's Exhibit 257, which would be at Tab 10. Is that the article you're referring to by Losick and Shapiro?

A. Correct.

238 Q. Now, Carl Woese is not an intelligent design advocate, is that correct?

A. Absolutely not. I mean, he's a well known and like I said respected evolutionary biologist

at the University of Illinois.

239 Q. Now, we've been talking about Darwin's theory of evolution. What's the common understanding of Darwin's theory? I should say his principal contribution.

A. His principal contribution was the mechanism to account for the variation that we see. So natural selection coupled with variation, which from a neo-Darwinian perspective once we understood genetic information was that mutation, natural selection over time.

240 Q. We're talking about the mechanism of evolution?

A. Yes.

241 Q. Is Darwin's theory of evolution a fact?

A. In terms can we demonstrate mutation and selection? Yes. In terms of extrapolating that to larger systems or going from, you know, the evolution of some of these machines that we're talking about, we don't have the evidence.

242 Q. Are there gaps and problems with the Darwinian theory of evolution?

A. There are.

243 Q. Is there a principal contention that you

have for the ability of this mechanism of natural selection to explain the origin of life that concerns intelligent design?

A. Right, when you look at the origin of life problem, yeah, I mean, you know, we don't, we can't reproduce it. It's a lot of speculation.

244 Q. Let me perhaps rephrase that question because it wasn't as clear as I wanted it to be. Is there a principal contention you have with the explanatory power of the theory of evolution that is particularly relevant for intelligent design?

A. I'm not quite sure what you're getting at, and other than the fact that we've got to explain, you know, these machines which I say by definition are irreducibly complex.

245 Q. Can natural selection account for the origin of these complex molecular machines?

A. Not at present. Again, we don't have the mechanism. I think that natural selection can preserve them, and this is in part I think where we may, you know, if I could look at in a crystal ball and see a melding of these two ideas. Natural selection is definitely a preservative. The question is whether or not

it's generative and if it can produce these novel structures de novo, but certainly once these structures are around it has a preservative effect, which is very, very, very important in our study of biology.

246 Q. Well, can natural selection account for the information storage systems required for the production of these molecular machines?

A. No. No. We have no understanding in terms of how nucleic acid information systems evolved, and in fact in our chemical experiments, looking at primordial conditions we can't get cytosine in all of the methods that have been tested to date.

247 Q. How about do we have a phylogenetic history of the single biochemical pathway for things such as the flagella?

A. No. Again I think I stated this that, you know, Jim Shapiro at the University of Chicago, Harold, a retired microbiologist at Colorado State, says we don't have a single phylogenetic history of a biochemical pathway or a subcellular organelle. A lot of conjecture, wishful thinking I think to paraphrase their view.

248 Q. And who was that view that you were just paraphrasing?

A. Harold is a microbiologist, although Shapiro has made similar statements. Jim Shapiro in an article that I just read last week, a fascinating article, said there's no contrivance of man that comes close to the simplest cell or one of the subcellular organelles.

249 Q. Now, the theory of evolution, particularly natural selection we've been talking about here, has it been able to explain the existence of a genetic code?

A. No.

250 Q. Has it been able to explain the transcription of DNA?

A. No.

251 Q. Has it been able to explain the translation of M-RNA?

A. No.

252 Q. Has been it been able to explain the structure and function of the ribosome?

A. No.

253 Q. Can it explain the existence of motility organelles such as the bacterial flagellum?

A. No.

254 Q. Can it explain the development of the pathways for the construction of organelles such as the flagellum?

A. No. Like I said, we have to phylogenetic history. I've worked on the bacterial flagellum for years and there's to my knowledge not a paper that can tell me, you know, the evolutionary assembly of this by a step-wise mutation selection program, and we may never know it. That's the problem.

255 Q. Is it fair to say that under this relatively broad category of difficulties that we just went through lies much of the structure and the development of life?

A. Oh, for sure.

256 Q. And does this then cause you to question whether a Darwinian framework is the proper way to approach such questions?

A. That's why I'm testifying here. I mean it's because of the scientific constraints I see in Darwinian explanation.

257 Q. Some of the plaintiffs' experts have described intelligent design as a science stopper. Would you agree with that?

A. Absolutely not. I mean, turn it around. If you just say, you know, like Woese, wave a magic wand of variation and selection, where does that get you? You know, I think from my own personal perspective, having something designed implies that there's purpose and, you know, I can start teasing apart that purpose and apply that in different ways, like a design engineer or a systems analyst would approaching the machine where you don't have the blueprints, you don't have the owner's manual, and that's the beauty of it.

258 Q. So you're a working scientist, I mean you kind of roll up your sleeves and go into laboratories and conduct experiments quite regularly?

A. Yeah. That's my passion.

259 Q. Do you know employ principles and concepts from intelligent design in your work?

A. I do.

260 Q. And I'd like for you to explain that further. I know you're prepared several slides to do that.

A. Okay, this is just a reiteration in terms of how we function in the laboratory during the

last half century, we've gained a greater understand of biology at the molecular level than the entire history of efforts in the proceeding millennia, and I don't think that's an overstatement. The vast inroads we have made in our understanding of the cell came by techniques essential to a design engineer.

261 Q. If you can read on from "our understanding of the cell"?

A. All right. I lost my place, let's see. Came by techniques essential to a design engineer, not elements derived from the theory of evolution. The mainstay technique of modern biology has made use of the concept of irreducible complexity of the cell's subsystems. And if I can have the next slide I'll iterate on what I mean by that.

262 Q. This concept of irreducible complexity, that was coined by Dr. Behe, is that correct?

A. Right, right, but I think any working molecular geneticist recognizes that this really explains the approach that we take. This is from Mike's, one of his publication, but I co-opted it here, "By irreducibly complex I mean a single system which is necessarily composed

of several well-matched interacting parts that contribute to the basic function and where the removal of any one of the parts causes a system to effectively cease functioning."

263 Q. Is this your understanding of the concept of irreducible complexity?

A. Correct.

264 Q. And I just want to know that this was from an article written by Dr. Behe which has I believe already been admitted as Defendant's Exhibit 203-H, for hotel. Is irreducible complexity one of the, I guess one of the arguments or components of the intelligent design argument, is that correct?

A. Right. And I find it difficult when, you know, even this definition is challenged, whether or not it's real or not, because to me as a geneticist this is really restatement of Beadle and Tatum's principle back in the 30's, the two individuals that got molecular genetics going in the last century, you know. One gene, one enzyme, the idea you can use mutational analysis to knock out as individual gene and produce a phenotype, all right -- so if we can go to the next slide.

265 Q. Let me just ask you one question before you move on. You have here in this definition, this system, underlined, bold, and in capitals, what purpose was --

A. I think because often this is the part that's misunderstood in terms of some of the people that debate these issues, you know. It's not, we're not saying that you can't find components of a given molecular machine associated with another machine and another function. I mean, I have no problem with microevolution co-opts and the certain parts, there are plenty of examples like this.

The point being the system that's being studied, the bacterial flagellum, if you take out one of the components of the type three secretion system of the flagellum, we know that we can build it, the cells don't move. That's not to say that you can't have a type three system involved in another function in the cell. But for the system that's being addressed it's irreducible and complex when the fact that we've identified all the components based on mutational analysis.

266 Q. Do you find that those who argue against

this concept of irreducible complexity change the definition to create a straw man to knock it down?

A. You know, I don't know if I'd say straw man or it's intentional. I mean, it's one way you can construe it, but I think it's a subtle but important definition that we're talking just about one system of the cell that we're addressing through mutational analysis, and again you can have components that may be similar in other systems that could be addressed separately, but it's a key point.

267 Q. If you could, I know we have another slide for this, break down for us this concept of irreducible complexity and how you employ it in your work in the lab.

A. Okay. Molecular machines are comprised of a core set of components that are arranged for a purpose essential for function of that machine. If one of these components is removed from the machine, there's a resulting overall loss of function. If there's no function, then there's nothing to select, you know, from a Darwinian perspective, or you have to assume that there would be some selective advantage for an

intermediate, but this implies that mutations in genes encoding pieces of a molecular machinery will yield selectable phenotypes based on this loss of function.

268 Q. Could you explain that?

A. Selectable phenotypes for a geneticist means that you mutagenize these cells. The hard part for us is coming with a screen or a selection to separate all the mutations that have occurred from the ones that you want to study in the system that you're interested in. I'll show you a picture of how this works in the lab really simply to get this point across, but this process of using mutagenesis and devising genetic screens and selections to identify loss of function has yielded astonishing findings over the last sixty years.

This is the bread and butter of molecular genetics. If these systems we worked on weren't irreducibly complex, we would know very little about them. This is a mechanism how the fact that we want to identify all the components of a given molecular machine, we make mutants that trash the system, sort out, map the mutations, how many genes are involved, and then start

piecing it back together. It's a very reverse engineering procedure more attuned to, you know, this concept of intelligent design or reverse the design process to understand how these systems work.

269 Q. Break down for us further this concept of mutagenesis, and I believe you have a slide --

A. Sure. All right. I work on the bacterial flagellum, understanding the function of the bacterial flagellum for example by exposing cells to mutagenic compounds or agents, and then scoring for cells that have attenuated or lost motility. This is our phenotype. The cells can swim or they can't. We mutagenize the cells, if we hit a gene that's involved in function of the flagellum, they can't swim, which is a scorable phenotype that we use. Reverse engineering is then employed to identify all these genes. We couple this with biochemistry to essentially rebuild the structure and understand what the function of each individual part is. Summary, it is the process more akin to design that propelled biology from a mere descriptive science to an experimental science in terms of employing these techniques.

270 Q. Do you have some examples employing this particular concept of the flagella?

A. I do, in the next slide. Hopefully this will cut to the chase and show you what we're talking about. This is an organism that my students and I work on. This is a petri dish about 15 millimeters size, filled with this soft auger food source for the organism. It's soft in the sense the organisms can swim in it, but it has some rigidity that they just don't slosh around. Now, each one of these areas showing growth were inoculated with a toothpick of cells, the wild type parent here. So this is yersinia enterocolitica, a good pathogen, double bucket disease if you ingest it.

271 Q. That's the center?

A. Yeah, that's the center, okay? So it can swim. So it was inoculated right here, and over about twelve hours it's radiated out from that point of inoculant. Here is this same derived from that same parental clone, but we have a transposon, a jumping gene inserted into a rod protein, part of the drive shaft for the flagellum. It can't swim. It's stuck, all right? This one is a mutation in the U joint.

Same phenotype. So we collect cells that have been mutagenized, we stick them in soft auger, we can screen a couple of thousand very easily with a few undergraduates, you know, in a day and look for whether or not they can swim.

272 Q. I'm sorry, just so we're clear on the record, the two you're talking about on the bottom left, the first one was the bottom left and the second one was the bottom right?

A. Right.

273 Q. Where you took away a portion of the flagella?

A. We have a mutation in a drive shaft protein or the U joint, and they can't swim. Now, to confirm that that's the only part that we've affected, you know, is that we can identify this mutation, clone the gene from the wild type and reintroduce it by mechanism of genetic complementation. So this is, these cells up here are derived from this mutant where we have complemented with a good copy of the gene.

One mutation, one part knock out, it can't swim. Put that single gene back in we restore motility. Same thing over here. We put, knock out one part, put a good copy of the gene back

in, and they can swim. By definition the system is irreducibly complex. We've done that with all 35 components of the flagellum, and we get the same effect.

274 Q. And those top left and the top right were restored bacterial flagellum --

A. Right.

275 Q. -- with the one missing part?

A. This is an essential aspect of doing these types of study to show that it's a single component you're dealing with. You complement with only that gene and show that you restore function.

276 Q. I believe you have another diagram?

A. In this manner we've, in other labs, so this would be a compilation of work done in a number of laboratories around the world. We've contributed to part of this right here and the front end up here, but this is a blueprint for building a flagellum. You know, you have a master control switch that's turned on when it's appropriate. To make a flagellum, turn on the first set of genes, you lay down, you know, a base plate on the inner membrane, and you start assembling from inside of the cell out.

So we're putting in, you know, a drive shaft, another ring, our U joint. There are checkpoint controls like just in the assembly of any machine. If there's a defective part there's a feedback loop that will shut down expression of all the succeeding genes to conserve energy in the cell. Eventually you have this rotary engine with a propeller that can extend about five to ten lengths of the cell.

277 Q. So this is a blueprint of the flagellum that was developed through using this mutagenesis technique that you're referring to?

A. Right. That and biochemistry and cell biology, I think David DeRosier's done a lot of work with the mutants, you know, showing their assembly. You get these, we call them rivet-like structures. So different mutants you can actually isolate these structures at various stages.

278 Q. Would it be accurate to say then the design principle which I believe you referred to them as work because these systems are irreducibly complex, is that correct?

A. By definition. Again, you know, this is

how we do this type of work.

279 Q. Now, there are some scientists, and Dr. Miller is one of them, that claim that the bacterial flagellum is not irreducibly complex, and he'll point to the type three secretory systems to make his argument. Are those arguments correct?

A. I think they were a valid argument when they first came out. In fact, we worked on type three secretion systems. So when we're talking about that, this structure over here on the right side of this slide, this is an electron micrograph, this is essentially a micro or a nano syringe for the plague organism, like I said, this has killed two hundred million people alone, and most Gram-negative pathogens have them.

We were working on the regulation between motility in yersinia enterocolitica and expression of virulence genes which involved a subset of these proteins back in the early 90's, and in fact we made the hypothesis that the toxins made in this system, we didn't know about type three secretory systems at the time, actually using Occam's Razor would be the

flagellum. I mean, we had good genetic evidence that the flagellum could be used for other than secretion of flagellar proteins, but there's a subset of proteins involved in both of these at the base that dictate what proteins are secreted through these structures.

You build a flagellum from the inside out, all the components are transported through this hollow core and assembled at the distal tip, and with this nano syringe you make toxins and they're actually injected into your white blood cells when you make contact. They're a subset of common proteins between those, and so after reading Mike's book I actually corresponded with him and said, you know, we may have an intermediate for the flagellum.

That's a possibility based on our early studies of this. These structures were identified in 1998 by electron microscopy finally, and Dr. Miller, Ken Miller has said that these are the intermediate structure for flagellum biosynthesis, and I was willing to entertain that view. But since then our own work and work in other laboratories I think is showing that it's actually the other way around,

that the type three system if anything has been derived from he flagellum. In one of my papers I make that argument. So really to explain this structure you have to presuppose the very thing you're trying to explain. In fact it's being derived from a more complex system.

280 Q. Are both of these systems irreducibly complex?

A. By definition I mean all the components for the type three system were identified by mutational analysis, and in this case attenuation of virulence.

281 Q. Would it be fair to say that if the type three secretory system was found to have preceded the bacterial flagellum, we'd still have difficulty with trying to determine how that one system that functions as a secretory system could then become a separate system that functions as a motor, flagellar motor?

A. Right. I mean, that would be a positive argument, I mean, in the sense that it could be an intermediate. But again I think the evidence is falling heavily against it. But sure, but having a nano syringe and developing that into a rotary engine, you know, is a big leap.

282 Q. You wrote a paper, and we showed it up here on this next slide, they referred to previously, "The Genetic Analysis of Coordinate Flagella in Type Three Regulatory Circuits and Pathogenic Bacteria," and I believe it's listed as Defendant's Exhibit 254, which should be under Tab 8 in the exhibit binder. If you can confirm that that's the article?

A. That's correct.

283 Q. Could you explain a little further this article, its findings and its implications for intelligent design?

A. Again it's a review of the reason, you know, that we've teased out why pathogenic organisms regulate production of a flagellum in a host environment, and they switch between these type three systems. We show in this paper that there is a logical reason for this, because if you operate these systems simultaneously, in other words if we artificially express flagellum protein, which makes up the filament of the flagellum in the host environment, it will be recognized and secreted by that nano syringe.

In fact, will be injected into a white blood cell. Since over the last three to four

years we've come to recognize that the sentinel cells of our innate immune system, white blood cells, neutrophils, dendritic cells, have on their surface a receptor looking for bacterial flagellum as a pattern recognition molecule of an invader, and if that receptor gets tickled with flagellum it will induce the innate immune response and an inflammatory response.

So the whole point I think it comes into play is why a lot of organisms shut off motility in the host environment is to hide this protein from invading cells, or from the sentinel cells, the white blood cells, that they're going to encounter. That has lots of ramifications. It explains yersinia pestis, the bubonic plague organism, is nonmotile even though it has residual flagellar genes in tis chromosomes.

Flagellar dysentery, the organism that causes bacterial dysentery, has flagellar genes in its genome, but it's nonmotile. Bordetella pertussis, which we were all immunized for as kids, whooping cough, has flagellar genes in its chromosome, but it doesn't express them because they all operate type three systems. The point being if the type three system is going to be

an intermediate, there would be to have sometime in their history where they would both be operational, and that would really work against the organism.

I'm going into detail and I don't want to bore people with it, but I find it, you know, fascinating that these important pathogens have lost flagellar synthesis over time, and there's a reason for it in terms of this. We're actually taking purified flagellum, knowing this interaction and why it's dangerous to expose white blood cells to flagellum. We can take purified flagellum, expose a mouse by aerosol or internasal, and the next day challenge it with ten lethal doses of yersinia pestis or francisella tularensis, which causes tularemia, and it shows significant delay time to death or even protection. I mean, this has been, this is really going to change things in terms of how we look at the initial stages of disease --

THE COURT: Did you get that, Wes?

THE WITNESS: Am I boring you, judge?

THE COURT: Oh, you're not boring me, but I'm concerned about his ability to get -- Wes

of course drew the short straw in the court reporter pool for the afternoon, and I'm just concerned that Wes got that. You're going to have to, when you get to a term, what my concern is when you get to a term like several of the terms to try to spell that. Not to protract things, but --

THE WITNESS: I apologize.

BY MR. MUISE:

284 Q. If you could go back, you mentioned several diseases and bacteria. If you could restate those perhaps spell to help us out. The disease for the whooping cough and some of the others that you've mentioned.

A. Okay, in terms of you yersinia, Y-E-R-S-I-N-I-A, pestis. That's the bubonic plague organism. Shigella, S-H-I-G-E-L-L-A, bordetella, B-O-R-D-E-T-E-L-L-A, so these are all organisms that operate type three systems that have lost the ability to make a flagellum over time. But the point I'm trying to make is that by approaching this kind of in a systems analysis way it suddenly make sense why organisms regulate these systems, why they're not displaying those proteins, and then we

can take advantage of this in terms of our understanding of the innate or nonspecific immune response and manufacture really novel vaccines. New adjuvants, we can use flagellum, you know, packed with epitopes for plague or tularemia or other organisms, and --

285 Q. Can you spell those, too? Tularemia was one.

A. Right, T U-L-A-R-E-M-I-A I think. I almost have to see it to write it. From Tulare County. Okay, so the point being that this has all kinds of applications in our own work.

286 Q. And so you, by looking at this from our perspective of real design you're finding a great deal of utility in applying that approach to it in terms of actually perhaps providing some antibodies or some way to resist these things that will be beneficial to, beneficial results for the community?

MR. HARVEY: Objection. Leading. I think he's summarizing a lot of testimony. He's not developing the testimony or moving it along there, which I wouldn't object to, because it does tend to move things along. I think he's testifying, and that's not proper when you've

got your own witness, particularly an expert witness, who should be able to explain.

MR. MUISE: Your Honor, it was an attempt to summarize, we had some fits and starts with the spelling of these bacteria, and it was just an attempt to summarize --

THE COURT: I think -- it's a close call, but I think it's a fair summary at this point. I understand the point. So I'm going to overrule the objection. You can proceed.

MR. MUISE: Do you recall the question?

THE WITNESS: Repeat the question.

THE COURT: Wes, why don't you read the question back for us.

(The record was read by the reporter.)

THE WITNESS: Close enough.

BY MR. MUISE:

287 Q. Do you have an answer to that question?

A. Yes, I agree. I think, you know, going back to Bruce Alberts that we're looking at this thing kind of from the systems perspective and --

288 Q. Dr. Minnich, another complaint that's often brought up, and plaintiffs' experts brought it up in this case, is that intelligent design is

not testable. It's not falsifiable. Would you agree with that claim?

A. No, I don't. I have a quote from Mike Behe. "In fact, intelligent design is open to direct experimental rebuttal. To falsify such a claim a scientist could go into the laboratory, place a bacterial species lacking a flagellum under some selective pressure, for motility say, grow it for ten thousand generations and see if a flagellum or any equally complex system was produced. If that happened my claims would be neatly disproven."

289 Q. Is this an experiment that could be done in a lab?

A. It could be, and I, you know, would say that, you know, up the ante. I'll give somebody a time three secretory system intact and the missing proteins required to convert it into a flagellum and let them go, see if you can get a flagellum from a type three system. That's a falsifiable doable experiment. That's just the type of experiment that could be subjected to this type of analysis.

290 Q. Would this be an experiment that you would do?

A. You know, I think about it, I would be intrigued to do it. Knowing the tolerance limits for these proteins and how they would assemble I wouldn't expect it to work. But that's my bias.

291 Q. You think natural selection could account for that, take the type three secretory system, the additional proteins, and see if natural selection can build a bacterial flagellum from that?

A. I'm not convinced that it could, but again it's a plausible experiment. They should write a grant and see if we can do it.

292 Q. One of the examples that had come up in the course of this trial and I know you're somewhat familiar with, you addressed it in your expert report, it's listed "Icon of Evolution: Antibiotic Resistance." Is this a good example of evolution in practice?

A. I don't think so.

293 Q. Why not?

A. Because it really, it's an extrapolation from the data. It's a good example of adaptation, you know, and here I'm talking about point mutations conferring resistance

to specific antibiotics like streptomycine, which is commonly used as a demonstration. You can show a population of cells are sensitive to this drug, put them under selective pressure, isolate mutants that are resistant. It comes with an extreme fitness cost.

You know, from my own experience in this you can almost, almost a doubling of the generation time required. These organisms have a difficult time competing. Once the selective pressure is removed you can get compensatory mutations, and this has been shown in the literature, that restore the growth rate, but only for the conditions in which you're doing the experiments.

In actuality in biology we have a term for this referred to as Mueller's Ratchet, and that essentially says that when you have a mutation that you turn the ratchet once you're limiting the organism's ability to respond to the next environmental condition required for an adaptational response. And so the more environmental insults or mutations that occur, you're turning this ratchet down tighter and tighter to the point where you're going to limit

the organism's ability to eventually survive.

So you can show this in this laboratory, it's a beautiful demonstration of adaptation in mutation, but to extrapolate this to the general principles of going from the simple to the complex I think it's out of bounds. If anything it's showing limits or the shortcomings of mutation. I don't think it has anything to do with the complexifying mutations required to drive evolution.

294 Q. I guess quoting from Carl Woese, you can't get there from here?

A. Yeah, that's exactly it.

295 Q. Now, based on your testimony thus far it would seem that the new information about molecular biology calls into question some of the previous assumptions about evolution, is that fair?

A. I think that's definitely fair.

296 Q. And do scientists other than intelligent design advocates recognize this?

A. Yes. This was in the literature. I can go back and look at this paper by Simon Conway Morris, again this is a paleontologist at Cambridge University, well known, this article

titled Evolution: Bringing Molecules into the Fold, you know, this is the one where he says that he's going to do this perverse thing about addressing the problems in evolution in the abstract, and he goes through the problems that we have. We cannot still differentiate phenotype from genotype.

In other words, the outward expression, the morphology of an organism from its genome, we have a problem in terms of phylogenetic assignments and looking at phylogenetic histories, related histories of derived from molecular clocks versus the fossil record. They're out of sync. Molecular clocks tend to indicate the organisms are much more older than fossil record. The paleontologists argue their interpretation is correct. Molecular biologists will argue that their interpretation is correct.

This has to be resolved. When we look at molecular data we get conflicting phylogenies. If you compare a cytochrome amino acid sequences, which was done back in the 60's and the 70's, compared the ribosomal RNA sequences, compared the superoxide dismutates,

other essential conserve genes or proteins in the cell, you'll generate a different phylogeny depending upon whether you're looking at one individually or in combination, and this is now being superseded by comparing entire genomes.

So bioinformatics is going to be critical in this next stage. You have this question of convergence that we mentioned before again with a beta protein, beta subunit of DNA polymerase, Morris remarks in a couple of examples in this paper and even says if evolution is channelled, in the sense that it's always coming up with the same solution being different routes, pretty complex problems, in his mind teleology is back on the table for discussion.

Now, this is a paper in Cell, and he says it's interesting that physicists are reaching the same conclusion in terms of the anthropic principle or the fine tuning principles of the universe. He cites Barrow and Tipler, one of which is a design proponent. As physicists he also cites a reference in terms of biology of Michael Denton, who has been involved in intelligent design and wrote a book previously to the one cited in this article, Evolution: A

Theory in Crisis. So here you have a well known paleontologist looking at the problems of evolution, recognizing that they're real, and considering maybe this word teleology, purpose, should be back on the table for discussion.

297 Q. Does he use that term in the paper?

A. He does. In the discussion at the end.

298 Q. Dr. Minnich, I'd like you just to sort of summarize some of these points that you've been discussing here.

A. I think if you look at the Carl Woese's paper and read it carefully, he says that nothing in evolution should be not subject to intense review. He even says common descent was a conjecture, an idea of 19th century biologists, that somehow got set in stone. We shouldn't be stuck to it. But I think in terms of my experience, we're dealing with dogmatism versus science and where the data is leading us.

Again to emphasize, we can't differentiate genotype from pheno. I read a paper last week, you know, one of the best phylogenetic histories we have is fossil horses in North America. These have been, you know, from the Pleistocene

and Miocene time period, and I'm not a paleontologist, but I'm interested in the molecular analysis. These have been well characterized in terms of their phylogenetic history and taxonomy, molecular techniques, isolation of fossil DNA comparing to mitochondrial sequences shows that this phylogeny is artificial, that they're all in the same taxa, perhaps even in the same species.

It can't explain the origin of information. This is still a major question in biology, and we're dealing with the most sophisticated information storage system that we know about. We can't explain how life initiated. Origins. We can't explain the existence of the genetic code, this frozen accident I referred to. Convergent examples in evolution are causing people to question, and this is at the molecular level, the organismal level.

So I would say that quoting Tulkinghorn, we're in a situation much like the physicists were at the end of the last century, and we suffer from this triumphal arrogance where we think everything can be explained by our Darwinian methodology, just like physicists,

everything can be explained in Newtonian mechanics. I think we're at a turning point, and that's not to say that all the work before is not valuable. I think it's critical. I think -- I love reading evolution, and these are important contributions to understanding of life, but I'm convinced there's something more there, and that's why I'm here.

299 Q. Dr. Minnich, I want to sort of shift our focus a little bit and talk a little bit about creationism. Is there a popular understanding of this term?

A. Creationism has to deal with viewing scientific or the empirical evidence through a literal interpretation of Genesis, six-day creation event.

300 Q. What is creation science?

A. Again these are scientists that are limiting how they interpret the data through a scriptural context of Genesis, a literal interpretation of Genesis.

301 Q. Plaintiffs countering that intelligent design is not science but rather creationism, are they correct?

A. No. We have don't have any precommitment

to any scripture, revelation, religion. Just looking at the empirical data and using scientific, standard scientific reasoning of cause and effect and asking is it real design or only apparent design.

302 Q. Dr. Miller made a claim that if the bacterial flagellum was designed, then it had to be created and therefore it was special creationism. Is that accurate?

A. I don't agree with that. I mean, it doesn't say anything about how it was designed, over what time period it was designed, how it's been modified, you know, over time in terms of evolutionary events. So I would disagree.

303 Q. Could the bacterial flagellum be designed over time under intelligent design theory?

A. Yes. I don't think we're limited by that.

304 Q. May I approach the witness, Your Honor?

THE COURT: You may.

305 Q. Dr. Minnich, I've handed you what's been marked as Defendant's Exhibit 220, a copy of Of Pandas and People, and I believe you testified previously you're familiar with this book, correct?

A. I am.

306 Q. If I could direct your attention to page 99?

A. Okay.

307 Q. Towards the bottom and then continuing on to the next pages it says, "Intelligent design means that various forms of life began abruptly through an intelligent agency with their distinctive features already intact. Fish with fins and scales, birds with feathers, beaks, and wings, etc., " and it goes on to say, this is the next page, "Some scientists have..." --

A. Can I interrupt? You're on 99? I don't see that on page 99.

308 Q. Page 99 at the bottom if you look, I'm sorry.

A. Okay.

309 Q. Look at the last paragraph.

A. Mine says, "Darwin has subjected a view of intelligent..." --

310 Q. Correct.

A. Okay.

311 Q. Keep going down five lines.

A. Okay.

312 Q. So we're at, "Intelligent design means"?

A. Right, intelligent design means.

313 Q. Let me read this again for you again. "Intelligent design means that various forms of life began abruptly through an intelligent agency with their distinctive features already intact. Fish with fins and scales, birds with feathers, beaks, and wings, etc." And it goes on to say, Some scientists have arrived at this view since fossil forms first appeared in the rock record with their distinctive features intact and apparently fully functional rather than gradually developing." Do you see that?

A. I see that.

314 Q. Sir, is it your understanding that creationism requires an abrupt appearance of life on earth?

A. Creationism, you know, scientific creationism, yeah, ex nihilo appearance of life forms.

315 Q. Is this ex nihilo appearance of life forms, is that a theological concept?

A. Yes, yes. Out of nothing.

316 Q. Does this statement in Pandas that I just reviewed with you, does this make intelligent design creationism?

A. No, I don't think so. I mean, this is a

literal interpretation of the fossil record where you see the sudden appearance of these forms, you know, fish with fins, etc. in a geologic record. From my interpretation this isn't ex nihilo, you know, creation from nothing.

317 Q. Are you familiar with other scientists who are not intelligent design advocates making statements regarding the fossil record using the term abrupt appearance?

A. Right. I mean, this is common in paleontology literature. From my understanding Woese even talks about it in the one paper saltational events.

318 Q. What's a saltational event?

MR. HARVEY: Your Honor, I'm going to object. A question or two on paleontology might have been not something to object to, but this man isn't a paleontologist. He has no expertise in paleontology whatsoever.

MR. MUISE: He's testifying here also about this particular book and that intelligent design science is not creationism. He mentioned in Carl Woese's article which he's been testifying to --

THE COURT: Heard that. Heard the last thing. Isn't he getting into paleontology?

MR. MUISE: All I'm asking him, Your Honor, he used the term saltational event. I asked him what does he mean by that, and that's the end of the question.

THE COURT: Well, whether it's the end or not, isn't that paleontology?

MR. MUISE: Well, he used the term, and I'm asking him what he means.

THE COURT: Well, the objection is that he's not qualified. Tell me why he is. Tell me where it's in his report. Tell me -- it's a technical objection, but it's an objection that's founded in the lack of qualifications.

MR. MUISE: He's testifying about the book, Your Honor. That's what he's, about it being good for science, and he said so in his report. He used the term, all I asked him was the term about saltational events and what did he mean by saltational events. He's familiar with the literature. He cited from Carl Woese's article. Carl Woese is a person he's been relying on in most of his testimony.

THE COURT: All right. That's your

argument. I'll sustain the objection. You'll have to ask a different question.

BY MR. MUISE:

319 Q. Dr. Minnich, is intelligent design a religious belief?

A. No.

320 Q. Why not?

A. Because again there's no precommitment to any religious tenet or system.

321 Q. Is intelligent design inherently religious or advance a religious belief?

A. No. Again, I think we're looking at the empirical evidence and asking, you know, specific questions in terms of the Darwinian mechanism and alternative interpretations.

322 Q. Do creationists in the sense that plaintiffs and their experts have used in this case require physical evidence to draw their conclusions?

A. No, I mean I think by definition if you're a creationist, you're going to rely on the authority of scripture regardless of any evidence that's presented.

323 Q. Is that different from a proponent of intelligent design?

A. Yes.

324 Q. How so?

A. Again we're looking at the evidence first and not making any precommitment or filtering it through any revelation or religious position.

325 Q. Are intelligent design's conclusions or explanations based on any religious, theological, or philosophical commitments?

A. No.

326 Q. Sir, do you adhere to the literal reading of the Book of Genesis?

A. I don't.

327 Q. Does intelligent design require adherence to the literal reading of the Book of Genesis?

A. It does not.

328 Q. Do you believe that the earth is no more than six to ten thousand years old?

A. I believe the earth is according to the estimates 4.5 billion years old.

329 Q. Is that the estimate that's accepted by the scientific community?

A. Yes.

330 Q. Does intelligent design require adherence to the belief that the earth is no more than six to ten thousand years old?

A. It does not.

331 Q. Sir, do you adhere to the flood geology point of view which is advanced by creationists?

A. I don't.

332 Q. Does intelligent design require adherence to the flood geology point of view advanced by creationists?

A. No.

333 Q. I have to -- let me strike that and go back because I misstated my question. Do you adhere to the flood geology point of view advanced by creationists?

A. No.

334 Q. And let me again ask does intelligent design require adherence to the flood geology point of view advanced by creationists?

A. No.

335 Q. Does intelligent design require the action of a supernatural creator acting outside the laws of nature?

A. No.

336 Q. Now, in your deposition you claim that the NASA SETI project, which stands for the "Search for Extraterrestrial Intelligence," that that program was seeking a supernatural explanation

by searching for intelligence from space. Do you recall that?

A. I do.

337 Q. And you also indicated that Nobel laureate Francis Crick's claim of directed panspermia was a supernatural explanation for the origin of life, do you recall that?

A. I do.

338 Q. In what sense were you using supernatural to describe these explanations?

A. I think in my deposition I made it clear that these were above our normal experience, or natural experience. So I categorized them as if they're are not natural to our experience they would be supernatural in that limited sense of the word.

339 Q. Is it not true that from a scientific perspective these explanation are actual natural explanations?

A. They would be, right.

340 Q. Does intelligent design rule out these sort of explanations for the source of design?

A. Not at all.

341 Q. Can science identify the source of design at this point?

A. No.

342 Q. Does intelligent design rule out a natural explanation for design foundation?

A. It doesn't.

343 Q. We heard quite a bit of testimony during the course of this trial about methodological naturalism, and I believe you indicated in your deposition you see that as placing limits on intelligent design, is that correct?

A. It does. It can. In the sense that it limits explanations it can be advanced, but it has the same kind of stricture on other avenues of scientific research as well.

344 Q. Does methodological naturalism necessarily exclude intelligent design from the realm of science?

A. No, it doesn't.

345 Q. Why not?

A. Again, I mean, there could be a natural cause for the systems we're trying to explain.

346 Q. Sir, are you aware that there's a statement that is being read to the students which is part of the controversy in this case?

A. I am aware.

347 Q. I'd like to read that to you here in a

moment. This is a statement read to the students from the January 2005. "The Pennsylvania academic standards require students to learn about Darwin's theory of evolution and eventually take a standardized test of which evolution is a part. Because Darwin's theory is a theory it continues to be tested as new evidence is discovered.

"The theory is not a fact. Gaps in the theory exist for which there is no evidence. A theory is defined as a well tested explanation that unifies a broad range of observations. Intelligent design is an explanation of the origins of life that differs from Darwin's view. The reference book Of Pandas and People is available for students who might be interested in gaining an understanding of what intelligent design actually involves.

"With respect to any theory, students are encourage to keep an open mind. The school leaves the discussion of the origins of life to individual students and their families. As a standards driven district, class instruction focuses upon preparing students to achieve proficiency on standards based assessments."

Sir, did I read anything to you in that short statement that in your expert opinion will cause any harm to a student's science education?

A. Not in my opinion.

348 Q. Sir, let me ask you, I want to go through a couple of these sentences. "Because Darwin's theory is a theory, it continues to be tested as new evidence is discovered." Is that true?

A. That's true.

349 Q. A theory is not a fact, is that true?

A. I think we talked about that today, yes. That's true.

350 Q. Gaps in the theory exist for which there's no evidence. Is that true?

A. That's true.

351 Q. And a theory is defined as a well tested explanation that unifies a broad range of observations. Is that a good definition of a theory?

A. Yes, it is.

352 Q. It says, "Intelligent design is an explanation of the origin of life that differs from Darwin's view." Is that true?

A. That's true.

353 Q. Sir, in your expert opinion should students

be made aware of this information?

A. Yes.

354 Q. Do you believe it will promote science education?

A. I do.

355 Q. Dr. Alters, who testified on behalf of the plaintiffs, made the following comments about in his opinion the effect or impact of this statement. I want to read you from his testimony, and he's referring to this, the statement I just read to you. "Now, what this policy is doing is saying that there's this other scientific view that belongs, it belongs in the game of science, and it's the one that most students will perceive as God friendly. It has an intelligent designer. Evolution doesn't.

"Now students are going to be in there discussing out on the playground, discussing in their class, among themselves or whatever, that the unit that they're now about to hear about, the evolution unit, that's now coming up is the one that's not God friendly, the one scientific theory that doesn't mention God. But this other so-called scientific theory, intelligent design,

is God friendly because there's a possibility that God has this other theory.

"What a terrible thing to do to kids. I mean, to make them have to think about defending their religion before learning a scientific concept, how ridiculous. This is probably the worst thing I've ever heard of in science education." What's your reaction to that those comments?

MR. HARVEY: Objection, Your Honor. Outside the scope of his expert report. He didn't submit an export report in rebuttal to Dr. Alters' report. No mention of the statement in the expert report. I don't think it's proper.

MR. MUISE: Your Honor, it's all in line with why he believes this is good science education. We've had one expert making these claims, and I'm asking him to comment on those claims as part of his opinion to demonstrate why this should be a part of science education. This was testimony from trial. To say he didn't have it in his expert report is --

THE COURT: What was testimony from trial?

MR. MUISE: What I just read, Your Honor.

THE COURT: Well, I understand that. That begs the question, the question has been raised by Mr. Harvey's objection is, is it in his export report. I do not believe it is. I think you can probably concede that point. Obviously it can't be because the report was prepared prior to Dr. Alters' testimony. Now, the objection then states that there's no rebuttal report that contains this. So in effect he's claiming I think that he's not qualified, and surprised. What do you say about that?

MR. MUISE: Your Honor, he's testifying about the --

THE COURT: I know what --

MR. MUISE: I understand that.

THE COURT: I know exactly what he's testifying about. Don't reiterate what he's testifying about. Tell me why I should allow the testimony based on the fact that it's not in the report and that it's, well, fundamentally not in the report, and I think there's a qualification objection inherent in this that I allowed Mr. Harvey to reserve. Dr. Alters in his testimony could take this one step further, he's qualified in that area to render that

opinion. Was he not?

MR. MUISE: Dr. Minnich is also rendering an opinion that he's qualified regarding this particular policy at issue and whether intelligent design is science and whether it's beneficial for the students.

THE COURT: No, that makes no sense what you just said. Dr. Alters was qualified prior to his testimony on the subject of, in the realm of whether he could testify as to whether or not this was good practice to read this statement to 9th grade students. Now, I understand the purposes of this witness generally, but you haven't qualified him on that point. It's on education, and --

MR. MUISE: I'm saying you accepted him for science education. Is that --

THE COURT: I accepted him subject to, don't misunderstand what I said, subject to objections by Mr. Harvey. Now, the objection goes generally to qualifications and -- it goes broadly to qualifications, but it goes precisely now to a statement outside the report. Now, you had the ability, and in fact you have the obligation if he's going to render an opinion

in this area to supplement the report and you didn't do that. So strictly speaking it appears to me to fall considerably outside the report. He may have an opinion on this, I understand that, but it's both outside the report and it's both that and not within the qualifications as I perceive them to be. I also said if you lay a foundation I might consider it. There is no foundation for the opinion, and therefore the objection is at this point sustained.

BY MR. MUISE:

356 Q. Dr. Minnich, should schools such as Dover make students aware of intelligent design as a scientific theory during their class instruction on Darwin's theory of evolution?

A. Through the reading of this one-minute thing, yeah, sure.

357 Q. Why?

A. I think it promotes critical thinking. It indicates to students that there's important problems that are being discussed in this important area of biology, and it will serve their education well.

358 Q. Should schools such as Dover make Pandas available to students as a reference book?

A. Yes.

359 Q. And why?

A. I think it's a valuable resource. It's another way of looking at empirical evidence and how it can interpreted, whether it's a fossil record or molecular data.

360 Q. In your expert opinion does the Dover policy at issue in this case promote good science?

A. Overall I think it does.

MR. MUISE: No further questions, Your Honor.

THE COURT: Thank you, Mr. Muise. All right, it's about eleven after 4:00. Do you want to get into cross today, or do you want to --

MR. HARVEY: I'm happy to give it a start.

THE COURT: We might as well use the time we have and go until 4:30. So you can proceed, Mr. Harvey.

MR. HARVEY: Your Honor, may I approach the witness?

THE COURT: You may.

CROSS EXAMINATION BY MR. HARVEY:

361 Q. Dr. Behe -- excuse me, that was a Freudian

slip.

A. We're clones.

362 Q. I didn't, that was not on purpose, I assure you.

THE COURT: Obviously the flagellum has you mixed up.

363 Q. Dr. Minnich, did anyone help you prepare your expert report in this case?

A. No, actually I wrote this over a fairly short period of time, so it reflects I think some of that speed.

364 Q. Now, you and Dr. Behe both, or together, you make the same claim, the claim of irreducible complexity?

A. Correct.

365 Q. And essentially if I understand your contention, it is that an irreducibly complex system is one in which it cannot function unless all the parts are there, and you take away one part and the system ceases to function, correct?

A. Correct.

366 Q. And the point that you're trying make for purposes of evolution is that irreducibly complex systems in your view cannot evolve?

A. I think it's a problem for evolution. In

other words, for each intermediate part you have to have some selective advantage to that intermediate structure, and that hasn't been demonstrated. We know that if you remove one part you have no function, and then if you have no function you've got nothing to select.

367 Q. You didn't originate this idea of irreducible complexity as a problem for evolution, did you?

A. No. I think Mike Behe coined the term, but underlying is the basic argument of design is to account for these complex structures that we find in nature to have the appearance of design, is it real design or apparent.

368 Q. Well, and in support of your argument today you spent a certain amount of time with pictures of what you called motors. Did I understand that correctly?

A. Correct.

369 Q. And you told us that the bacterial flagellum was a true rotary engine, right?

A. By definition in the literature that's what we find.

370 Q. And I wrote in my notes that you said it was incredible, is that correct?

A. Right.

371 Q. Do you remember that?

A. I used that.

372 Q. And you said it has all the components of a rotary engine?

A. Correct.

373 Q. I guess what I'm trying to say is you're really convinced that this looks a lot like a machine that a human would make?

A. Right, and I think the literature supports that.

374 Q. Now, Dr. Behe did not originate the concept of irreducible complexity, putting aside the word irreducible complexity, but the concept of irreducible complexity as a problem for evolution, did he?

A. I don't know, you know, the entomology of the phrase, so --

375 Q. Are you aware that that specific problem was posed in the creationist literature, the creation science literature, as a problem for evolution?

A. No, I'm not. I'm not aware of.

376 Q. Take a look at what's been marked as P-853.

A. 853.

Q. Please, and Matt, if you can bring it up.
A. Are these in order?
Q. It's towards the back. I can help you if you like.
THE COURT: You can approach.
A. I got it.
Q. Dr. Minnich, I'm showing you a publication of the Creation research Society Quarterly from June of 1994. Do you see that?
A. I do.
Q. That's two years before Dr. Behe published Darwin's Black Box, isn't it?
A. I'll take your word for it.
Q. You don't know what year Dr. Behe published Darwin's Black Box?
A. `96, `97, I'm not --
Q. I'd like to -- have you ever seen this publication before?
A. No, I haven't.
Q. Well, I'd like you to go to pages, there's page numbers in the upper, in the corners, in the upper corners, and I'd like you to look at pages 16 to 21. I'm not going to ask you to read it, but I'd just like you to look at it and see -- Matt, if you could page through beginning

with page 16 to 21, we'll go through it, I'll invite you to read it if you'd like to, but if you see on page 16 there's a section that begins "bacterial motility"?

A. I see it.

384 Q. And then on the next page if you turn the page you'll see, Matt, if you can just highlight the language in the lower right-hand column? Yeah, right there, the words "bacterial flagellum," and it's a description of the bacterial flagellum in this piece of literature from this creation science organization, and then if you turn the page again to page 18, there's a description there of the bacterial flagella rotor. Can you highlight that lower paragraph there, Matt? And you'll see it says, "As resolved by electron microscopy, it consists of a series of flanges, grooves, and wheels, yes, wheels, mounted on an axil and turning on bearing surfaces with an efficiency that would be the pride of any industrial research and development operation." Do you see that?

A. I see it.

385 Q. And then if you'd just please turn the page one more time, there's a diagram, and it's

actually Figure 9 in this, and Matt, if you could blow up Figure 9? You have to go to the next page. I'd like the language at the bottom, please. And then if you could, would it be possible to put up Dr. Minnich's slide 18?

(Brief pause.)

386 Q. And I'd like to ask you just to look at that. Do you see on the Figure 9 from this creation research society publication that there's a picture of the motor rotor complex of the bacterial flagellum?

A. Yes, I see.

387 Q. And that's very similar to the picture you put up of the bacterial flagellum, isn't that correct?

A. Well, I don't know in terms of the labeling of the parts. I haven't read the --

388 Q. Well, actually that's what I'd like you to look at for just a second. You'll see that you have labeled something called the universal joint on your, that's D-274, right?

A. Right, and again this is, this picture is out of a biochemistry textbook, Voet and Voet.

389 Q. I understand.

A. Okay.

Q. I understand. But I just want to -- you have a picture of the universal joint?

A. Right.

Q. And then if you look to the picture that's in the creation research society publication, you'll see that there's, that that diagram has a universal joint as well. Do you see -- actually if you look at the bottom and the language at the bottom.

A. What's the letter designation?

Q. It's actually "H," letter designation "H".

A. Okay.

Q. It's called the connective hook universal joint.

A. Right.

Q. And that's the same as in your diagram?

A. Correct.

Q. And then if you look, there's in this Figure 9 from P-853 there's something that's designated "MR," and that's the motor ring?

A. Okay.

Q. And you have motor rings in yours as well, is that right?

A. Okay.

Q. Do you agree?

A. I agree.

Q. And then there's something called, in this Plaintiff's Exhibit 853 there's something called a stationary ring, and in yours you have, also have something in that same place, except it's called an "S" ring, is that right?

A. Now we know that that's a single structure in the "S" ring.

Q. In this Plaintiff's Exhibit 853 there is something that's designated with "AX," and it's called the axil. Do you see that?

A. Correct.

Q. And in yours you have the same thing except it's called the drive shaft, right?

A. Right.

Q. You see that's the same function, right?

A. Right.

Q. Do I have that right? And of course they both have what's been marked as "F," which is the filament. Do you see that?

A. I see it.

Q. Now, and if you turn to page to the next page of this publication, on page 20 -- Matt, can you bring this up? On the left-hand side of the page, about one-third of the way down

there's a reference there to bacterial nanomachines. Do you see that?

A. I see it.

404 Q. And that's the same way you referred to the bacterial flagellum, isn't it?

A. I referred to it as a nanomachine or a macromolecular machine.

405 Q. A bacterial nanomachine?

A. Right. That's explained in the literature, right.

406 Q. And then here's where the claim of essentially what I believe is irreducible complexity comes in, if you look on the right-hand side of the page it says -- it's actually the first full sentence on the right-hand side underneath the diagram, it says, "However, it is clear from the details of their operation that nothing about them works unless every one of their complexly fashioned and integrated components are in place." Do you see where it says that?

A. I see it.

407 Q. And then finally, and I'll bring this to a close, if you go to the abstract on the page, page 13? Matt, if you could just highlight the

second half of that, beginning with the word "in terms of biophysical complexity"? I'll read it to you, it says, "In terms of biophysical complexity, the bacterial rotor flagellum is without precedent in the living world. To the micromechanician of industrial research and development operations it has become an inspirational, albeit formidable challenge to best efforts of current technology, but one ripe with potential for profitable applications. To evolutionists the system presents an enigma. To creationists it offers clear and compelling evidence of purposeful intelligent design." Do you see that?

A. I see it.

408 Q. And I'd like you to agree with me, Dr. Behe, that that is essentially the same argument --

A. Minnich.

409 Q. I did it again, I'm sorry. I'll just ask the court reporter just when he hears that to just put in Minnich. I'd like you to agree with me, to know whether you agree with me that that is the same argument that you have advanced here today in your direct testimony.

A. Right, I mean in terms of -- I don't have any problem with that statement. And I would add that Howard Berg at Harvard University refers to the bacterial flagellum as the most efficient machine known in the universe. So across the board whether, I don't -- what are we arguing here?

410 Q. I'm just, you're just confirming for me, and I think you just did, that what we have just reviewed in this Plaintiff's 853 is the, precisely the same argument that you advanced today in support of your, in your direct testimony, isn't that correct?

A. Yeah, in essence I mean I don't disagree with you. If you're trying to make a connection with creationism though I would disagree.

MR. HARVEY: Well, let's take a look at another exhibit. Could you please go in your binder to what's been marked as -- Your Honor, am I going to be able to run over for a few minutes? Because if not I might as well stop.

THE COURT: Why don't we -- Wes has been out here a while, because we've had an extended second session this afternoon because we started early, so I think this would probably be a good

time to break. We'll invoke the mercy rule for Wes's benefit because of a lot of complicated testimony this afternoon. All right, you're going to be able to wrap up obviously it would appear to me your cross and any redirect comfortably within the morning tomorrow?

MR. HARVEY: It's very much my intention to do so.

THE COURT: All right. Let's try to shoot for that. We'll reconvene for what appears to be our final day at 9:00 a.m. tomorrow. We will have all morning to complete this witness's testimony. My best guess is that we would reconvene after lunch and we'll have the evidentiary arguments as we spoke about yesterday, and then we will follow with the closing arguments by counsel in the afternoon.

MR. ROTHSCHILD: Your Honor, one question. What is your plan or ascertation for the order of closing arguments?

THE COURT: Well, it's your burden.

MR. ROTHSCHILD: Right.

THE COURT: So --

MR. ROTHSCHILD: My view is that we would then go second if that's acceptable.

MR. THOMPSON: Your Honor, I believe the plaintiffs have always gone first.

THE COURT: Yeah, why would you go second if it's your burden?

MR. ROTHSCHILD: I think my understanding it was my burden, and I was not planning on rebuttal, but that I would go second.

THE COURT: No, I would allow you to reserve for rebuttal if you want, but the way I see it you'd go first and I'll allow you to reserve time for rebuttal. I think that's appropriate under the circumstances for the plaintiff to do that, but I think you ought to go first, I agree with Mr. Thompson in that regard, and then we'll hear from the defendant, defendants, and then if you want to carve out part of your time for suitable rebuttal, and you're aware of, if you're not Liz will tell you how much time you have left out of the hour that each side appropriated for your openings, closings, and in the case of the plaintiff the rebuttal, there will be one rebuttal as to the plaintiff. If we didn't make that clear before, that's the way we should do it. All right? Anything further?

MR. HARVEY: No, Your Honor.

THE COURT: All right, we'll see you all at 9:00 a.m. tomorrow. We'll be in recess until then.

(Court was adjourned at 4:27 p.m.)

Tammy Kitzmiller, et al. vs. Dover Schools

4:04-CV-02688

Trial Day 21, Afternoon Session

4 November 2005

I hereby certify that the proceedings and evidence are contained fully and accurately in the notes taken by me on the trial of the above cause, and that this copy is a correct transcript of the same.

s/ Wesley J. Armstrong

_____

Wesley J. Armstrong

Registered Merit Reporter

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