IN THE UNITED STATES DISTRICT COURT

IN AND FOR THE DISTRICT OF DELAWARE

- - -

CAREDX, INC. and THE BOARD OF TRUSTEES OF THE LELAND STANFORD JUNIOR UNIVERSITY, Plaintiffs, vs. NATERA, INC., Defendant.	:	CIVIL ACTION
	:	NO. 19-567 (CFC)(CJB)
CAREDX, INC. and THE BOARD OF TRUSTEES OF THE LELAND STANFORD JUNIOR UNIVERSITY, Plaintiffs, vs. EUROFINS VIACOR, INC., Defendant.	:	CIVIL ACTION
	:	NO. 19-1804 (CFC)(CJB)

- - -

Wilmington, Delaware
Monday, May 17, 2021
9:00 o'clock, a.m.

- - -

BEFORE: HONORABLE COLM F. CONNOLLY, U.S.D.C.J.

- - -

Valerie J. Gunning
Official Court Reporter

APPEARANCES:

FARNAN LLP
BY: BRIAN E. FARNAN, ESQ.

-and-

WEIL, GOTSHAL & MANGES LLP
BY: EDWARD R. REINES, ESQ.
(Redwood Shores, California)

-and-

WEIL, GOTSHAL & MANGES LLP
BY: DEREK C. WALTER, ESQ.
(Silicon Valley, California)

-and-

WEIL, GOTSHAL & MANGES LLP
BY: ANNA E. DWYER, ESQ.
(New York, New York)

Counsel for Plaintiff
CareDX, Inc.

MORRIS, NICHOLS, ARSHT & TUNNELL LLP
BY: DEREK J. FAHNESTOCK, ESQ.

-and-

QUINN EMANUEL URQUHART & SULLIVAN LLP
BY: KEVIN JOHNSON, ESQ.
(Silicon Valley, California)

-and-

APPEARANCES (Continued):

QUINN EMANUEL URQUHART & SULLIVAN LLP
BY: SANDRA L. HABERNY, ESQ.
(Los Angeles, California)

-and-

QUINN EMANUEL URQUHART & SULLIVAN LLP
BY: ANDREW M. HOLMES, ESQ. and
FELIPE CORREDOR, ESQ.
(San Francisco, California)

Counsel for Defendant
Natera, Inc.

SHAW KELLER LLP
BY: KAREN E. KELLER, ESQ.
EMILY S. DiBENEDETTO, ESQ.

-and-

GOODWIN PROCTER LLP
BY: KEVIN DeJONG, ESQ.
(Boston, Massachusetts)

-and-

GOODWIN PROCTER LLP
BY: DARRYL M. WOO, ESQ.
(San Francisco, California)

Counsel for Defendant
Eurofins Viacor, Inc.

- - -

P R O C E E D I N G S

(Proceedings commenced in the courtroom, beginning at 9:00 a.m.)

THE COURT: Good morning. Please be seated.

All right. Welcome, everybody. Before we get started, I will have a roll call.

In light of the CDC guidance in my courtroom going forward, we're going to do what the science says or allows, which is I am not going to require masks. You are welcome to wear a mask if you would like to. You are not required to wear a mask. The one exception is I will require witnesses to not have a mask on so I can make a fair assessment of credibility. I will leave that up to you all, what you do.

You are required, as at least as of today, the requirement has not changed, that in the hallways, in the public areas of the building, we have not removed the mask requirement, and that's only because we just not have had a chance for all the judges to meet and figure out what to do in light of the CDC's recent announcement.

All right? Welcome. All right, counsel. Let's start with plaintiffs.

MR. FARNAN: Good morning, Your Honor.

THE COURT: Good morning.

MR. FARNAN: Brian Farnan on behalf of the plaintiff, and with me is Edward Reines, Derek Walter and Anna Dwyer, also Weil Gotshal & Manges.

THE COURT: All right. Thank you.

MR. FARNAN: Thank you.

MR. FAHNESTOCK: Good morning, Your Honor. From Natera, it's Derek Fahnestock from Morris Nichols. With me from Quinn Emanuel are Kevin Johnson, Sandra Haberny, Drew Holmes and Felipe Corredor. And from Natera, Arka Chatterjee.

THE COURT: All right. Thank you. Ms. Keller?

MS. KELLER: Good morning, Your Honor. Karen Keller from Shaw Keller. Glad to be back in the courthouse.

Also with me today on behalf of defendant Eurofins from my office in the back is Emily DiBenedetto. She's a new associate with our firm. Also Darryl Woo from Goodwin Procter and Kevin DeJong, also from Goodwin Procter.

THE COURT: Thank you. All right. So just at the beginning, a couple of things. Housekeeping. One is I have to get out at 3:30. I cannot stay after 3:30. I think we should be able to wrap this up even before noon, but we'll see.

I know people traveled. I want to give you all the opportunity. I especially want to give the plaintiff

the opportunity to lay whatever record it feels is necessary and make any arguments it thinks is necessary.

I am clearly very skeptical of these patents. As I studied them over the weekend, I am even more skeptical. I have some regret that I didn't just directly address the issue when I reviewed the Magistrate's initial report. The problem is the Federal Circuit case law is not clear. I think it's conflicting at times. It does not put a district court judge in a very comfortable position, especially when reviewing a colleague's assessment of the 101 analysis, knowing it's de novo review, knowing the case law is what it is, knowing frankly what various Federal Circuit judges have said about their own case law. It made me very reluctant to overturn a Magistrate decision.

So what I did in my order, and I forget which case it was, but the case where I adopted the final order and made a comment really just borrowing from case law out of the Federal Circuit that it would be premature at this stage to make an adjudication. I let that case go forward. I invited a motion to dismiss in the other case. Then there was a motion to dismiss, but it was withdrawn, and then it was joined in summary judgment, and that's where we are.

Then we had summary judgment, and I have a gatekeeping mechanism for summary judgment that I've adopted from the District Court of Hawaii where I say in my

scheduling order you should only put facts in your statement of facts that are "absolutely necessary" to adjudicate a summary judgment motion, and the movant put in its statement of facts, it cited its own expert declaration. And if you have two competing experts, you necessarily have a factual dispute. So I had no choice in my mind but to deny that summary judgment motion.

And then that followed with the interlocutory appeal request where the movant said, hey, you never had to consider extrinsic evidence, and, of course, as I indicated in the oral telephone conference, telephone conference, that issue had never been squarely addressed to me.

Now, in fairness to the defendants, they could have said, well, I addressed that that, they raised it in a motion to dismiss. But be that as it may, it wasn't squarely presented in the summary judgment motions and so therefore I denied the summary judgment motion.

Now, but as I indicated in that phone call, I'm concerned about waste of parties' resources, waste of judicial resources, unnecessarily bringing in a jury and having them to adjudicate things that they don't have to adjudicate, so that's why I thought maybe we ought to have this hearing.

Now, the curious thing is we don't have a formal motion pending before me and my sense is as a judicial

management thing, I can sua sponte, as I've done, invite what I've done a reconsideration of my prior rulings, if you will, but you all may want to think about that.

I do think the model I'm following as indicated in the telephone call is the way the Federal Circuit has addressed indefiniteness. That is they've done it under the guise of summary judgment even though there are competing expert declarations that the Federal Circuit has been willing to address indefiniteness and it seems to me this would be the most efficient way to resolve the issues here.

So, now, the other reason I'm having this hearing is because maybe there's going to be testimony presented to me that makes me completely rethink my skepticism and, of course, I have not made a definitive judgment. So that's where we are. All right.

Does anybody think it's necessary to have a motion be put formally in front of me by the defendants, and if so, I don't know if the defendants want to make one or what?

MR. REINES: Your Honor, may I address you?

THE COURT: Yes.

MR. REINES: Thank you.

Our understanding of what's happening here today, and the Court has been I think pretty clear and open with everybody and I appreciate that, is that this is

essentially a bench trial on Step 2 where the Court is going to make credibility determinations as the Court pointed out with respect to the mask requirement and the witnesses and it's going to issue presumably Rule 502 findings and conclusions. I don't mean to be presumptuous. I'm not you, Your Honor, and Your Honor, you know, is going to do what you want.

We didn't understand there was any motion, so we are not treating it as a motion. I assume there are motions -- there are typical motions that you would have in a bench trial context and that would apply afterwards. That's the way I'm thinking about it. In that regard I want to say that I think the way the parties work together and know each other have laid out today, which I think might help Your Honor just so that you know there's orderliness, is that we were each going to make a relatively short presentation, your classic PowerPoint, just to reframe and coming attractions. Then the expert for the other side would testify with cross. Then our expert would testify with cross.

They may want to do something, some cleanup in their rebuttal context and then no close because we would need to process the transcript and Your Honor has plenty of things already, and then perhaps what the Court wants at its preference in terms of post-hearing briefing, I would think

that the rules would apply, findings and conclusions and all of that. That's just my presupposition subject to adjusting.

With respect to the record, I think what makes sense and I don't know that there's disagreement and I think this is an important elemental issue, is that we treat in evidence essentially the summary judgment record so that the literature -- you know, neither side is going to object to authenticity or any other kind of objection to that.

So that's all in the record as though presented in a proper way in the context of a trial so that we're not shuffling in literature because I think the record is fairly finite in that regard.

And then, of course, we would preserve via letter and via our submission in connection with the summary judgment the additional discovery we would do because discovery isn't closed, so there's just discovery that we would do because we think this is a fact intensive question akin to obviousness and so all the normal stuff that you would do. We have not started depositions in any meaningful way, but that, that would be part of the record, too. So I hope that isn't too many things.

THE COURT: That part of the record would be what you have not yet done, you have yet adduced yet in discovery?

MR. REINES: Right. And the declaration submitted by myself with obviously support from the team as to what we were realistically talking about in terms of discovery they think would bear upon the question with conventionality, and I think Your Honor, as observant as you are, we noted, for example, they're serving subpoenas on the sequencing companies at the time period to see what exactly the state was with the new NGS sequencing and things like that.

THE COURT: Right. Okay. So I guess --

MR. REINES: Does any of that not make sense?

THE COURT: Well, a guess a couple things. The first reaction is I don't think this is limited to Step 2.

MR. REINES: Right. That's fine.

THE COURT: You've already said you're in Step 2. The way I look at it is that you have said that it is premature to make a determination as to 101 because you need to present and maybe even go acquire evidence. That's number one. Is that accurate?

MR. REINES: Mostly, but we do -- and I really don't want to cross Your Honor on this, but we do believe that Step 1 is a matter of law and, you know, as Judge Burke found. So in that sense it's not premature, but as to the fact-intensive questions, we do think it's premature.

THE COURT: Okay. So what I want you to do today is to afford you an opportunity to adduce any evidence that you believe is necessary to demonstrate why you believe the patent is not invalid under 101. Now, whether we call it a bench trial, I'm not sure it really matters, but maybe we should quickly try to resolve that.

I mean, as I say, the best example, this thing that seems most akin to is a situation where a patent has been challenged as indefinite and where a Court has either ruled with or without a hearing, and then the Court has declared after briefing, summary judgment briefing it's called, the patent to be invalid as indefinite and that has gone on appeal to the Federal Circuit, and the Federal Circuit has explicitly said that it would entertain, and it has entertained a case in the position as I've just described.

So I, for instance, had a case like that where I -- the parties called it a summary judgment dispute even though they both proffered competing expert testimony, so they both agreed the record had conflicting evidence and yet they both agreed it should be adjudicated on summary judgment. I ruled in a posture of summary judgment. It went up on appeal and it was affirmed and I wasn't the first District Court that sent up to the Federal Circuit a case in that posture. I mean, to me, it's by definition. If you

have competing expert testimony, you don't have summary judgment in a sense, but that's what they called it. It's just a vehicle to get it there.

Does it matter whether we call it a Rule 52 bench trial or whether we just call it a hearing?

MR. REINES: I have a lot of thoughts about that and Your Honor has clearly thought about this closely.

First of all, with respect to indefiniteness, this is an issue I've thought about for a long time. There's a case called B.J. Services, which I think is probably the first panel decision after Markman to address this question, and there again I don't want to say it was a hundred percent square, but there they found it was a jury question in the case of indefiniteness.

For what it's worth, my editorial comment on indefiniteness is that there's -- I like to think of it as this is not Federal Circuit or any other case law. I like to think of it as applied and on its face. The on-its-face-style indefiniteness I think to be is a pure question of law. If it's as applied and it gets fact intensive, for example, how do you measure and is the measurement clear, that kind could of thing, that gets into fact intensive necessary. I think there probably is a jury trial right on that.

In your case, it sounds like the parties waived

that and that, you know, I'm sure they had good reasons for doing that. That's not what we're doing here as the Court knows from our submissions.

So I think it does matter in that sense because I think as we put a letter in, I know it's a little ad hoc, but we tried to keep it as confined as we could, that there is a jury right.

THE COURT: I got you on that.

MR. REINES: All right.

THE COURT: And that issue is going up on appeal.

MR. REINES: All right. Assuming you decide against us.

THE COURT: No. Well, if you want to brief it, but, yes. And if you think it's necessary to have more briefing on the jury trial issue, I'm going to give you the opportunity.

MR. REINES: Thank you.

THE COURT: As far as I can tell right now, the Federal Circuit explicitly left it open. Right?

MR. REINES: There is no binding Federal Circuit precedent on it.

THE COURT: Right.

MR. REINES: On that specific question, yes.

THE COURT: Right. Okay. But I will entertain

it. Let's assume we get beyond it.

MR. REINES: Yes.

THE COURT: Let's assume for argument's sake I conclude you don't have a jury trial right to adjudication of the facts underlying the 101.

MR. REINES: Then we're in a bench trial on 101.

THE COURT: All right.

MR. REINES: What I think --

THE COURT: And that's number one. So you want to call this a bench trial?

MR. REINES: I would much rather call it a lot of other things, but I'm afraid circumstances force me to call it that and, you know, we've raised the prematurity. We raised the jury. Your Honor is doing the best that you think you can with the circumstances. Everyone is trying to do that.

The only thing I want to say is in terms of today, come forward and do it, I think in fairness, based on the summary judgment record, because that's the -- we didn't exchange expert reports in connection with this. We have the reports that were submitted --

THE COURT: You can rely on all of that and that's part of the record.

MR. REINES: I'm treating that as part of the evidentiary record in evidence. I want to be clear in

saying in terms of what fact discovery we would do, we put in a declaration before that sets it forth so we're not just waving arms. There are specific things we would propose for that, again, including recognizing their subpoena.

So anyway I've said enough and I'm sure Mr. Johnson wants to speak. If you have any other questions though, I enjoy --

THE COURT: So you think we should treat this as a bench trial and where you were forced to forego your jury trial right?

MR. REINES: Yes, but I don't think that is right to do it, because we have not had the normal procedure that you would have, you know. And I raised this on the phone call that we had where Your Honor heard us out, is that normally, for a trial, you would have all the procedures attendant to a trial in terms of the exchanges and completion of discovery and we don't have that here.

But what is happening is a bench trial. That's what I see it as. I don't see it as a glorified summary judgment motion. I mean, basically, what the issue is, Your Honor, is, and you probably picked this up already, we're under the Markman analysis of whether a question is more appropriately for a jury or for a judge, and both parties have I think engaged under that rubric and so that's what we're doing.

So I think the Court has made the decision that it's a jury trial -- that there is no jury trial, that it's for the bench, and I'm assuming that you're finding facts. You want to see the credibility of the experts and that's where we are and I'm going to do best to satisfy you. In fact, I'm going to do my best to persuade you that your instincts as a layperson in terms of technical expertise -- obviously, your advanced extraordinary skill of the art in the law, to persuade you, because I think the record is compelling that hardly is the technology applied here conventional. But you'll be able to see the witnesses. You're better at that than others.

THE COURT: I agree that, and I probably am guilty of buying into that language about it's conventional. I'm not sure that's the only question.

MR. REINES: Okay.

THE COURT: Okay. I mean, my question is: I read the patents and they're just describing the observation of natural circumstances that correlate, so I don't even know that we get to the conventionality. But I want you to have the opportunity, because what I need to do is, I'm going to leave here for sure, whatever we call this, I'm going to leave here and go back, and starting from scratch, I am going to deep dive into the 101 analysis. That's what I'm going to do.

MR. REINES: And we appreciate that very much. I would like to think at the end of the day you're going to say, maybe I still go with what my initial instincts were, which you probably relied on your instincts a lot and have been glad you did, but I have to give it to the plaintiff. They gave me things to think about. There are definitely points on both sides at a minimum, and when I look at it, I think about it, there are real issues and they presented them well. That's my goal.

THE COURT: All right. Let's see how the defendants want to characterize it.

MR. JOHNSON: Thank you, Your Honor. Kevin Johnson on behalf of Natera.

We're going to try to speak as one voice on this side of the table just so we're efficient.

We agree with you, Your Honor, that from our standpoint, this could be viewed as a reconsideration motion, a reconsideration motion with respect to Rule 56 that this is an extension of what happened in the record on Rule 56 on the summary judgment record.

Your Honor could go further and make Rule 52 findings of fact as well, and so we believe that after today you're going to be presented with unequivocal evidence that there is no issue of genuine material facts here and that you are going to make a finding that the patents are invalid

on Section 101 because they are directed to both Step 1 and Step 2 and they're naturally occurring phenomena with applying conventional techniques that were well-known in the art.

I agree with Mr. Reines up until the part about additional discovery. We think there's no additional discovery that's needed here.

THE COURT: Well, you don't even think we needed evidence.

MR. JOHNSON: That's right.

THE COURT: I wish you would tee that issue up. I wish you had never cited in your statement of facts your expert and proffer, but that's what you did and somebody didn't pursue a motion to dismiss. That's what you did. But you know what? I wish I had done things differently too.

So here's how I view this. I view this as essentially, it is sua sponte on my part offering a reconsideration of the motion for summary judgment by the defendants, but summary judgment in the context of patents eligibility, and, in particular, if that's clear from the way the Federal Circuit has treated indefiniteness, a little bit different.

So I want to make sure that the plaintiff has the opportunity to adduce any evidence it thinks would

preclude summary judgment or would preclude a motion to dismiss adjudication of invalidity. That is the way I view the hearing. And, Mr. Johnson, I don't fault you at all for characterizing it as a Rule 52. I think it is somewhat confusing and I'm sure I contributed to that conclusion. As I said, you know, it's kind of like you make one mistake, it has a lot of ripples.

So I don't think it's going to matter in the sense of, as a practical matter, what we do today. I just want both sides to put on the record whatever they think they need to put on a record for me to make an informed 101 decision.

MR. JOHNSON: Understood.

THE COURT: And at some point later today I will speak with the plaintiff and the defendant. We'll ask what you all want. If you want further briefing, and I will listen to all of that as well. Okay?

MR. JOHNSON: Thank you, Your Honor.

So we are in agreement with the procedure that Mr. Reines laid out.

THE COURT: And I think that's a great process. Okay. We talked about that. We'll start.

MR. JOHNSON: Thank you. And on behalf of the defendants, Mr. Woo is going to present the brief opening.

THE COURT: Actually, okay. That's fine. At

your convenience.

Mr. Woo, you're going to go first?

MR. WOO: Yes, Your Honor.

THE COURT: All right.

MR. WOO: Could we have our slides up, please?

So in the Rule 56 contention that Your Honor has outlined for you, I think that we -- you do have the authority under Rule 56(f)(3) to raise this motion sua sponte and to the extent that it's necessary procedurally, I think my client certainly would join in that.

THE COURT: Hold up a second, please. I've just been informed that the courthouse has lost phone and Internet connectivity, so if you have a problem operating is system, that's going to explain it.

MS. KELLER: May I approach, Your Honor?

MR. WOO: I don't think the Internet is going to be a problem.

I was saying, Your Honor, that if Your Honor -- if procedurally Your Honor deems it appropriate, defendants would join in Your Honor's sua sponte reconsideration or raising Rule 56 motion under (f)(3).

THE COURT: All right.

MR. WOO: So let me just briefly outline where we are to give Your Honor a framework for what we want to present today.

We can actually -- we may have previewed this, I guess, Your Honor. Maybe clairvoyance.

We think the focus ought to be on the fact that there is no genuine issue of material fact or conventionality. The only dispute here is between the intrinsic admissions and the extrinsic opinions of the expert that CareDx is going to offer today and has presented in the summary judgment papers.

And not every dueling expert situation presents a genuine issue of material fact and, indeed, the intrinsic evidence here will show that the written description admits that unless otherwise indicated, the practice of the invention employs conventional techniques within the skill of the art and the only -- and there is no otherwise indicated, anything otherwise indicated.

The patent only disclose existing commercial products -- machines and kits -- to perform the claimed steps in accordance with the manufacturer's instructions because there's no disclosure in the patent of any non-standard ways to use the commercial products. And the evidence that CareDx is going to try to offer that's extrinsic to the intrinsic record we would argue cannot overcome the intrinsic record as a matter of law.

If I could have the next slide.

So with the strength of the intrinsic record and

the patent, we think that all analytic paths will lead conventionality here.

The extrinsic evidence cannot overcome the intrinsic admissions that the patentee made when trying to get the patent. Many courts, as you know, have found on Rule 12 motions. And the patentee is bound, as we say, we argue, that -- to the representations to the public it made about what its invention was about and what it was not about. There is no evidence that they're going to present permitting a reasonable jury to find against conventionality, and that's, of course, the standard for Rule 56.

Dueling expert testimony doesn't raise a genuine issue. There's a case actually on that, Mortgage Grader, 811 F3d., 1314, that says that just because you have dueling experts doesn't mean you have a genuine issue of fact, especially as we have here whereas we'll show today, that the defense expert will not actually directly address conventionality. He goes to tangential things about the technology limitations that are not claimed or disclosed by the patent, so they don't raise a genuine issue.

THE COURT: When you say conventionality, what do you mean?

MR. WOO: So we don't have a case that actually says, Your Honor, in so many words, this is how you

determine conventionality.

THE COURT: No. What do you mean by it?

MR. WOO: What me mean by -- let's skip to -- if we can skip to slide 7.

So what we mean is basically this. We don't have a case that says explicitly directing the district courts how to address conventionality, but we do have the MPEP, the Manual For Patent Examining Procedures, and in accordance with the PTO, conventionality is where you have an element that is so well-known, it need not be described in detail in the patent specification.

And the way the PTO treats conventionality is sort of the flip side of enablement. You know, the patentee, it's well settled that a patentee can describe things in the patent as well-known or understood so that they don't have to go into detail, but when they do that, it's an admission that it's conventional, because there's -- it's not something that they really invented.

And as we'll see from the testimony of Dr. Quackenbush, based on the intrinsic record, there is nothing in the intrinsic record that is not written up. Everything is well-known.

And so conventional we think should be easy found as a matter of the intrinsic record and there's nothing that CareDx can do to raise a genuine issue of

material fact as to that.

If I can just -- let's see, go on to -- actually, this is the next slide.

And that's what we have here. We have here a case like Cardionet, where there's nothing in the specification that says anything specific about how this is good for doing transplant diagnosis other than the conventional steps, each of which is well-known and understood and practiced by commercial techniques and machines that are disclosed in the intrinsic record.

Let's go to the next slide.

And, in fact, here we have a somewhat unusual situation where the patent actually admits that the practice of the invention employs, unless otherwise indicated, conventional techniques of the all of these topics, which are within the skill of the art.

And we've, as Dr. Quackenbush will point out and explain to the Court, there is nothing in the patent that says otherwise. There's nothing otherwise indicated in the patent. It's all about using commercial machines or techniques that are well-known in the art.

And, indeed, we asked their expert at his deposition explicitly, is there anything that is actually explicitly called out in the patent as unconventional? And his answer is kind of, well, it's not quite direct, but he

admits that many of the technologies were known, and just like the patent which says, you know, unless otherwise indicated, he never says -- he never points out anything that's actually -- that's not known. Everything is known that's in the patent specification, the written description.

And he comes up with these other two arguments. One, there are some limitations to the technologies. There are always limitations to the technologies, but that doesn't render them nonconventional or unknown.

And then he also refers to how the application of the -- the application of the techniques to detection of donor DNA in cell-free systems is not conventional or routine. But that isn't a point for 101 either as the may owe, Ariosa and Cleveland Clinic cases point out. If all you're doing is using conventional steps to elucidate a quantification of a molecule that is a law of nature, diagnostic for a certain disease, that does not qualify under Section 101.

Next slide.

And indeed the things that Dr. Van Ness will point to about the shortcomings or the limitations of the technology that is, of the steps that are indicated and claimed by the patent are all things that are not relevant to the 101 analysis because they're not claimed and they're not described anywhere in the patent. And you'll hear about

that as explained by Dr. Quackenbush, our expert.

And then a good example of how all of this comes together and works is the Ariosa versus Sequenom case. The message there is like what we have here. Things that are specified at a high level of generality with no particulars as to how this is an improvement that allows you to do certain things that are claimed here. It is just the steps of the patent -- it is just the standard steps of amplification and so forth to figure out if you've got cell-free fetal DNA and whether there's any defect in the unborn child. And that is basically what we have here.

The case -- next slide. And we put together this slide, Your Honor, because I think it's important to look at the actual patents that were at issue in all of those diagnostic cases that are like this one, which only use conventional steps to figure out whether or not you've got a quantity of a molecule that is diagnostic of a disease.

The Ariosa case is one of them, and if you look at the actual patent, a lot of times the case law, the case decision itself doesn't go into that kind of detail. But if you actually look at the patent that was at issue in Ariosa, which we did, and present on this slide, you'll see that the language that patent uses is much like the language that we see in the CareDx patent. Standard techniques, standard

nucleic acid amplification, using a commercially available kit, the Saiki kit.

And then we have the same sort of thing on the other side in CareDx. The patent admits it uses conventional techniques, techniques known in the art performed by citable method and then citing a number of commercially available machines to carry that out.

And we have a number of other cases in the slide deck that we presented to Your Honor. I'm not going to go through them in the interests of time, but they have basically the same thing. We set out the patent that was at issue and how that compares to this one.

So now that brings me to the patent here in this case. Oh, sorry. There's one other thing I wanted to mention. Your Honor earlier asked about conventionality and we think that based on the MPEP and the laws of enablement, like I said, it's kind of the flip side of enablement where, you know, the patentee gets to claim things well-known, not actually say anything about them.

We think conventionality is established by the written description's admission of conventional techniques, the lack of otherwise indicated nonconventional techniques, the reliance only on commercially available products to perform the claimed steps, the lack of disclosure in the details of how to use those products, the reliance only

instead on the existing art. And we're going to show Your Honor the admissions of CareDx's expert.

Next slide.

Now, let's look at the claimed methods at issue here.

So we asked the other side, asked Mr. Reines whether or not they would stipulate to, that the independent claims are representative and they refused. But we would point out that they have never opposed any notion of the independent claims not being representative in any of the briefing and their expert has not opined on any of the dependent claims. So we think as a matter of law that the independent claims are representative of the dependent claims and we'll elucidate testimony to that effect.

Next slide.

THE COURT: I don't think you need testimony on what they've argued in the litigation.

MR. WOO: Right. You're right.

THE COURT: Just to save you time, because we'll never get through the day if you do that. Now, I'm interested in what they say in response to your argument, but that seems to me it's legal argument.

MR. WOO: Very well, Your Honor.

So we have the claims, the claimed method, and there are three patents at issue and they each have these

four steps in common, more or less. Right? Obtaining, genotyping, sequencing and quantifying. We have color coded them to match those, easy to will follow.

Next slide.

And as to these steps, you know, we're going to hear from Dr. Van Ness, their expert. Would you agree with me that the inventors on the patent at issue in this case did not invent a new technique for providing or obtaining a sample with cell-free DNA? This is the obtaining of samples limitation.

I would agree that they did not develop a new technology.

Do the inventors claim to have invented genotyping?

No.

Did the inventors claimed to have invented high-throughput sequencing in the patents?

They have not.

And were they the first to come up with the idea of quantifying cell-free DNA in the sample? Were they the first?

No.

So we have not only the intrinsic record that makes it clear alone that there's nothing out of the ordinary and nonconventional about these patented steps, and

Dr. Van Ness actually agrees with that. So there really isn't a genuine issue over this.

Next slide.

I think that's it. Yes. And at this point, Your Honor, I would like to turn this over to my colleague, Ms. Haberny, who will present Dr. Quackenbush.

THE COURT: Okay.

MR. REINES: Thank you, Your Honor.

THE COURT: I'm afraid with the internet, is this going to work? The internet is back on. All right.

MR. REINES: All right. So I think to start in walking Your Honor through the state of the art of the technology, there's going to be at least one key question I think for today's proceeding. I would like to start with Lo's 1998 Lancet publication. He clearly stated there the donor-specific DNA sequences are present in the plasma of most liver and kidney transplant patients. You have the patient. The donor is there because of the or began transplant.

Next slide.

Here we are. He states the concentration of donor DNA in the recipient's plasma may be a mark are for rejection.

So I think that we all should be on the same, at the same place, but that's the natural phenomena here and

it's disclosed in Lo's 1998 Lancet publication.

THE COURT: And that may be a marker for rejection. You draw a conclusion from observation of the natural phenomena.

MR. REINES: Is that correct.

THE COURT: But you don't get the patent with that.

MR. REINES: Well, in 198, you could have.

THE COURT: Wait, wait.

MR. REINES: But under current law.

THE COURT: You could patent that you draw a conclusion from an observation of a correlation?

MR. REINES: I don't want to distract this.

THE COURT: No. I want to make sure. That's not patentable. Right?

MR. REINES: Prior to the four Supreme Court decisions between 2010 and 2015, you probably could have and it would have been found. I'm talking about the shifting standards. But under current law, the Alice test, just claiming the correlation would fail.

THE COURT: All right.

MR. REINES: I didn't mean to distract you.

THE COURT: No. I asked you to clarify.

MR. REINES: I took it literally. Could Lo have patented in '98? Probably.

THE COURT: All right.

MR. REINES: Moving to the patent, we looked at column 7 and this goes through and it cites the Lo, Lancet. So I think it's very clear that in acknowledging that, yes, you can use the donor specific cell-free DNA in the recipient in order to determine whether or not you're in a rejection. Okay?

And here, there was a follow-on study and this is all laid out in the patent in Liu and they were trying to figure it out. Said, what Lo tried to do using a conventional PCR didn't work basically is the way I read what Lui's -- what Lui stated, because there was just too much background of the recipient DNA, right, because it's like a needle in the haystack, which is the problem that everyone is dealing with.

So the patent is very upfront that it's not claiming the natural law and it's very upfront what the problem is.

And let's look at the next slide because that will explain this more. It goes through a whole bunch of studies. I'm not going through every chapter and verse. It says, while each of these studies demonstrates donor DNA in bodily fluids, they are all limited to the special case. Just to go through it, microchimerism is --

THE COURT: What?

MR. REINES: Microchimerism. I'm going to explain it because it's a fancy word. Let me explain what I think it is.

The way, the approach in the art at the time of the invention was to, and this is a common thing in the cell-free DNA area that created about a ten-year desert in the development. People were trying to use the internal inherited features of the DNA, for example, the Y chromosome because it's unique to be able to find it amidst the needle in the haystack.

And so what they did was where the donor was a male and the recipient was a female, you could measure the, theoretically at least, the Y chromosome presence and say, okay, how do we have this from the donor because we see it's male, so basically looking male/female rather than looking beyond that. And so a lot of people tried to do that, group after group. It's documented in the specification itself.

And then there were also problems with distinguishing the alleles. Alleles mean just the differences from one person to the other. If you have a C in one place and I have a T in one place, an allele. That's a SNP. I don't mean to overload with it, but single nucleotide polymorphism means single nucleotide difference, SNP, which will come up today. Allele is usually a broader piece, but that's where it has a SNP in it, for example, or

multiple polymorphisms. Okay? Try not to do too much of that.

But microchimerism is as a complication, for example, would be if the organ recipient had a male baby a few months earlier, they might have residual male DNA in their bloodstream because fetal DNA gets into the bloodstream and that would show up as a false positive, so it didn't really work well for that, for that reason, because it only dealt with a quarter of the scenarios, the other reason, and then because they were using, at least in the case of Lo, they were using conventional PCR rather than more advanced tactics. That was another problem.

So the invention was to provide a universal approach where we can deal with it regardless of gender. Non-invasive detection, okay, for all organ recipients without consideration of gender we see there, and it talked about some of the approaches of how we're going to do that.

THE COURT: Incidentally, that is how you read universal? You think that is used in that particular sentence, it's a synonym for not limited to gender?

MR. REINES: I mean, synonym, that's too strong for me. It includes that. Universal means everyone can be treated regardless of gender. But I assume there could be -- you know, you're going to see that we're going to have

some -- Your Honor and I are going to have some respectful disagreements perhaps based on earlier statements about this subject, but part of the whole complication here is there are a variety of ways one could do this. There's just a universe of ways that you could try to approach this.

And so, yes, there are other ways you could do it that would be less than universal that don't rely merely on the paternal, so universal isn't just solving for gender. It's solving for the potential that someone comes up with a method that's not able to treat the entire population.

THE COURT: I'm not sure I understand what that means.

MR. REINES: There could be approaches that have age limitations or whatever, that have some other limitation. The point of it being universal is it covers all people. There's just not one way to do this.

THE COURT: Couldn't the other, the prior -- why did the other, the pre-existing Lo, for instance, not cover all people?

MR. REINES: Because they were looking only for paternal DNA. I mean, because that's what I was explaining. Because they were looking for paternal --

THE COURT: So aren't all people either men or women?

MR. REINES: The Lo technique would not have

applied to -- as shown up on the slides, the Lo technique would not be suitable for a male donor recipient, organ recipient, especially if there was a male donor.

THE COURT: I thought it's only if there was a male donor.

MR. REINES: The state of the art was the only way people were trying to do it in the literature that I showed that's documented in the patent was via a male donor and a female recipient.

THE COURT: Or vice-versa. Right?

MR. REINES: No.

THE COURT: No. Only one way?

MR. REINES: My understanding is it was one way.

THE COURT: Okay. So the technology did not exist for a female donor and a male recipient? It only is a female recipient and a male donor?

MR. REINES: I'm not trying to parse Your Honor's questions because they're good. When the technology -- part of the problem with this proceeding from our perspective is since the natural phenomena was known in 1998 and no one came up with the invention that we have in 2009, that tells you all you need to know.

THE COURT: That's where I think a lot of the mistake came in.

MR. REINES: Okay.

THE COURT: I don't think that the fact that somebody didn't recognize a correlation between natural phenomena until a much later date tells you that it's patentable. What it tells me is it's great discovery. Right? And I think there's a huge disconnect there and I think that's actually, if I really boil down your side, I think that's what your argument is, and I don't think that's right under the law.

MR. REINES: Okay.

THE COURT: That's discovery. But let's not go off on a segue because I do want to make sure I understand, because I think I may have misunderstood.

The reason why I brought up universal, I thought the prior, the pre-existing state of the world did apply to -- it applied to, I thought, and I think it's incorrect now, it applied to situations where the donor and the recipient were different sexes, but that, I think I oversimplified it. It sounds like you should correct me on that.

MR. REINES: I don't know that it's that important. I think the point being is you can tell as why, because a female is XX and a male is XY.

THE COURT: Right.

MR. REINES: Right. So in the case where it's a female donor and a male recipient, if I have this right, is

that what the DNA you're going to find there, it's going to be like, you know, it's going to be XY, XY, XY everywhere. And so the XX of the female is not really going to be very distinguishable from that whereas in the other scenario, you have XX, XX everywhere.

THE COURT: I guess that's why it's only one way. All right.

MR. REINES: But there's like an ultra fundamental misunderstanding here that I think we might need to go back to.

THE COURT: Okay.

MR. REINES: So let's go all the way back -- and, boy, do I wish this thing worked. Go back to the -- back more. Okay. If we could go one more slide.

Okay. Apart from cell death -- so this is what Lo taught. Secondary graft, other cause of tissue damage in transplanted organ would also be expected to result in the liberation of DNA in the patent.

So this is where Your Honor said something crucial.

THE COURT: Right.

MR. REINES: Your Honor said people didn't recognize the correlation until much later and that's not true. People knew the correlation in 1998, and that's on CareDx slide 3, Exhibit B5 at 1-2.

THE COURT: Just so you know -- I will let you go ahead.

MR. REINES: Okay. So the correlation was known in 1998. People knew if we could measure the cell-free DNA in the recipient's blood and we see increases due to tissue damage on cell death from that, there's a rejection process potentially going on. It's not perfect like most things are not perfect.

THE COURT: All right.

MR. REINES: And so people were -- the starting gun had rang in 1998. If you hadn't figured it out before, because there's argument that this went back to the forties --

THE COURT: Okay.

MR. REINES: -- to go and see if you could measure that. Could you come up with laboratory techniques and a strategy for measuring what's going on in the recipient.

THE COURT: Right.

MR. REINES: That could allow you to measure that so that you could exploit the natural phenomena that is the correlation that's disclosed in 1998.

There's no late discovery of the correlation. Sorry. That's why I was cutting everybody out of the pool on that. The correlation was known in 1998.

THE COURT: Okay.

MR. REINES: I don't there's any dispute about that.

THE COURT: All right.

MR. REINES: All right. I will get back to my presentation. Good. It's working. Beautiful.

All right. So universal approach, again, I'm just being careful in my answering. Primarily what they are referring to with universal approach is all genders, but universal is universal. There are all kinds of strategies you could have because it's a complicated area with a world of biological and chemical lab techniques you can use that might come up with other strategies that are partial. That's all I'm saying. So universal isn't a synonym for not gender. It means everything.

THE COURT: Okay.

MR. REINES: Okay. Sorry. Maybe it's the over-lawyer in me for answering it that way.

All right. So the cell-free DNA didn't really become something that was used for a diagnostic tool after the patent. That was a new emerging thing depending on what time you have, '08, 09, '07 and that kind of thing.

And here is a paper that it would be difficult to differentiate the origin of cell-free DNA in the plasma of heart transplants, making the use of plasma-free DNA

impractical for detection of organ rejection.

Okay. So if all of this was so conventional, it's like some someone comes up with doing an auction and we put it on a computer and we kill those patents, because it's trivial. Basically, that's what we have. It's the Alice overlay. You can't take the natural phenomena that appends trivia and say that you're claiming it because the trivia is real old stuff. That's the basic rule putting it in a more colloquial way.

This guy didn't know it and his team of six researchers. They didn't know it because they concluded that it was impossible. The paper came out from the inventors, Steve Quake and his team, including Hannah Valentine, who is a very important figure as well, Stanford professor. It came out, universal non-invasive. PNAS wouldn't publish it if it was just a trivial application of known lab techniques in a robotic way to the correlation that was known since the 1998 Lancet article.

This Hannah Valentine, very prominent. She stated that when she came up with the kernel of the idea -- this, by the way, is a publication -- this isn't a self-serving thing we're presenting to the Court as a puff piece. This is relied on by the other side to show it's conventional. So I'm just using their document.

When I saw that, I thought, wow, this technique

could probably be used to monitor heart rejection, and she came out and she said she had an aha moment, and the point being here because they attempt to use this document to show conventionality, but it can be tricky. Although every human is unique, the actual of sequence of much of our DNA varies very little. That's the needle-in-the-haystack problem. Okay.

Another document they tried to idea on states for the first time, we can now use cell-free DNA for practice diagnostic questions.

Here's Dr. Quackenbush in a proceeding relating to patents from 2012 that was submitted at or about the same time as these proceedings. Unlike cellular DNA, cfDNA, again, try to help you with the lexicon because it can be an alphabet suit. Cf is cell-free. It is typically present in such low concentrations that detection and analysis was difficult with prior techniques. He's talking about a 2012 patent that existed, said prior techniques.

Prior to 2012 made it difficult because cell-free DNA is so, is such low concentrations. That's the needle-in-the-haystack problem.

Here's another statement. A person of ordinary skill in the art would not expect a method designed for cellular DNA to be applicable to cfDNA. So all of these conventional techniques that everybody knew about at the

time, you would just assume you could apply it to cell-free DNA and voila, it's simple to do. And, again, this is in the proceeding regarding the 2012 date.

Next slide.

So looking at the claims, the claims have all manner of specifics. Simplifying has four.

THE COURT: Just again so I can understand, what I understand you to be saying is, there's an aha moment, to use your terminology, that contrary to kind of conventional thought -- I shouldn't use the word conventional. So let me start over.

You are saying there's an aha moment that these conventional techniques, these existing techniques actually could show the correlation?

MR. REINES: Could show is the problem. It's laboratory techniques performing measurement having to pick a strategy for doing it and then selecting the steps that would work.

And so --

THE COURT: So that being the steps --

MR. REINES: Yes, yes. It's not a crazy thing. You asked a question. So Hannah Valentine is in the medical school more focused on organ transplant patients. Steve Quake, extremely prominent, was a leader in cell-free DNA for fetal diagnostics, Down Syndrome tests, because you can

get the fetal DNA and figure out if you've got Down Syndrome rather than extremely invasive and often fatal amniocentesis. There is a five percent kill rate.

So he was recognized broadly. Had a company that he started in that area. Also he worked at various companies. Helicos you'll hear about a fair amount of time. He was the founder of Helicos.

So he was at the cutting edge of using a very new technique called next generation technology. By no means conventional in 2009 from our perception. We will show you evidence that I think will back up what I say and everything that I way.

And Steve Quake was a leader on using sequencing for cell-free DNA analysis. So when Hannah Valentine learned about -- that Steve Quake with his advanced sequencing techniques in his lab, she put the two and they got together and they collaborated and they came up with the detail. It wasn't like she said, you can just buy a toaster oven and do this.

THE COURT: The way you describe this, you make it looks like it's a new technique.

MR. REINES: What's new is -- this is all emerging technology. Anyone who says this isn't emerging technology in 2009 is I think inconsistent with the record.

Next generation sequencing was new. It was a

couple years old. You could buy beta systems. Advanced Ph.D.s might have the system. Generally, people of ordinary skill in the art, certainly, their person of ordinary skill in the art with a bachelor's, Dr. Quackenbush, isn't getting these advanced systems with knowledge of how to work them.

So NGS is emerging and cell-free DNA science at a diagnostic level measuring it is emerging. That's why I think that's what it is. That's how it is. And we think the evidence is going to show that definitively.

So here you go through the claims. You provide the sample, talk about how you do that. You extract the cell-free DNA from the sample. You selectively amplify now target deoxynucleotide sequences. That can be complicated because what you have to do -- you can't use the whole genome because -- -well, you could use the whole genome. Someone might have a method of doing it with the whole genome.

But one approach, a strategy, you selectively amplify it so that you are only pulling out the DNA from the whole genome in the sample to only what areas you're interested in that you think will tell the difference between one person and another person. Okay.

But when you do the selective amplification, there are problems with that that Dr. Quackenbush knows all about. It's in that declaration I showed, which is you've

got to use primers, and the primers can have conflicts. It's just not simple to do selective amplification and target -- and selecting targeted. That's one strategic decision.

Having a thousand --

THE COURT: So does the patent teach a new way to do that selection?

MR. REINES: I don't -- I don't think it invents -- typically, that's called multiplex PCR although they bring up the concept of using droplets. They basically say there's a system of using droplets.

THE COURT: But the bottom line it's known, it does it.

MR. REINES: The droplets were released. The first product using droplets, a client of mine, I tried a verdict in front of Judge Andrews. That product, and we'll show you today, was released in 2009 -- was released in 2009, the droplet product.

So, yes, Dr. Quake didn't invent the RainDance new droplet machine, but to say it's so obvious you would use the droplet and do target and do this and do the other thing is just inconsistent with the fact that it took ten years for people to figure out how to do it in. And in 2008 I just showed you one example of someone saying it can't be done and then all of these people are following the wrong

path of trying to look for the paternity inherited, because they were more comfortable with that strategy.

So, no. You know, almost all inventions are made of known things. That's like saying, you know, if you came up with something knew that used known material, that therefore you never have an invention, right, and the common Supreme Court statement that almost every current, contemporaneous invention is made up of a new combination of known elements.

THE COURT: You know, it sounds to me like, and I've got to think of it like an analogy that would be very -- make it understandable. It's like the technique, it's undisputed you did it.

MR. REINES: Which technique?

THE COURT: Selection.

MR. REINES: Well, that one is.

THE COURT: It may have occurred very recently, but it exists.

MR. REINES: Yes, step C, although a thousand -- using a thousand where you're looking at the thousand single nucleotide polymorphism, I don't think they've shown that to you in the record. That's a lot, that's a lot, because you have to put in -- you have to put in primers to get the PCR and they can have conflicts, so you have to pick the primers.

That's why Dr. Quackenbush in the Guardant case is so adamant that it was very hard to do this kind of thing. Actually, it's in the Natera case, too, where he said it, but the point being, you know, the Supreme Court stated, you know, again and again that while a natural phenomena is not inventive, a process is not -- unpatentable simply because it contains a law of nature and that an application, italics emphasized, of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection, because if you get into this, and Diamond v. Diehr is must reading for this. If you get into this analytic dissection where you dissect out each element, is it old, is it old, is it old, Diamond v. Diehr, it's a ridiculous way to do it. You can't do analytic dissection because nothing will survive. You have to look at the claims as a whole, a new combination. So let me leave it at that.

So it's a thousand single nucleotide polymorphisms, not conventional in my view, performing a high-throughput sequencing reaction, not conventional. The high-throughput with a new --

THE COURT: Well, it's new. Does the patent tell you how to do it?

MR. REINES: Yes.

THE COURT: So you're telling me --

MR. REINES: I'm going to show you. The patent goes --

THE COURT: That I would not have known how to do high-throughput sequencing unless I read this patent?

MR. REINES: A person of ordinary skill in the art might not have, especially if they've only got a B.S. What we do, what the patent does, it spends a lot of time on it. It takes you to patent applications because it's newly breaking.

You know, as Your Honor knows, patents don't just issue, so it takes the patent applications to describe them. If it was so well-known, and that's the otherwise indicated that the other side has made much of.

If I could go through, I will try to be as, you know, I will try to be as efficient with your time as I can. But, yes, high-throughput sequencing was an emerging technology. That's a fact. Okay.

Providing sequences, quantifying the amount and then using markers distinguishable between them. We talked about that, using the 1,000 single nucleotide polymorphism.

This is a similar thing. They are each different. You know, here there's a reference to digital polymerase chain reactions, digital PCR, or high-throughput sequencing. So it just shows you, it's not just one technique. Your Honor treats it like it's so obvious, you

would just use it.

THE COURT: First of all, I'm not saying it's obvious.

MR. REINES: Okay.

THE COURT: What I'm saying is this. I'm trying to think of an analogy that communicates how a Joe Six-Pack thought.

MR. REINES: Sure.

THE COURT: That's where I would rest. All right? And what it looks to me is, you've got techniques of observation, and maybe some of them emerged recently, you know, like six months before this patent ask applied for, maybe some were from 1998. Okay. But they were existing. And you're --

MR. REINES: Like every case.

THE COURT: Is there any technique? I mean, does the patent teach or claim a new technique?

MR. REINES: It depends what you mean by technique. Yes, it's a new method.

THE COURT: Doesn't it really, what it teaches you is applying existing techniques to make these observations? That's what it seems to me.

MR. REINES: In the new combination, yes.

THE COURT: Well, we'll get to the new combination. That's what we'll get to.

So the equivalent to me is, you bring up, oh, this high-throughput. Please, you need to correct me if I'm wrong. The way I understood it was, the folks that read this patent, they know what high-throughput is. They know how to do it. But nobody thought to, to give you the best case scenario, nobody thought to apply it, to look for the free-floating DNA and make the observation that's necessary to decide whether there's going to be a rejection or not.

So to me that's like saying, go back to somebody invented a pair of binoculars and you just figure out where you focus it. What you are trying to say, somebody realized, point the binoculars at a certain section of a forest or a certain section of a tree and you can make determinations that nobody ever, until your guy came along, nobody ever thought to point the binoculars at that particular spot of the forest or the tree. That's the way I'm seeing it. Now, you should disabuse me of that.

What I want to make sure though is, my starting point is that all the techniques, according to the written description of the patent, there's nothing knew about that. They are "conventional," but what's inventive, what's new -- yes, inventive about the patent is, as you say, the combination, the order of the techniques.

Is that a correct summary?

MR. REINES: No. I have a lot of problems with that.

THE COURT: Okay.

MR. REINES: I think a lot of it is from the legal perspective, and when you see patents after patents in case after case, what you just said could apply to virtually any invention that comes along. Okay. That all the pieces were known and someone just had to use their wits to figure out that two and two equals four.

THE COURT: No, no, no. That's where I disagree with your summary of what I've just said.

MR. REINES: Oh.

THE COURT: I'm talking about when somebody tries to patent what is ultimately an observation of natural phenomena. They are not creating phenomena, they are observing phenomena. They are observing free-floating DNA. Right?

What I'm saying, it's not an obvious thing. It's relating solely to patents that are directed at testing, i.e., observing and making correlations about natural phenomena, because we agree, right, free-floating DNA is a natural phenomenon. You agree with that.

MR. REINES: Yes.

THE COURT: Okay.

MR. REINES: That's in the prior art. The

patent acknowledges that. It's not claiming it as the invention.

THE COURT: Even if it wasn't prior art, it's a natural phenomena. It's out there.

MR. REINES: Right. The fact -- I don't want to get in loops, but the fact that the patent acknowledges it makes clear it's not claiming it as an invention, it makes clear it's not claiming it's as an innovation.

THE COURT: The patent acknowledges I think in the written description all of the techniques you just identified.

MR. REINES: Well, by acknowledges --

THE COURT: It discusses them, doesn't it?

MR. REINES: Of course it does.

THE COURT: Okay.

MR. REINES: Of course, it does.

THE COURT: And it doesn't claim, it's doesn't say I'm teaching you in my claims how to conduct high-throughput -- I'm sorry. What's the word?

MR. REINES: High-throughput sequencing.

THE COURT: Right. It doesn't claim that.

MR. REINES: Let me just --

THE COURT: Is that right? It doesn't claim that. Right?

MR. REINES: Yes. It's not an invention of new

sequencing method.

THE COURT: Okay.

MR. REINES: But that's so extreme that it just shows how it can't be the right inquiry.

So let me, from a legal perspective, okay, just because I think there's a lens issue on this. The question -- if the question was, especially where the natural law is a known thing to workers in the field and acknowledged such by the patent, the issue is what did they do more that they are claiming as an invention and here it is they came up with a new measurement method, set of laboratory techniques for doing this. Okay? That's clearly what they are intending to patent.

Now, as Judge Burke said, maybe that's frivolous. Maybe that's like Joe Six-Pack would know how to do that himself. You go buy a sequencer at the 7-11 and you put it in and you're done. That would make it obvious. But what we -- but what's clear is what they are claiming is the new measurement technique that you may not like. Okay?

Now, that's Step 1. That's why we don't fail Step 1.

Step 2 --

THE COURT: Where is the new measurement technique that it claims?

MR. REINES: This combination of -- this combination applied cell-free DNA.

THE COURT: And that combination of techniques, it all existed --

MR. REINES: If you analytically dissect it like Diamond v. Diehr tells you is the siren song of one practitioner and one judge after another, yes. If you want to do an analytic dissection, we say is multiplex known, is sequencing known, is of known, cell-free DNA known, is this known? Yes.

If you go through an analytical dissection and say is every concept in there, is it an invention of any of those, is that the invention? Yes, your answer will be, no, each one thing in there isn't an invention.

THE COURT: Right. It's the combination. You will say this, the order of them?

MR. REINES: I think it's the order of them in the combination, but I think primarily, most persuasively, it's the application of them to the context of cell-free DNA, which is, because it's so hard to measure, to come up with a method and have the insight that this will actually work for this when all the workers are going in the wrong direction. But all of these are obviousness questions.

The point is, what is being claimed? They are

not claiming the natural phenomena. They're not saying our invention is the natural phenomena, that's what we cover, that's why we have a patent.

What they are saying is, we've came up with this new measurement method that Judge Connolly is skeptical of to apply the invention. And Hannah Valentine, Steve Quake think that was an invention and PNAS, and Judge Connolly on a weekend reads just the first pass, whatever, third pass, doesn't think that that is an invention.

Okay. That's a dispute. But the point is, under Step 1 we're asking what are they seeking to claim is the invention, and they are not seeking to claim the invention, the natural law, the correlation, because they acknowledge that it's in the prior art. What they are seeking to claim is this set of steps that you think is obvious. I'm going to call it for what I see it.

And they are saying, we don't think it's obvious. Now, Step 2 --

THE COURT: Let me just ask you a clarification on Step 1.

MR. REINES: Sure.

THE COURT: Observation of natural phenomena, what's that?

MR. REINES: If it was just merely, that's the Ariosa case and that's why it's so different, which I was

involved with as well.

It was basically a lab proof. I don't know this is Joe Six-Pack. Think of it as high school lab class. It was to say, those claims fall because all they said was I detect cell-free DNA in the blood.

THE COURT: Yes. And my question is: Is observation of --

MR. REINES: They were claiming that was the invention. They said no one ever knew that.

THE COURT: Observation. If a patent purports to just patent observation of a natural phenomena, right, is that Step 1?

MR. REINES: If the observation uses an innovative measurement technique or observational technique like, you know, comes up with using selective amplification --

THE COURT: Let me do it this way. Let's say I went and I tried to get a patent. I said, I saw with my naked eye, I saw a natural phenomena.

MR. REINES: That's a good analogy.

THE COURT: Is it patentable?

MR. REINES: Under Sequenom v. Ariosa, no, although people disagree.

THE COURT: Isn't it Step 1?

MR. REINES: That claim is directed at the

natural phenomena because it's just the proof.

THE COURT: That's my point. I think you have oversimplified when you said it's -- that nobody purports here to claiming natural phenomena and you've taken issue with my skepticism of that, because just so we're clear, and you need to correct me if you think I'm wrong, and you will.

I understand the first step of Alice when it says you can't patent natural phenomena. I understand that includes you can't patent observation of natural phenomena.

Now, I want to hear the other side, but that's how I understand it. And if you both think I'm wrong on that, please let me know, because that's the way I view it. That's why you can't only not patent energy, you can't patent the observation of energy, and that's why you can't patent Einstein's E equals mc squared. And so it's not just, because I know it literally says you can't patent three categories. I understand it simply at least includes observation of natural phenomena. Am I wrong on that?

MR. REINES: Certainly.

THE COURT: Okay.

MR. REINES: Okay. And the reason is, the simple way, just in terms of logic is if you came up with something that satisfied you that Hannah Valentine and

Steve Quake came up with a new way of measuring cell-free DNA in an organ recipient, okay, let's say you said, wow, they came up with the high-throughput sequencing NGS, although everyone knows Quake wasn't one of the leaders in that field, but not just this patent.

You would say even though the claim is to the observation of a natural phenomena, I don't think Your Honor would strike that down, you know, invite summary judgment motions and all of this. I don't think you would do that. Right?

So when you are saying -- do you understand what I'm saying?

THE COURT: I do and I wouldn't.

MR. REINES: Okay.

THE COURT: Because the observation in that case would be -- the observation would be the output of the measuring device. It wouldn't be talking about object serving --

MR. REINES: Okay. This is the output of the multiplex sequencing. I mean, the analogy is one to one. There's no daylight there.

THE COURT: Except you're not claiming these measurement techniques. You're saying they pre-existed in the field.

MR. REINES: That is to be measured under --

whether this combination of a method is to be measured under traditional standards of whether it's actually obvious or not.

That's what Your Honor -- I'm telling Your Honor that is what your gut is about, is that you think it's obvious to put this combination of things together. That's what's going on here. And that's not to be done back of the envelope for important patents by major inventors in the field and just say, that's -- read it over the weekend.

You pull out this from 2009, this technique from 2008, this from 2007. You put them together, voila, everyone would know that, invalid, back of the envelope.

No. So what I'm saying, Your Honor, is that whether -- this is a method of laboratory techniques for measuring the cell-free DNA. That's what they are saying the invention is.

You are not buying it. Okay. I will have to live with that for at least some period of time. But that is what the debate is.

Now, the Step 2. So I explained to you why I don't think it meets Step 1. We've had our back and forth. I'm confident it meets Step 1 because they are not saying what they are claiming, what the claim is directed to is the natural phenomena. They're saying we came up with all of

this as a combined method that is at first pass, your view is that seems like not much. Okay.

And that's what Judge Burke said. I'm not saying what they did was great. I'm just saying that's what they think they directed their claim to and that's eligible subject matter.

Now, you go to Step 2, and the point of Step 2 is you can't just put to nothingness on top of it. Right? It has to be something more than just put it on the internet, right, where a lot of this started or got their fuel from in the software field, the insulting inventions that we all see, kind just put it on the internet. No. That doesn't turn something that's not inventive to inventive and I get it, I get it.

But here, I don't think we're at that trivial level where you're in a position, and that's why you -- the people have all these expert reports. That's why we're looking at literature. That's why we're having witnesses to say I think that's all ultra obvious to the point that it's just tack on, throw away. I think we're going to show that it's actually inventive, because if it wasn't inventive, then why did no one do it after 1998?

Now, that goes to your question about, well, it was all known, because in 2009, there was something that came out. That's not the standard. The well-known

conventional is like stuff that if there's not really an obviousness debate about it. That's why the Supreme Court called it akin to obvious. It's not an obviousness analysis, but it's higher standard. It can't be a lower standard than obvious. I mean, it can't be that it's easier to show that it was just, the application of conventional, well established stuff, that doesn't have any inventive concept, and that's easier to prove than all of the safeguards you have in an obviousness analysis for secondary considerations and everything else.

That wouldn't make any sense at all and that's what we have to avoid falling into is saying, like, I think this combination is obvious and that's what I'm going to try to show today with the aid of my team and Derek Walter. We're going to try to show you with our expert, Dr. Van Ness, that people cell-free DNA with a needle in a haystack and these techniques were around. They were emerging. And putting this combination together and doing it with a novel and nonobvious invention, we're not going to have to prove that today, hopefully, but it's not a trivial laboratory technique like we see in the software cases or the business method cases where we were all offended. Okay?

So I feel bad for Mr. Johnson. If I could move on to the rest, I will try to finish up relatively quickly.

THE COURT: Sure.

MR. REINES: All right. So this statement, which is -- I think the other side knows the deal. I think the other side knows that this is all -- you know, isn't really Step 2 stuff. I mean, they can speak for themselves and do quite articulately at that. They know at a minimum there are going to be fact disputes and they don't think the Court should be deciding them in a bench trial before the jury. Maybe that passes muster with the Supreme Court ultimately, maybe it doesn't, but there's enough debate that they want to focus on the intrinsic evidence. I'm just going to be candid with you, because that's the way to steer away all of this stuff.

And this is the sentence that they rely on. Now, all of these techniques here are boilerplate animal cell culture, molecular cloning. These are -- none of this is high-throughput sequencing, selective amplification. And it does say, unless otherwise indicated.

And if the patent really thought that it was doing nothing except just claiming the natural law and that -- I mean, this would be a confession. The Court would be holding this as a confession of obviousness or confession that there's no invention here, because they use this language once they admit that the correlation was known in the art, because you would just say, okay, the correlation is known, all the techniques are so obvious, known, and how

to combine, they're known and how to apply them are known, there's no patent. That is preposterous.

But let's look at the specification and let's defend it unless otherwise indicated. Okay. The invention provides a universal approach. So they are saying people were doing it a different way and we're doing it using the sequencing technique and we're going after the cell-free DNA systematically through the methods that we described.

So they are not acknowledge that they have no invention in terms of the measuring techniques. Now, here, this is what Your Honor is asking about. I'm glad we put the slide together.

This, did the patent just say, high-throughput sequencing, go grab your typewriter, pick up a laptop? No. It went through high-throughput sequencing involves the use of technology available by Helicos and then it describes it with patent applications. Now, the fact is, Helicos sold one system, one system. So there's one set of people skilled in the art that had it.

Dr. Quackenbush's lab ordered it and never got it. He was a scientific advisor in '08, so he was a scientific advisor to this new sequencer, a sequencer that ended up only having one sale.

It's telling you what you can use with the pico titer plate.

U.S. public patent applications, it's not issued.

And down here at the bottom, and all of those were incorporated by reference.

So, no, people didn't know you could just click on Amazon and open up the instruction manual and do this. This was emerging technology. Here we go.

THE COURT: Do this, what's "this"?

MR. REINES: Oh, in this case? Well, there's the whole -- it's the whole method which in some case one has selective amplification with SNPs. Another has digital PCR --

THE COURT: You were talking about high-throughput.

MR. REINES: Different things.

THE COURT: What does the "this" mean when you said it?

MR. REINES: When I said "this," that the person wouldn't know that they could just click on Amazon and get it and use the instruction manual and get it right, that's referring to the entire claimed invention, which is different in the three patents. Okay?

But this is dwelling on how you would do high-throughput put sequencing, which was an emerging technology by any measure. That's why these are all patent

applications. There may be a patent number in there, but it's largely patent applications.

Here we go. High-throughput sequencing of RNA can take place using AnyDot in Germany, patent application. In particular, it allows for tests, and it just gets into the detail. So, no, they didn't assume that a person skilled in the art could just go down to their local Safeway and pick it up.

It explains here that, you know, that we're using this kind of sequencing with a target nucleic acid approach, which is where you're not doing the whole genome sequencing. Just another approach.

Now, here we go. This is a 2008 publication of John Quackenbush, their expert. Although -- he says, although we have not quite reached the point where cost and technology are no object, new sequencing techniques, that's the stuff that, you know, I don't want to say one to one, but that's related to the techniques just described in the patent application, have not simply changed in landscape, but have placed basic clinical and translational research scientists into a new and unfamiliar world in which entirely different types of questions can be addressed. This is in 2008, right before the critical date.

The rapidity with which this change has occurred has left many unaware of the opportunities that these new

technologies provide. However, even though those aware of the opportunities are faced with the issues of the upfront costs and infrastructure that limit access.

Here's something relied upon by the other side, which is what I like to do. This is a chart that you'll notice in the papers, it's in their expert, Dr. Quackenbush, in his report he included this.

Next generation sequencing, which is high-throughput sequencing. That's not disputed. Complex sample preparation, limited scalability. Limited quantitation, which is the very issue. Can you quantitate the amount of the cell-free DNA as it changes? Okay. This is December 31, 2007, state of the art. And if you look at Quackenbush's expert report, his go-forward expert report, and he cites this as the state of the art at the time. Yellow flags abound.

Also from Helicos where Dr. Quackenbush was the scientific advisor, NGF -- and this is in 2011. NGF technology, next generation sequencing, high-throughput sequencing, appear to said biases and are hampered by the lack of absolute quantitative accuracy. Additionally, the practical application of sequence data for molecular diagnostics, bing, bing, bing, bing, bing.

THE COURT: Does the patent claim any technology that increases quantitative accuracy?

MR. REINES: I think it puts together the state of the art of quantitative accuracy, because Dr. --

THE COURT: So my question is, and I think it's a yes-or-no answer: Does the patent claim a technology that increased quantitative accuracy?

MR. REINES: Over what everyone else could do at the time? No. There's not, like, the people of extraordinary skill in the art, could they do something and did he put several together that weren't applied in this way? Definitely.

Here's another one, 2009, the systematic errors of the NGS technology. These are yellow flags. It didn't mean you couldn't do it. Obviously, you could do it. Otherwise we would be having a different debate in front of you.

To be clear, we're not saying in any way you couldn't do it. We're just saying this isn't conventional. I mean, it seems so easy. This isn't like, oh, easily, you just used that, which is what the test is. Is it so conventional to use this stuff, because look at all the yellow flags.

Although recent improvements in the NGS platforms will mitigate these issues. All aspects of the NGS platforms, laboratory methods, sequence alignment tools and base calling algorithms partially contributed to the

problems, and therefore it needs to be simultaneously optimized. Yes, with the guidance in the patent as to what the goals are, what combination of techniques you use, you can do it, there's no question.

This is the Harris paper. This is their evidence. This isn't our evidence. This is their evidence. I'm sorry. This is ours. I apologize. I apologize. But there's plenty more.

So we're at the point of ours. This is a 2009 paper. As the day goes, I want to be clear whose is which if I misspoke. The same thing. There is no consensus as to the magnitude of technical variation in NGS in 2009. The cost has dropped dramatically.

Here's Natera's scientist. Okay. This is Zimmermann, Dr. Zimmermann from Natera, 2008. As to date, only two potential proof of principle studies have been performed, been performed. It is too early to answer these questions. This relates to digital PCR, which is a different technique, which just shows you there's not just one technique where you do this. Digital PCR can be used, too, for this organ rejection analysis to do the quantitation. It just shows you it's not one-dimensional.

This is Natera's scientist. I think I said it right. It's on the slide. The establishment of multiplexed reactions is generally a major challenge and this is not

possible for SNP-based approaches where you're looking at multiple SNPs at one time.

Just to break down that argument for you, well, you could do a thousand each in its own test tube, which isn't very practical and they won't show you anyone that ever did that, because otherwise you have to multiplex that, which is a major challenge, as stated in this article, or they say you can use the new RainDance system that came out in 2009 and use droplets, where each droplet effectively serves as a test tube and you can do it that way. These are emerging techniques, well established.

Here we go. Dr. Quackenbush. Multiplex PCR, which is this idea that in one tube, you're going to look at multiple SNPs. When multiple pairs of primers are added to the same PCR reaction, nontarget amplification products may be generated -- that's bad -- such as amplified primer dimers.

This is particularly applicable to the situation as claimed in which one wishes to measure the DNA of one individual in a biological sample of another individual. Doing this multiplexing PCR, it's complicated.

Now, it's doable. And did Dr. Quake invent multiplex PCR? No. Did he recognize if you couple these techniques together, he was claiming that as an invention, not the natural phenomena, and that answers question one.

They rely on the Cantor reference, which is a patent application. What Cantor used is something else, mass spectrometric analysis. Okay. And he was mostly -- this patent is really focused on fetal diagnostics. Late-breaking. I mean, the patent they are relying on is a patent application. I don't know when it was filed, but this is a 2007 publication.

We showed a feasibility of the use of mass spectrometric analysis for the discrimination of fetal point mutations. We further show the feasibility of the approach for the minimally invasive prenatal diagnosis. So digital sequencing, mass spec.

So the Cantor reference they rely on and say, oh, this is old hat does not describe genotyping profiles to identify SNPs. It uses something else, which shows you it's not just clicking on Amazon and no disclosure of sequencing.

Now, they rely on this Gordon reference. It's about elk and cattle. Even they admit that it's pretty far afield. That they rely on to show you it's new. Next generation sequencing provides high numbers of DNA sequencing to detect the trace amounts of unique zero biomarkers associated with breast carcinoma, because this is also cancer, the cell-free system. This is 2010. It's not hardly well established. So for these reasons the claims

are eligible under both Alice Step 1 and Alice Step 2.

And I'm happy to answer any other questions. We're going to present the experts. But I hope we're having better communication than I've been able to achieve prior to today.

THE COURT: All right. Are you ready?

MR. REINES: Thank you.

THE COURT: Next?

MR. JOHNSON: Your Honor, unless Your Honor has any questions, we would call the first witness, Dr. Quackenbush.

THE COURT: All right. Sounds good.

MR. JOHNSON: And Sandra Haberny is going to handle the direct examination.

THE COURT: All right. Thank you.

MS. HABERNY: Good morning, Your Honor.

THE COURT: Good morning.

MS. HABERNY: Your Honor, we have some exhibit binders we'd like to hand up.

THE COURT: Okay.

MS. HABERNY: May we approach?

THE COURT: That would be great. Thank you.

For the record, I think it's important. Anything that has already been put into the record is in the record and anybody can refer to it in any way they

want.

MS. HABERNY: Thank you, Your Honor.

MR. REINES: Your Honor, I apologize. We didn't hand these out. It was my oversight.

THE COURT: All right.

MR. REINES: May I approach?

THE COURT: Please.

... JOHN QUACKENBUSH, having been duly sworn/affirmed as a witness, was examined and testified as follows...

DIRECT EXAMINATION

BY MR. HABERNY:

Q. **Good morning, Dr. Quackenbush.**

A. **Good morning.**

Q. **Did you prepare slides that you would like to use in your testimony today?**

A. **Yes, I did.**

Q. **I believe we've pulled those up for you. Would you please turn to Exhibit A1 in your binder.**

A. **I don't have a binder.**

Q. **Oh.**

(An exhibit binder was handed to the witness.)

THE WITNESS: Now I do. All right.

BY MS. HABERNY:

Q. **Do you have your binder now?**

A. **Yes, I do.**

Q. **Would you please turn to Exhibit A1 in your binder.**

A. **Yes.**

Q. **Is this an expert declaration that you submitted regarding your Section 101 opinions in this case?**

A. **Yes, it is.**

Q. **Okay. So before we dig into your opinions in detail, would you please tell the Court how you're currently employed?**

A. **Certainly. I have a slide that has some of my qualifications.**

So I'm a Professor and Chair of the Department of Biostatistics at the Harvard School of Public Health. I hold a number of other academic appointments. So I'm a professor and former director for the Center for Cancer Computational Biology at the Dana-Farber Cancer Institute.

I'm also a professor at the Chan Division of Network Medicine at Brigham and Women's Hospital, and I'm the director of the quantitative biomedical research center at Harvard.

Q. **Thank you.**

Would you please describe your experience for the Court and your qualifications that are relevant to the patents we'll be discussing today?

A. **Certainly. I started working in 1992 on the human**

genome product. I worked for, first for the Salk Institute, so part of the DNA sequence sequencing process.

In 1994 I moved to Stanford where I started working on strategies for mapping and sequencing.

In early 1997 I moved to a place called The Institute For Genomic Research. There we did large scale DNA sequencing. We did analysis of genes and gene fragments. We developed technologies and applied them for understanding how genes turn on and off in different ways.

In 2005 I was recruited to the Dana-Farber Cancer Institute because there was this rapid expansion of genome data and genome technologies, and I was recruited there to help with this strategy and I worked at the Dana-Farber Cancer. Part of the work we did there included the analysis of circulating tumor DNA.

In 2008 we had a high-throughput sequencer, a next generation sequencer that was funded by a local charity.

In 2009 we got a federal research grant to upgrade that, and the work I've done since involved large scale analysis of many types of data, including cell-free DNA data.

Q. **And would you please describe your experience relevant to high-throughput sequencing, which is one of the**

technologies we're discussing today?

A. **Certainly. So I worked at the Institute For Genomic Research and that was one of the early centers involved in sequencing the genome, the public genome, and we had a large collection of DNA sequencers that would generate thousands of bases of sequence every day.**

When I moved to Dana-Farber, I got one of these -- one of the commercial sequencers. It was the Illumina Genome Analyzer II, and in 2008 we sequenced an ovarian sequencer genome. It took us about two months. When we got the grant and got the next sequencer in 2009, we did that in two weeks.

So I was involved in that kind of sequence generation while I was at Dana-Farber. We also sequenced in cell-free DNA, worked with a group at MGH that was looking at brain tumor cell-free DNA and I did some work with some ovarian cancer circulating DNA and breast cancer circulating DNA.

Q. **Thank you.**

Dr. Quackenbush, what were you asked to do for this case?

A. **So I was asked to look at the patents, the claimed invention in these patents, the technology that was used, and simply to look at whether the technologies in isolation were routine and conventional as of the time the patent was**

filed and whether the combination was something that was considered routine and conventional.

Q. **And what are your opinions regarding that?**

A. **So I think it is summarized on the next slide.**

The claims recite routine and conventional methods at a high level of generality. They simply tell us to use conventional techniques.

The written description discloses only the use of standard or commercially available machines or kits for performing the methods.

The patents themselves don't teach or disclose any protocols whatsoever other than to use the existing technologies.

The patents don't disclose or teach any modifications for the standard use of the recited methods. They also present a combination of methods, but that combination of methods is really a logical combination that one would apply in a straightforward way to arrive at the desired result, and that was in conventional use as well where other applications like cell-free DNA from tumors or cell-free DNA in neonatal testing, prenatal testing.

Q. **Thank you.**

I'd like to ask you some more detailed questions about your opinions, but first why don't we present to the Court an overview of the patent claims that we'll be

discussing.

A. **All right.**

Q. **So to clarify first for the Court, do all of the patents share the same written description?**

A. **Yes, they do.**

Q. **And do all of the patents share the same priority date?**

A. **Yes, they do. I believe it's November 2009.**

Q. **Thank you.**

And how many independent claims are in each of the patents?

A. **Each claim has one independent claim.**

Q. **Okay. Would you please walk us through an overview of the independent claims in the patents?**

A. **Certainly. So in analyzing this, I've grouped the claims in four steps or four components. Element 1 is obtaining or providing a sample, which has transplant recipient cell-free DNA in that sample.**

The next is genotyping, and this involves detection of what are called polymorphisms or SNPs, single nucleotide polymorphs and using them to generate profiles.

Then the next element is sequencing the cell-free DNA using what they refer to as a multiplex or high-throughput sequencing or using other technique called digital PCR.

And then the fourth element is determining or quantifying the amount of donor cell-free DNA.

Q. **And would you please show us where in claim 1 of the '652 patent these steps are found?**

A. **Certainly. So claim 1, it's very easy to see. Sub-element A is providing a sample.**

Claim --

THE COURT: I'm good with this. Your papers were good with this. The slide is very helpful. I'm just cognizant of time. You know, you're good. You've got your four steps. You can move on. All right?

THE WITNESS: All right.

THE COURT: I want to make sure both sides get to present what they need to.

MS. HABERNY: Understood.

THE WITNESS: The four steps are here.

BY MS. HABERNY:

Q. **And one final question about the four steps: Are the patents directed to using these four steps to observe a naturally occurring phenomenon?**

A. **Yes. Cell-free DNA coming from a transplant.**

Q. **Thank you.**

So I would like to ask you about the conventionality of obtaining a sample containing cell-free DNA. This is found in the '652 patent, claim 1A, the '497

patent, claim IC, and the '607 patent, claim 1A.

What is your opinion on whether a person of skill in the art would understand providing or obtaining a sample of cell-free DNA as recited in the claims to be conventional as of November 2009?

A. **So this is a conventional technique. It was well-known in the art.**

Q. **And do the claims replace any particular technique or method or protocol for obtaining a sample of cell-free DNA?**

A. **The claims don't provide any guidance other than to obtain or provide this.**

Q. **Does the written description provide any guidance as to how to obtain a sample of cell-free DNA?**

A. **The written description has just one statement about the cell-free DNA. Call that up. It simply tells me to use any method known in the art such as a syringe or a vacuum tube.**

Q. **Slide 13, please.**

Did you see anything patents that indicated the inventors came up with a nonconventional way to obtain cell-free DNA?

A. **No, nothing at all.**

Q. **Okay. Let's turn to the conventionality of the genotyping in establishing polymorphism or SNP profiles as**

recited in the claims. And this is in claim element '652 1B and '497, elements 1A and 1B.

First, would you explain to the Court what genotyping is?

A. **Certainly. So genotyping is essentially trying to create a genetic fingerprint, and if we look at our genomes, the genome collection of DNA in the cell.**

DNA, deoxyribonucleic acid, and it's made up of this series of elements called bases. We call the bases by four letters -- A, G, T, and C. And your genome and my genome are going to be very similar, but there are going to be some differences, and those differences tend to occur in common places among people.

So we refer to the differences as polymorphisms from the Greek group many forms, so the different forms in different individuals. And a polymorphism is simply a region in the genome where a variance exists.

Q. **Will you please explain to the Court what a single nucleotide polymorphism is?**

A. **Sure. So I just talked about the bases, and one of the common differences between your DNA and my DNA might be a difference of a single base, and so that will be a single base, the difference between us. So the bases are nucleotides, so it's a single nucleotide polymorphism.**

Q. **And are single nucleotide polymorphisms also referred**

to as SNPs and pronounced snips?

A. **Yes, they are.**

Q. **And what are polymorphism or SNP profiles?**

A. **So a polymorphism or SNP profile you can think of as a DNA fingerprint or using forensics. It's a way of identifying the source of DNA.**

Q. **And what is your opinion as to whether a person of skill in the art would understand genotyping to establish polymorphism or SNP profiles as recited in these claims to be conventional as of November 2009?**

A. **So genotyping was a well-known conventional approach. There were many commercial tools for doing genotyping at the September 2009, in particular genotyping of these SNPs as of November 2009.**

Q. **And do the claims provide any particular way of performing genotyping or generating polymorphism or SNP profiles?**

A. **So neither the claims, the claims don't provide any method for doing it. They simply tell us to obtain a genotype. The written description doesn't provide any particular method. All the written description does is tell us to use techniques that, or methods that are known in the art.**

Q. **Would you provide some examples of those methods in the written description?**

A. **Certainly. So they tell us that, in the lower left, that a company, Applied Biosystems, sells kits with a test they call TaqMan for looking at SNPs, and that was the technique that was developed in 1995 and was commercially available.**

They also discuss Sanger sequencing for identifying SNPs. They also, I believe, discuss chip-based technologies for identifying SNPs. And you can buy chips as of the time it would detect 500,000 or more SNPs on a single chip in a single assay.

Q. **And do the inventors in these patents claim to have invented any special way of genotyping?**

A. **No, they don't. They simply tell us the genotype or to obtain the genotype.**

Q. **Do the claims or the written description of the patents identify specific SNPs in connection with the invention?**

A. **No, they don't. They don't give us any guidance for all as to what SNPs one would want to use to perform the invention.**

Q. **What does the written description say about this?**

A. **So the claims don't tell us anything other than to test SNPs or to test a certain number of SNPs. The written description points out that there were at that time, at least as to the knowledge of the inventors, about**

1.2 million variations that had been catalogued since the human genome was sequenced since the year 2000 and many more genomes tested.

So they found 1.2 million places where the DNA varies between an integral common link and they simply say that the usable SNPs could be any of 500,000 or what are called heterozygous SNPs or 160,000 homozygous SNPs.

So they're telling us out of the universe of 160,000 SNPs, we should use some of them, but no guidance beyond that.

Q. **So if a person of skill in the art were reading the patents, how would they know which specific SNPs to use in connection with practicing these claims?**

A. **They would have no guidance whatsoever. They simply know that they should use some of the SNPs.**

Q. **Now I would like to ask you some questions specific to the '607 patent, particularly '607 patent claim element 1C.**

So claim element 1C recites performing selective amplification of target DNA sequences where in the selected amplification amplifies a plurality of genomic reasons comprising at least with one-thousand SNPs and wherein the said selective amplification is by PCR.

What is that step describing?

A. **So PCR is polymerase chain reaction. This was the**

technique that was invented by Kary Mullis in 1985 and it's a technique for doing what we would call selective amplification.

So the genome is 3 billion bases long. If you want to target a region, such as one that contains the polymorphism, you can design two genetic sequences called chimers or bracketed, and then PCR will make many copies of the DNA between those primers. It's selected because you're selecting the area you are going to amplify and then you make copies and you can do this one element at a time. You can pull them together.

When I was at Stanford between 1994 and 1997, we would do over 10,000 PCRs every night overnight. Set up the machines, let them go, and they would run.

Q. And specifically, what does selective amplification refer to?

A. So selective amplification is copying a selected region that one wants to target and look at. The goal for doing that is if you make more copies, it is easier to analyze.

Q. And what is the overall goal of this selective amplification step in the '607 patent claims?

A. Well, again, it's making copies to make it easier analyze it.

Q. Does this relate in any way to genotyping?

A. **So you would make the copies. If it contains a polymorphism, then you can more easily identify the polymorphism, so that is why this refers to selective amplification for genotyping. They include single because it's doing it for the genotype.**

Q. **Did a '607 patent claim say whether the 1,000 SNPs must be PCR amplified all at the same time and in the same tube?**

A. **Neither the claims nor the specification provide any guidance.**

Q. **Could the 1,000 SNPs be divided up and amplified separately in different tubes at different times according to the '607 patent claims?**

A. **So, again, they don't provide guidance. You could easily do that, and as I mentioned, when I was at Stanford, we were doing 10,000 PCRs. You could amplify 10,000 SNPs with conventional technology ten years before the patent.**

Q. **Do the claims of the '607 patent require the use of droplets?**

A. **No, they don't. They don't give any guidance at all as to how to do this other than to simply do it.**

Q. **And you were here for Mr. Reines' opening argument. Was Mr. Reines accurate when he said the claims require droplets?**

MR. REINES: Your Honor, I object. I didn't say

the claims require a droplet. I said nothing of the sort. I said if you didn't want to do a thousand different tubes or if you didn't want to do multiplex --

THE COURT: Actually, let's do this. What he said wasn't in evidence anyway, so let's move on.

MS. HABERNY: Understood.

THE COURT: I mean, I think it's established, you don't think the claims require droplets?

THE WITNESS: No.

BY MS. HABERNY:

Q. **Could a person of skill in the art use traditional PCR to perform selected amplification as recited here?**

A. **Yes, one could.**

Q. **And how far back were persons of skill in the art using PCR to do selected amplification?**

A. **So Kary Mullis, I described in 1985 Kary Mullis was doing it in 1985. It was a rapidly adopted technology because it was so powerful.**

Q. **And does any part of the patent whatsoever provide a protocol for providing selective amplification of at least 1,000 SNPs by a PCR?**

A. **So neither the claims nor the written description provide any sort of guidance at all other than to use conventional technology for conventional machines or commercial machines.**

Q. **So the claim, claim element 1C of the '607 patent also recites homozygous and heterozygous SNPs. Specifically, it says that at least 1,000 single nucleotide polymorphisms comprise homozygous SNPs, heterozygous SNPs or both homozygous and heterozygous SNPs.**

What are homozygous and heterozygous SNPs?

A. **So a SNP is a single nucleotide polymorphism. We generally use it to talk about a place where genomes may differ, and if the genomes have the same base at that position, he call them homozygous, the same. If they are different, we call them heterozygous, meaning they're different. So the homozygous SNPs and the heterozygous SNPs essentially constitute the universe of all possible SNPs at the location we cited.**

Q. **So if we go back to the claim language that we're discussing. Let me go back to slide 20. What is this claim element actually reciting?**

A. **So it talks about using homozygous SNPs or heterozygous SNPs or both, which means you use SNPs from the collection of SNPs because those are all possible combinations.**

Q. **What does the written description say about homozygous and heterozygous SNPs?**

A. **We showed this earlier, talked about this earlier. They simply state that there are up to 500,000 heterozygous**

and 160 homozygous SNPs.

Q. **Does the written description provide any guidance whatsoever as to which homozygous and which heterozygous SNPs one would use in practicing these claims?**

A. **No. I believe there is no mention of the SNPs at all in terms of number of SNPs and they don't provide any list or guidance of SNPs one way.**

Q. **So does the written description discuss selected amplification of at least 1,000 SNPs at all?**

A. **No, it doesn't.**

Q. **Does the description discuss selective amplification of anything in particular?**

A. **No, it doesn't.**

Q. **What does the written description say about selective amplification?**

A. **It's really silent on selective amplification. It tells us simply that one can use existing techniques and it lists a large number of techniques. Most of these are simple modifications. I wouldn't say simple.**

Most of these are modifications from PCR, but all of these are well established in the art and so they are simply telling us if we do selective amplification, we should use well established widely used conventional PCR techniques.

Q. **Thank you.**

Now I would like to ask about your opinions on the conventionality of high-throughput sequencing of cell-free DNA to detect SNPs, and this is in claim element '652 patent 1C, '497 patent 1B, and '607 patent 1B.

For purposes of your opinion here today, is there a difference between high-throughput and multiplex sequencing?

A. **So they are generally used as synonymous terms with each other although one can point to some differences that might occur, but essentially, they're referring to the same basic technology.**

Q. **And what is sequencing?**

A. **So earlier I talked about DNA being a series of letters being composed of elements, nucleotides that we referred to as letters.**

The sequence is the series of letters and sequencing is running a reaction in the lab and using instruments to determine the series of letters in a piece of DNA. The reason that's interesting is it might include polymorphisms or it might include instructions for yourself to make the protein that they're comprised of.

Q. **And what is high-throughput sequencing in the context of these patents?**

A. **So high-throughput sequencing simply refers to generating sequence at a rapid rate and the claims**

themselves don't give us any guidance as to what particular -- what specifically the inventors meant by high-throughput sequencing.

In the written description, there are a number of callouts to high-throughput sequencing technologies. So they talk about a company 454 Life Sciences and suggest a commercial industry can be used to do this. Helicos suggests that their commercial instrument can be used. Clonal sequencing from Solexa. By the time this patent had issued, Solexa had been bought by Illumina. Later they talk about using an Illumina sequencer to generate this data.

Another technology they mentioned was from a German company. They also refer back to a 2001 paper by Craig Venter that discusses high-throughput sequencing.

Q. **Was high-throughput sequencing widely used as of November 2009?**

A. **So by their definition, it was used as of 2000. It was widely used by 2009. The technologies were rapidly adopted once they became available commercially. So they were really conventional techniques.**

Q. **Could we please pull up the '652 patent at column 15, lines 21 through 60. The '652 patent, column 15, lines 21 through 60.**

Dr. Quackenbush, there are a number of patent

applications referenced in this portion of the written description. Are those the only high through-put sequencing disclosures in the written description of the patent?

A. **Well, we had -- I think there's a description of high-throughput sequencing or the use of one of the high-throughput sequencing instruments in Example 2, but essentially, all of the written description includes is a list of individual instruments. They don't provide guidance as to how to use them. They don't provide any specific protocol. All they simply tell us is that we should use some of the commercial instruments or some existing technologies.**

Q. **So in addition to these patent applications, does the written description also describe commercially available high-throughput sequencing products?**

A. **Yes, it does.**

Q. **And are you aware of certain limitations such as scalability bases, quantitative accuracy and others that existed in November 2009 with high-throughput sequencing?**

A. **So any technology at all is going to have limitations. Right? And those limitations don't make them nonconventional.**

What I think of, a year ago, nobody heard of Zoom. Now Zoom is everywhere. It's rapidly adopted. It's conventional. My son schedules Zoom meetings with his

friends. Does it have limitations? Yes. Are there problems with it? Yes. But that doesn't make it unconventional.

These technologies were introduced. They were rapidly adopted. Mr. Reines was talking about cost and other things. If you have a half-a-million dollar instrument and a new one comes out, you're going to trade it in as soon as you can if that new one is really going to be much more useful.

And so the technology was spreading rapidly. There were limitations as there are today that you can point to, but it doesn't diminish the fact that the patent doesn't tell us to do anything other than to use the conventional technology to generate the sequencing.

Q. **Do the patents claim any solution to any problems associated with high-throughput sequencing?**

A. **No. They simply say use the instruments and generate data.**

Q. **And do the patents contain any protocols for using high-throughput sequencing other than by standard manufacturer's procedures?**

A. **No. Each one of the instruments comes with a manual. The manual tells you how to do it, provides tips. The tips are just like a recipe on a box. You follow the instructions and the tips are usually well generated so they**

generate data. In 2008, Renee Rubio with a bachelor's degree in my lab was generating sequence data on a regular basis using the manufacturer's instructions.

Q. **Can we now turn to the '607 patent?**

A. **All right.**

Q. **And this recites -- this is slide 26, and this recites high-throughput sequencing comprising sequencing by synthesis. What does sequencing by synthesis refer to?**

A. **So some of the high-throughput sequencers, the '454, the Solexa and Helicos were often described as instruments that did sequencing by synthesis.**

So the Venter paper referred to high frequency using another method, but at least those three instruments did it in a slightly different way.

So DNA is a string of letters, and what you can do is synthesize another piece of DNA using a technique kind of like PCR, and sequencing by synthesis means you add the next base and you detect it. Then you add the next base and you detect it and you add the next base and you detect it. So you determine the sequence by synthesizing the DNA and detecting it in every step. So this is simply referring to the use of a specific methodology that would embody the commercial instruments.

Q. **You mentioned a few commercial instruments that applied sequencing by synthesis. Were the Illumina machines**

that were available in November 2009 also machines that used sequencing by synthesis?

A. **Yes. They were, in fact, the dominant instrument for doing sequencing by synthesis by that time.**

Q. **Was high-throughput sequencing, sequencing by synthesis, widely used in conventional by November 2009?**

A. **Yes, it was. It was widely used and there are many references in the application talking about applications of that.**

Q. **Do they report sequencing by synthesis?**

A. **Other than listing the instruments, they don't provide any details at all.**

Q. **And do the patents provide any protocols for using high-throughput sequencing specifically with cell-free DNA?**

A. **They don't provide any protocols for doing anything. They simply tell us to obtain sequence. They list methods and they provide a list of instrument manufacturers with references to other known art.**

Q. **So if we could please turn to slide 28. It's the '497 patent at claim element 1D and the '607 patent at claim element 1S, and these recite quantify and donor specific cell-free DNA when the donor cell-free DNA makes up at least .03 percent of the total circulating cell-free DNA in the sample.**

What does the reference to donor cell-free DNA

making up at least a .03 percent fraction of total cell-free DNA mean?

A. **So, you know, sort of basic biology, basic math. Right? Your body is fairly large and when your cells die, they release cell-free DNA.**

A tumor is much smaller, or not a tumor. Excuse me. I do a lot of work in cancer. But a transplant is much smaller, so when transplant cells die, they release DNA. So the amount of transplant DNA in your bloodstream would be smaller than the recipient's DNA.

And so what this is doing is simply saying you limit for -- or describing a limit for detection of sensitivity for the amount of donor DNA in the recipient's body. Well, in the recipient's bloodstream.

Q. **And what does the written description say about this at least .03 percent donor fraction?**

A. **So the claims don't tell us how to achieve it. The written description doesn't tell us how to achieve it. The written description simply tells us that this is one of the -- this limit is consistent with the performance characteristics of in this case the genome analyzer, the sequencing by synthesis machine that's commercially available.**

Q. **And who was the manufacturer of the gene know analyzer?**

A. **That would be Illumina.**

Q. **Does the written description tell you to do anything special with the high-throughput sequencing machine to get down to a .03 percent limit of detection?**

A. **You know, they tell us this instrument generates ten million molecules worth of sequence and it detects 3,000. That gives you that level of sensitivity. So they don't tell us to do anything other than to load it on the machine and run it.**

Q. **Does the written description state anything about how a person of skill in the art can increase the sensitivity of high-throughput sequencing?**

A. **So they do provide a description of how to increase sensitivity, which is simply to obtain more sequence, right, which is well-known with any kind of measurement. If you want to make a better measurement, you measure more.**

Q. **Can you point to an example of that in the written description?**

A. **Sure. It's right here. It's called out. It just says, higher sensitivity can be achieved simply by sequencing more molecules. That means use more channels. And when they refer to channels, the Illumina sequencer had something that looked like a microscope slide added onto individual channels. Simply showed you load one, you load two, you load three, you load four.**

Q. **And is there anything nonconventional about achieving higher sensitivity by sequencing more molecules?**

A. **No. I mean, this is standard practice in many fields. To make a better measurement, you make more measurements. To get higher sensitivity for detecting molecules, you simply sequence more molecules.**

Q. **Do you see any indication that the named inventors invented the idea that sequencing more molecules will provide more sensitivity?**

A. **No. I mean, this is -- this has been well-known in the art. Measuring more has been known for hundreds of years. Measuring more in sequencing has been known since sequencing was invented.**

Q. **Can we now turn to the '607 patent at element 1D, and this recites another limitation that said sequencing by synthesis reaction has a sequencing error rate of less than 1.5 percent. What does error rate refer to?**

A. **So in this case the error rate is referring to miscalling a single base, and what this is saying is that there are fewer than one-and-a-half spaces miscalled by the technology out of every hundred base of sequence. All right.**

Q. **So does the written description discuss sequence error rates?**

A. **So the sequencing error rates simply refers to, it's**

referred to in the written description, simply describes the inherent error rate of the instrument. And so in this case they are referring to an error rate for the Helicos machine of between 0.5 and 1.5 percent.

Q. **All right.**

A. **So they don't provide any description as to how to get to that error rate other than to use an instrument which claims to have that error rate.**

THE COURT: Basically, when you buy the machines, do they tell you the error rate? How is that communicated in sequencing?

THE WITNESS: So it's often in their sales material. The error rate is often described in the protocol book. You tend to get big booklets telling you how to use them and describing the instrument.

THE COURT: Is it coming from the manufacturer or is there a standards setting body?

THE WITNESS: It comes from the manufacturer. It often occurs in scientific publications. So like with the human genome project, the goal is to get to an error rate of less than one in a thousand, and to do that, they simply define the sequencing depth that they needed knowing from the instruments what the error rates were. And if you get correlated error, the claims are in place. But the errors should be random, so if you sequence enough to reduce

the chance of things coming together, but, you know, these are either provided by the manufacturer or other scientists describing them in the literature. In this case I think this is simply referring to what the manufacturer claims was the error rate.

BY MS. HABERNY:

Q. **And if I could point you back to the sentence you've highlighted, which says, typical sequencing error rates for base substitutions vary before platforms, but are between 0.5 to 1.5 percent. Is that specific to the Helicos machine?**

A. **So this isn't specific to the Helicos machine. All of these instruments really had to reach a sequencing error rate limit, which was low. And, you know, again, if you are going to invest three-quarters of a million dollars in your machine, you don't want to get one that's going to give you noisier data than you have to. Right?**

So the manufacturers were really pushing to improve the sequencing error rate and they were advertising the instruments based on this rate. But this isn't specific of the performance of these sequencers at the time of the invention, the claimed invention.

Q. **And just to clarify for the court reporter, as it may have been hard to hear, did you say is or is not, this sentence is or is not specific to the Helicos machine?**

A. **No. This isn't specific to the Helicos machine. This represents the typical sequencing error rates.**

Q. **Was it conventional as of November 2009 to do high-throughput sequencing with an error rate of less than 1.5 percent?**

A. **Yes, it was.**

Q. **Are there any examples of actual experiments using high-throughput sequencing in a patent?**

A. **So the only description of high-throughput sequencing as an experiment is Example 2 and the only description of how they did this, they don't tell us anything about how they got the samples and set up the reaction. All they tell us is that four lanes of Illumina sequencing were used to compare in our different levels of substitution of donor DNA into recipient DNA. So it's an experiment that wasn't even using cell-free DNA. The experiment they did was mixing to see how low the detection limit was they could obtain.**

Q. **And is Illumina still in business selling high-throughput sequencers today?**

A. **Yes. Illumina sells thousands of sequencers every year.**

Q. **And how would you describe Illumina's position in the high-throughput sequencing market?**

A. **Even as of 2009, they were the dominant instrument**

provider in the market.

Q. **And what kind of sequencer did the inventors use in Example 2 of the patent?**

A. **So I believe they actually referred specifically to it as the Illumina genome Analyzer II. This was the sequencer that was commercially available beginning I think in 2007. I know we bought one in -- we leased it with in 2008.**

Q. **Was there any nonconventional use of high-throughput sequencing described in Example 2 of the patent?**

A. **No. They simply tell you to run four lanes to look at their four samples. So they put one, one experiment or one sample in each lane.**

Q. **Does Example 2 provide any proceed tow comes for high-throughput sequencing?**

A. **No. In reading this, what I would assume is you would simply follow manufacturer's instructions.**

Q. **Now, Example 2 includes some statements about error rates, quality scores and resequencing. Does this disclosure repeat anything nonconventional?**

A. **No. Again, these are sort of the typical error rates for these instruments at the time in which the data was collected. Quality scores are something that the instruments provide, so when you run the sequencer, it gives you a list of bases, and then for each base, it assigns a quality score, and the software instrument's internal**

assessment as to how accurate that base is.

So, you know, really they're just telling us to run the instrument and take the data that comes out and that data is going to have a ceratin level of quantity. In this case, the error rate is less than, between 0.3 and 0.5 percent.

Q. **And what about the use of more SNP locations? Does that describe anything non-conventional?**

A. **So this is consistent with what we looked at earlier, that if you want to get more accurate data, you simply use more data. So they tell us that more SNP locations should also improve the yield of signal with no change in protocol, which means simply using the manufacturer's instructions and looking at more precise genomes.**

Q. **Are there any other examples anywhere in the patent disclosing experiments using high-throughput sequencing?**

A. **No. This is the only one.**

Q. **Now I would like to turn to something specific to the '497 patent, which at element 1D refers to quantifying SNPs from cell-free DNA using digital PCR. What is digital PCR?**

A. **So earlier I talked about PCRs as a way of copying or amplifying a selected segment of DNA. Right. And if we make copies, it's easier to see.**

In digital PCR, you take a sample that contains DNA. If you want to look for one that has a polymorphism,

then what you do is you dilute it and put it in tubes. If you put it many tubes, many reactions. And you dilute it down hopefully so that each tube, each reaction vessel has only a single molecule in it but you don't know what molecule is there. So you do a selective amplification. You add these little synthetic pieces of DNA called primer that bound your region and you add them to all the tubes and then you run a PCR reaction.

And if the tube doesn't have your piece of DNA in it, nothing happens. They call it a zero. If the tube does have your piece of DNA in it, then it gets amplified and you can detect it's a one. So it's basically a way of counting molecules by diluting them, running PCR and then counting where they occur.

Q. Would it --

A. So it's digital. It's a series of zeros and ones.

Q. What is your opinion that a person of skill in the art would understand using digital PCR in the context of the '497 claims to be conventional as of November 2009?

A. Digital PCR is conventional, was conventional. There are a number of publications cited in the patent talking about digital PCR and its invention. Mr. Reines talked about CDC having invented some of the machines that do that. There were other instruments who were being developed and marketed to do digital PCR. So one reading this would

understand it was conventional.

Q. Do the claims of the '497 patent recite any specific methods for using digital PCR?

A. No. They simply tell us to do digital PCR and I believe they list some of the instruments. In fact, referring back to Dr. Quake's article in 2006 as a way of doing it.

Q. Are there any examples of experiments using digital PCR in the patent?

A. So the only other experiment described in the patent is Example 1 and this describes the use of digital PCR, and all they tell us to do is to use it as described before in two papers by Dr. Quake, one in 2006 and the other in 2007.

Q. Does Example 1 provide any protocols for using digital PCR?

A. No, they don't provide any protocols at all. It simply states, do it as described in the papers.

Q. Does Example 1 describe any nonconventional modification for using digital PCR?

A. No, they don't provide any guidance, any modification, any protocols. Do it the way it's done.

Q. Are there any other examples of experts using digital PCR in the patents?

A. No, there are none.

Q. Have you seen any indication that the inventors of

these patents invented an innovative way to apply digital PCR?

A. **No. I mean, running digital PCR is conventional. Think don't tell us no do anything new or anything innovative. They simply tell us to do it.**

Q. **Okay. Let's turn to the conventionality of quantifying donor cell-free DNA in the sample using SNP profiles or polymorphism.**

What does the term quantifying donor cell-free DNA mean?

A. **Quantifying just means measuring and they want to measure how many donor cell-free DNA is in the recipient's body, and the reason is naturally that if the transplant is being rejected and dying, it's likely to increase. So it simply means measuring how many of the donor DNA is in the recipient's bloodstream.**

Q. **And is that anything more than simply observing the presence of a quantity of cell-free DNA in the sample?**

A. **That is all you're really doing. You're counting how many donor molecules there are for every recipient molecule. That's how you do the quantification.**

Q. **And to be clear, is the cell-free DNA that's being quantified, can you tell the Court whether or not that's a natural phenomena?**

A. **So it's a natural phenomenon when cells die, they**

release DNA, that's why it's called cell-free DNA. And, again, as a transplant rejection, if the transplant is starting to be rejected, the immune cell is attacking it, the cells are dying, you would expect naturally more DNA to be available. So that's really the basis for this whole field, is that when transplants are being rejected, you would expect them naturally to release more cell-free DNA.

Q. What is your opinion regarding whether a person of skill in the art as of November 2009 would understand quantifying donor cell-free DNA samples using SNPs to be conventional?

A. So this type of analysis is completely conventional and it's described in the written description as being conventional.

So they tell us that this quantification involves a series of steps using methods that are known in the art and they simply saying steps for quantifying nucleic acid are known in the art. You know, having a number of molecules that come from the donor is a pretty simple approach.

Q. Do you have any personal experience relevant to quantifying cell-free DNA using SNPs as of the November 2009 time frame?

A. So I mentioned that early on when I was at Dana-Farber, we were doing some analysis of circulating

tumor DNA. We were involved in a project with a group at Massachusetts General Hospital that was looking at circulating prostate cancer DNA. We did some analysis for them. So they generated the data using the existing technologies. They gave us the data. We analyzed it to try to differentiate between donor -- between a patient and tumor, so there's normal DNA in tumor by quantifying the DNA. And that actually -- the discovery actually led them to launch their own company.

We also did some work looking at ovarian cancer, which is one of my emphasis areas when I started, and breast cancer circulating DNA.

Q. **And how does circulating tumor DNA relate if at all to the circulating cell-free DNA that's recited in the patent claims?**

A. **So circulating DNA in your system naturally occurs when cells die. As tumors are growing, you can detect the tumor DNA because as it's growing, some of the cells die and lose DNA.**

If a fetus is developing, as part of the natural development, some of the cells die. The fingers separate between each other. They die and release that circulation. If the tumor is being reject, it releases cell-free DNA.

And in terms of analyzing and detecting the kind of DNA, the laboratory protocol and techniques that one

would use would be identical because if I gave you DNA and said it's cell-free, didn't tell you where it was from, you wouldn't know whether it was from a donor or from a tumor. In a lot of ways, in protecting DNA from a tumor in a transplant would be easier. Right?

Your tumor is 99.9 percent identical to you. If a mother has a fetus, that child carries half her DNA, so if the DNA is 50 percent identical to her. If you have a transplant, if I give you my kidney, my DNA is going to be much more different from yours than your son or daughter's would.

So detecting this DNA uses the same techniques and in some ways can be thought to be easier because there are more differences between that DNA and the recipients.

Q. And did you use high-throughput sequencing in any of that work?

A. So the work we did in looking at practical variant and prostate cancer was all using high through-put sequencing technology.

Q. How did you come up with the protocol that you used prior to November 2009 to do the work you've just been describing?

A. So we largely used protocols that were available from the instruments. That's where you start. Sometimes you adjust them a little bit. I don't recall the exact

protocols we used, but I remember we generated the data fairly quickly after we got the sample. So, you know, we didn't have to do a lot of optimization with the protocol. We really more or less followed manufacturer's instructions.

Q. **Now, let's go to the '652 patent at claim element 1B, and this recites where in sensitivity of the method is greater than 56 percent compared to sensitivity of current surveillance methods for cardiac vasculopathy, or CAV.**

So we talked about sensitivity earlier with respect to the .03 percent donor fraction and the 1.5 percent error rate. Is the sensitivity referenced here the same or a different kind of sensitivity than we were just discussing?

A. **So what they are referring to here is a clinical sensitivity. It's not errors in the DNA. This is a sensitivity for detecting who is going to reject a transplant. All right. In this case it's a heart transplant, which is why it's cardiac allograft vasculopathy. So they're looking for heart failure and this simply says the technique should have a sensitivity capable of detecting 56 percent of those heart transplant failures.**

Q. **And what is current surveillance methods or cardiac allograft vasculopathy?**

A. **So the patent doesn't describe that in the claims. In**

the written description, they mention two, coronary angiography and intravascular ultrasound, and those, according to the paten, are the currently available method.

Q. **So going back to the claim language, do the claims tell a person of skill in the art how to achieve this sensitivity listed here?**

A. **No. They simply say that the method should achieve the sensitivity. They don't describe any protocols, any modifications. They don't ten tell us how they're quantifying the DNA. They simply tell us that assay should have this level of sensitivity.**

Q. **And does the written description anywhere discuss how to achieve the sensitivity?**

A. **No. The written description just provides in addition to the passage we just look at this passage, which sort of sets 56 percent as the lower bound, and then says in other embodiments, you could get greater sensitivity, but, again, it is do event tell us how to even get to 56, let alone to a hundred percent.**

Q. **Did you review Dr. Van Ness', CareDx's expert, his declaration that he submitted in this case?**

A. **Yes.**

Q. **Did he provide any opinion regarding the sensitivity limitation in claim element 1D of the '652 patent?**

A. **No, I don't believe he did.**

Q. **And did you attend Dr. Van Ness' deposition in this case?**

A. **Yes, I did.**

Q. **Did he provide any opinion about the sensitivity limitation in claim 1B of the '652 patent?**

A. **No, he didn't.**

MS. HABERNY: Your Honor, we're prepared to discuss the dependent claims. We argued in our summary judgment motion that claim 1 of each patent is representative of the dependent claims. CareDx never opposed that, so, you know, they are not agreeing today to treat claim 1 as representative, so it's up to Your Honor. You know, it's our position they waived any opposition to the claims being representative, but we're prepared to go through all of the dependent claims if Your Honor would like to hear it.

THE COURT: Are you sitting around the rest of the day?

THE WITNESS: Yes, I am.

THE COURT: Let's not do that right now.

MS. HABERNY: Okay. Then --

THE COURT: How much time do you have left to finish direct?

MS. HABERNY: Not very much. Probably a few more minutes.

THE COURT: Okay.

MS. HABERNY: Can we please pull up claim 1 of the '652 patent at the preamble in Step 1A.

BY MS. HABERNY:

Q. **So claim 1 of the '652 patent recites a method for detecting transplant rejection, graft dysfunction, or organ failure, comprising providing a sample comprising cell-free nucleic acids from a subject who has received a transplant from a donor. And can we please go back to our discussion of cell-free DNA in the earlier slides on that?**

So would you explain to the Court what cell-free DNA is?

A. **So early we talked about DNA being the blueprint for making a cell. That is packaged in the body called chromosomes, and those chromosomes are packaged in a nucleus. We're talking about bases. The human genome is three billion bases in length. You have two copies, one inherited from your mother, one inherited from your father.**

So there are 46 chromosomes that package the six billion bases all tied up in the nucleus. When the cell dies, the cell breaks open and enzymes from the cell break down into smaller fragments and so those get released and they get released out of the cell into the bloodstream.

So the cell-free DNA that arises is the natural

phenomena that occurs whenever cell dies, and since they are in your body, they occur in the bloodstream naturally.

Q. **And is cell-free DNA a natural phenomenon?**

A. **Yes, it is. All of us have cell-free DNA in our body. All of us have cell-free DNA in part because cells in our body are dying.**

Q. **What is transplant rejection?**

A. **So a transplant is rejected when the body's immune system attacks the transplant. That's why transplant recipients are generally on immunosuppressive drugs to try to prevent that from happening. But naturally, what happens is the body explores that. If the body starts to reject it, it will kill the cells. The cells are dying at a high rate and they are going to be releasing more transplant DNA into the system.**

So this presence of donor DNA is going to happen even if the transplant isn't being rejected and the amount of donor DNA is going to increase if the transplant is being rejected.

Q. **And is transplant rejection something the body natural does?**

A. **Yes. That's why transplant recipients are given immunosuppressive drugs. It's something you want to avoid. It's part of the reason why the best transplants are often from relatives, because your body is more likely to see that**

as being your organ, but it's a completely naturally occurring phenomenon.

Q. **Can we please call up Step D of claim 1 of the '652 patent.**

Step 1D recites, diagnosing, predicting, or monitoring a transplant status or outcome of the subject who has received the transplant by determining a quantity of the donor cell-free nucleic acids based on the detection of the donor cell-free nucleic acids and subject cell-free nucleic acids by the multiplexed sequencing.

How does this quantity of donor cell-free DNA relate to transplant status or rejection?

A. **So the donor cell-free DNA should increase if the transplant is being rejected. All right. And that is something we know that makes, you know, sort of simple biological sense. If you are killing your kidney, there's going to be a lot of kidney DNA if you have that kidney transplant.**

So all this is really telling us is if one has to determine the quantity of donor DNA, but it doesn't really tell us how to do that other than the sequence doesn't tell us how much indicates transplant rejection. It simply says determining a quantity.

Q. **And is the amount of donor cell-free DNA present in a transplant recipient something that happens naturally based**

on the status of the transplant?

A. **Yes. The transplant is being rejected. More cells die and the amount of cell-free DNA increase.**

Q. **So does claim 1 of the '652 patent recite anything more than using routine and conventional methods to detect the natural phenomena of donor cell-free DNA in a transplant recipient and correlate that back to transplant rejection?**

A. **It doesn't tell us how to do it. It simply recites using simple technology, natural phenomena, and there's no further guidance on how to do this in the written description.**

Q. **Can we pull up claim 1 of the '497 patent, please. Can we pull up the preamble, please.**

So claim 1 of the '497 patent recites a method of detecting donor specific circulating cell-free nucleic acids in a solid organ transplant recipient.

And is does donor specific circulating cell-free nucleic acids in a solid organ transplant recipient?

A. **So that is circulating cell-free nucleic acids that have come from the transplant.**

Q. **Is that something that happens naturally?**

A. **Yes, it does.**

Q. **So does claim 1 or do any of the claims of the '497 patent recite anything more than simply detecting the natural phenomena of donor cell-free DNA in an organ**

transplant recipient?

A. **No, they don't.**

Q. **Can we pull up claim 1 of the '607 patent, please.**

And claim 1 of the '607 patent recites a method of quantifying kidney transplant derived circulating cell-free DNA in a human kidney transplant recipient.

Dr. Quackenbush, what is kidney transplant derived circulating cell-free DNA?

A. **So that would simply be circulating cell-free DNA that came from a kidney that was transplanted from a donor into a recipient.**

Q. **And does that cell-free DNA occur naturally?**

A. **It occurs naturally at the time of transplant and a healthy transplant and in a transplant that's being rejected.**

Q. **So does claim 1 of the '607 patent recite anything more than simply observing the natural phenomenon of kidney transplant-derived cell-free DNA in a human kidney transplant recipient?**

A. **It simply tells one to use conventional methods to make that observation.**

Q. **So going back to the independent claims and putting it altogether, would you please tell the Court whether a person of skill in the art would have found the claimed combination of steps recited in these patents to be a logical and**

straightforward combination of methods as of November 6, 2009.

A. **So, you know, it's pretty simple. Right? There are four elements that we talked about earlier. One is providing a sample. One is genotyping. Another is sequencing, and the last is detecting. And this is a callout from Figure 5 in the patents and it lists these four elements. Right?**

And each one of the elements we talked about is conventional. You can buy a kit or buy a machine to do it. And the kits wind up having problems and the machines wind up having problems, but whether they were introduced, they were widely adopted, widely used. They were available. People knew how to use them. People with bachelor's degrees were running them.

So these are each conventional technique. Right. Now if you put them together, there's something here.

Well, if you are going to quantitate, determine the amount of donor DNA, all right, you need a sample to do that. Right? And if you are going to quantitate something, you need measurements. Right?

So we get a sample. We determine something by making measurements. What do we measure? They tell us to measure sequence and they tell us to use genotyping because

we want to look at places where the donor recipients differ. Right?

It's straightforward, it's logical, it's conventional. People were doing this in prenatal diagnostics. They were doing it with these transplants. They were doing this kind of analysis to look for infections, and Mr. Reines talked about helping cattle. The technology was so widely used, it was used in agricultural applications. So -- and wildlife applications. And so this is just a straightforward logical combination of conventional technology to observe the natural phenomenon of donor DNA in a transplant recipient's body.

Q. **Do the patents describe a special protocol for using the claimed methods and combinations?**

A. **There's no description of any protocol. Simply use these methods.**

Q. **And do the patents describe any protocol for anything at all?**

A. **No. They simply tell us to use the existing technology in existing kits, things like syringes.**

Q. **Do the claims of a patent recite a special method for detecting cell-free DNA as opposed to other types of DNA?**

A. **No. Mr. Reines mentioned there may be difficulties in detecting cell-free DNA. It's broken into smaller fragments, so there are these aspects of analyzing it. But**

the patent doesn't provide you with guidance whatsoever as to how to overcome what limitations might exist. It simply says you get it off the shelf. You couldn't order it from Amazon, but you could definitely order it from the instrument manufacturers.

So we can order these things and we can run them in a logical order and they don't tell us how to overcome any limitations that might occur.

Q. **So do the patents disclose any way to overcome any limitations with cell-free DNA?**

A. **None whatsoever.**

Q. **And do the claims recite a special method for detecting organ transplant cell-free DNA as opposed to some other cell-free DNA such as fetal or tumor?**

A. **No, they don't. They tell us to do nothing special at all.**

Q. **And would it have been conventional for a person of skill in the art in November of 2009 to use the claimed method to detect foreign cell-free DNA from a source other than transplant?**

A. **Yes, it would have.**

Q. **I'd like to show you now a statement at column 5, lines 36 through 49 in the '652 patent, and it reads, the practice of the present invention employs, unless otherwise indicated, conventional techniques of immunology,**

biochemistry, chemistry, molecular biology, microbiology, cell biology, genomics and recombinant DNA, which are within the skill of the art, and this statement is also present in the written description of the '497 and '607 patents.

Dr. Quackenbush, what would a person of skill in the art understand reading this portion of the patent?

A. **This would tell me that unless they were indicating something was new or inventive or describing a new protocol, a new technique, a new technology, that otherwise what we should do is just use the conventional techniques because that is what this written description in the claimed invention is based on, the use of conventional techniques.**

Q. **And what do you base that opinion on?**

A. **Well, they don't provide protocols for anything in either the claims of the written description. Every single step in the process represents a method that was known or was available in a commercial instrument or commercial kit. They don't provide any modifications of standard protocol.**

So they don't tell us to take this kit and then do something different with it, to add something special or to change some element of it. They don't even tell us what SNP to look at out of the 1.2 million they say exists and which could be tested on a commercial platform.

The combination of steps they have is really what you would do. If you want to measure something, you

have to have something to measure, you have to make measurements, you have to make informed measurements.

So the methods and their combinations have also been used for other types of cell-free DNA. Mr. Reines was talking about Hannah Valentine and it was used for fetal DNA and said you could use it here, too.

So, you know, this is nothing that appears very conventional -- very non-conventional. Nothing that appears very inventive in this patent. It's really the standard methods applied in a logical, straightforward manner.

MS. HABERNY: Thank you. I pass the witness.

THE COURT: Okay. Thank you.

Let's get a sense of time. We have this. You're going to cross-examine for awhile?

MR. REINES: Correct.

THE COURT: And then you're going to have your expert?

MR. REINES: That's it.

THE COURT: In terms of the evidence?

MR. REINES: That's it.

THE COURT: Okay. So my court reporter needs a break. Let's take a quick break and then can we go pretty quick at lunch, but we should be able to finish. I don't see any reason why we can't finish by 3:30. Right?

MR. JOHNSON: Agreed.

THE COURT: All right. So do you want to break until like five of? Will that work for folks? Does that work for you?

THE WITNESS: That's fine.

THE COURT: Thank you.

(Short recess taken.)

- - -

(Proceedings resumed after the short recess.)

THE COURT: All right. Please be seated.

By, the way, just for the next witness, too. I've got a screen down here, which is that screen. So if the witness kind of sees me doing this, that's what I'm doing. All right.

MR. REINES: We have binders for the cross.

THE COURT: Thank you.

(Binders handed to the Court and to the witness.)

THE COURT: All right.

CROSS-EXAMINATION.

BY MR. REINES:

Q. **Thank you, Dr. Quackenbush. It's good to see you live.**

I'd like to ask you about the natural phenomena. You agreed that the natural phenomena in the CareDx patent the is the correlation of circulating cell-free donor DNA in

the transplant recipient's body with organ rejection?

A. **That is a natural phenomenon and natural phenomenon is the release of cell-free DNA from the transplanted organ.**

Q. **You are -- your statement of the natural phenomena includes the correlation between the increase in donor DNA in the bloodstream of the recipient with organ rejection; is that correct? That correlation is part of the natural phenomena?**

A. **I mean, naturally, if the transplant is being rejected, the amount of cell-free DNA is going to increase, so if I understand your question, yes.**

Q. **And you'd agree that the presence of circulating cell-free donor DNA in organ recipients was known to skilled artisans by 1998 with the Lancet article from Dr. Lo?**

A. **I think it was known at least that far back. Yes, Dr. Lo reported in 1998.**

Q. **It might have been before that? Can you plans, please answer?**

A. **Yes, it might have been before that. At least as far back as Dr. Lo.**

Q. **And in terms of that Lancet paper we saw earlier, I am going to try to be efficient here with time. That also stated that the concentration of donor DNA in the recipient plasma may be a marker for rejection?**

A. **I believe that's correct. I'm going to assume if you**

are not going to show the article, you're quoting it correctly.

Q. **I mean, I can put it up if you would like.**

A. **No, that's fine.**

Q. **Okay. And in terms of the correlation that you just described as being the natural phenomena in the CareDx patents, that was disclosed in the Lo Lancet article; is that correct?**

A. **So a correlation may have been disclosed. Again, I don't recall precisely, but this would be a natural phenomena that would occur. That as the transplant died or it was attacked by the immune system, donor cell-free DNA would increase.**

Q. **And skilled artisans knew that in 1998?**

A. **I believe they would.**

Q. **The patent acknowledges that this correlation is in the prior art; is that correct?**

A. **I believe it does, yes.**

Q. **And the patent also identifies papers authored by Liu Zhang and Warren and we can put that up. Why don't we put that up and walk through that a little bit. That's at B1, which is the '652 patent at column 7, line 61.**

A. **This binder 1?**

Q. **Yes. You can follow on the screen. Yes, it's in binder 1. Just the lettering B1?**

A. **Okay.**

Q. **Should have easy availability there. It refers to the different papers authored by Liu, Zhang and Warren that were attempted to pursue a strategy of using the paternal aspect of the DNA to perform the detection; is that correct?**

A. **So you say not paternal, but if an organ comes from a male, it's going to have Y chromosomes and the sex is determined by the presence of a male chromosome. They're talking about detecting the Y chromosome from the transplant in the background of a female recipient's body.**

Q. **Now, you didn't read these papers when you formulated your opinion in this case; is that right?**

A. **I may have read them. I don't recall. I would have to look and see if these were actually -- I may have read them. I don't know if I cited them. I would have to look in my report at the list of things that I had referred to.**

Q. **Okay. So in terms of those papers, those papers didn't set out the, what you've been calling a logical method for forming organ rejection analysis using the correlation? The four step method?**

A. **So they were talking about detecting things. They were talking about measuring them. They were talking about trying to make a determination. And, in fact, at a high level, having a Y chromosome is a genotype. It's information about your genetic background that distinguishes**

you from the female. Right?

So in essence they were talking about all four steps. They may not have used sequencing. They used I think -- I think some of them used PCR and the patents refer to digital PCR. But they kind of do talk about the logical set of steps one would use.

Q. And you don't know whether you read those publications; is that correct? That's what you told me in deposition at that time?

A. I don't recall if I've read them. I've read them since, but I don't recall if I read them at the time I gave my deposition.

Q. Okay. And in terms of -- so you're saying that they disclosed the inventions in the patents-in-suit? That's what you are now saying, because they used that four step method?

A. I don't think I made that statement. What I said was they described methods, approaches to making measurements that would be conventional, logical; right?

Q. That answers my question.

A. Okay.

Q. Now, the patent is not claim that the invention, the recognition that circulating cell-free DNA is in the blood; right?

A. I'm not sure what the patent is claiming as the

invention other than the stated claims, so I would guess no.

Q. **And you don't believe that the inventors claimed to have invented the correlation that you described as the natural phenomena in this case; right?**

A. **That's part of the natural phenomena and they don't claim to have invented that correlation.**

Q. **And you would agree, wouldn't you, if the claims are directed to the application of methods for obtaining samples, genotyping, high-throughput sequencing and measurement of circulating DNA, applying that to the natural phenomena. That's what it's directed to; is that correct?**

A. **So I understand directed to is a term in patent law and I'm not sure what the limitations of that are.**

THE COURT: I'm not either. I'm not kidding.

THE WITNESS: I would agree with Mr. Reines, that they are describing the use of the set of steps to detect donor DNA. I think one of them talks about detecting rejection, but they're mostly directed toward detecting transplant donor cell-free nucleic acid. I don't think they actually talk about rejection.

Q. **But in terms of, in your words, what the claims are directed to is the application of methods for detecting to the natural phenomena; is that correct?**

A. **Again, I don't know directed to.**

THE COURT: Directed to, because I agree. I think Courts, you know, it means that it relates to. It generally discusses and it can be used very imprecisely. It can be very broad. It can be narrow. But I mean, so if that's what kind of what's tying the witness up, I actually get it. Let's face it. A lot of opinions in patents law. You've got a patent directed to a very general subject and sometimes they invalidate the patent, sometimes they don't. Sometimes they have a problem using directed to.

BY MR. REINES:

Q. **Let me do it this way. I would like to direct you to your deposition at page 180, lines 3 to 14. You have that in your binder.**

The question was: Do you believe that the basic thrust of the claims in suit is to the naturally occurring correlation?

And your answer was: So, as I explained earlier, my best interpretation is that these claims are directed to the use of conventional methods for obtaining samples, genotyping, high-throughput sequencing and measurement of levels of cell-free -- circulating cell-free DNA over time and their applications to a naturally occurring phenomenon, the presence of cell-free DNA and the measurements of these changes over time.

Do you see that?

A. **I do.**

THE COURT: And you agree with that? Is that a fair summary of what you think?

THE WITNESS: The one thing that I would modify if you ask me is I don't think they talk about detection over time. I may have been mistaken when I said this. They really just talk about the -- the application of the standard techniques to detecting donor DNA. So I don't think there was a temporal element that was introduced and I may have misspoken when I said this.

And this is sort of a general summary. Right? There are other techniques like digital PCR that were used. But, you know, in general, I would say I would still agree with this.

BY MR. REINES:

Q. **Okay. You understand the first step of the Alice test is whether the claims are directed to the natural phenomena or whether they are directed to the application of techniques to the natural phenomena.**

Do you understand that legal standard?

A. **So I'm not a lawyer, I'm not a patent attorney. I don't know nuances.**

Q. **Okay.**

THE COURT: Actually, I don't think it would be helpful to have him comment about Alice. My God, a Federal

Circuit can't interpret Alice.

MR. REINES: I will move on.

THE COURT: You're not going to put it on a scientist.

THE WITNESS: Thank you.

THE COURT: I say that with due respect and I've written about this a number of times, and the Federal Circuit itself has acknowledged. Sometimes it applies analysis under Step 1 in certain opinions and others it applies it in Step 2, and you can't reconcile those opinions.

So it's really not fair to put it on a scientist and not a patent lawyer. So I don't need to know what a witness thinks about Alice. I'm more interested in what you think about Alice.

MR. REINES: Thank you, Your Honor. That's kind.

BY MR. REINES:

Q. **I would like to turn to preemption as I was doing. In terms of preemption, you did not consider whether any of the claims in suit preempt others from using what you are alleging as a natural phenomena; right?**

A. **So I don't understand fully the legal definition of preemption.**

Q. **Okay. Let me do it that way in view of the Court's**

guidance on the last one. There are methods for using the natural correlation, the natural phenomena in this case that are different from the claimed inventions; is that correct? For example, the prior art that I showed you using the gender?

A. **Mr. Reines, I'm not sure I understand what question you're asking me.**

Q. **I'm asking you if there are other ways to use the natural correlation that you've identified in this case other than what is claimed in the patents-in-suit.**

Do you understand that?

A. **So I didn't identify natural correlation. Right? The patents don't necessarily talk about -- if the natural correlation is that tumors -- not tumors, sorry, that transplants release cell-free DNA, could there be other methods to detect it? Yes.**

Q. **Okay.**

A. **If that's my understanding of your question.**

Q. **And Dr. Cantor, who you know, or at least know of, he used, he proposed masks back one way as an alternative?**

A. **So, again, I wouldn't just say that he said use mass spec as an alternative; right? You can't just turn on a mass spec machine and detect transplant rejection. There are other things you have to do. Right?**

And so what was Dr. Cantor using? He was

describing in his patent a technology for identifying genotypes and sequence. All right.

So could you use another technology to determine sequence? Sure. Right? And the patent owners in the patent don't tell you how to determine sequence in the claims. They simply say sequence. So could you have used another -- another manufacturer's instrument that didn't appear in the list of instruments they cite in the specification? Certainly.

There were other instruments commercially available that patent owners didn't cite in their written description that would perform sequencing in a very similar manner to -- you know, the manners described. A company called Pacific Biosystems that they didn't cite to.

Q. **Okay.**

A. **Why? I don't know.**

Q. **In terms of your opinions in this case, you didn't support your opinion with anything regarding preemption; right?**

A. **I don't think there's an opinion in my declaration that talks about preemption. All I was really looking at and the analysis that I did --**

Q. **I'm just asking you that question.**

A. **That's what I did. The analysis I did is simply to look at whether these were conventional and if the**

combination was conventional.

Q. **Please answer my question. My question was just whether you considered preemption. It wasn't what you did do. All right.**

You don't know whether there were any tests using cell-free DNA for organ rejection that were actually being used in patients as of 2009; is that right?

A. **I don't know. I'm not a transplant physician.**

Q. **You can't identify any validated test that used cell-free DNA for any purpose as of 2009; is that correct?**

A. **In any context? I'm not sure.**

Q. **And you believe the tipping point for when the technology state of the art could actually harness the correlation in order to make an organ transplant injection method was in 2008 or 2009; isn't that right?**

A. **So the Lo article talks about being able to do this in 1999 or 1998, so I don't know what the tipping point is. I don't know what you consider the tipping point, you know.**

When a commercial test became available is somewhat different from when we knew it was feasible. Right? Patents, my understanding, often issue before there's a commercial product. So in my declaration I cited to some prior art, like a patent from Dr. Lo and a patent from Dr. Cantor that talk about the ability to do this

before, to detect cell-free DNA and applications to transplant before 2009.

Q. **Let me just ask the question again. Please try and listen to it.**

The tipping point for when the technology in the state of the art could actually harness the correlation, the natural phenomena, in order to make an organ transplant rejection method was in 2008 and 2009; isn't that true? That your testimony?

A. **I'm not sure what you are referring to.**

Q. **Okay. I would like to direct you to your deposition transcript at page 145, lines 3 through 17. And the question I posed is: When was the tipping point that the technology could reach towards actually harnessing the correlation in order to make an organ transplant rejection method?**

And you stated, if you looked at the literature, 2008, 2009.

That was your testimony at deposition? I'm just asking if that was your testimony.

A. **So I didn't say tipping point. I said is that if you look at the literature that I was able to cite in 2008 or 2009, I may have had the dates wrong, for Cantor and Lo, so we can look at those.**

I would say the publication of Cantor and Lo

described in their patents the use of these methods for obtaining samples, genotype, quantifying DNA in a number of other applications. So I may have mis-answered your question.

THE COURT: Actually, he did not say tipping point, and that's a lesson for counsel. Like, if you gave me that, if somebody said in their brief that based on this deposition the witness said that this tipping point occurred, you would lose credibility with me in a brief because that's not what it says.

The question says it. There was an objection to the question. The answer does not affirm that there's a tipping point. So that's a lesson for everybody.

I pay real attention when I read the briefs if somebody tells me what a transcript says and I go look at it, and after I look at it, if I see mischaracterizations of it, even if it's minor --

MR. REINES: Yes. I would like to argue that point, Your Honor.

I'm not mischaracterizing anything here. The question is: When is the tipping point, and he said, if I look at the literature, I would be able to say 2008, 2009.

THE COURT: Actually, if you end it where you did, at the comma, that's true, that's what it says, but that's not what the entire answer says.

MR. REINES: Understood.

THE COURT: And you can argue all you want, but at the end of the day, I will be the fact-finder. I'm just telling you how I read the facts for your benefit so that you know going forward what you can stretch and what you can't.

MR. REINES: Understood. I just -- you know, understood. I'm certainly not here to mischaracterize anything to the Court.

BY MR. REINES:

Q. **Are there aspects of cell-free DNA that make it more challenging to work with in some contexts than others?**

A. **Yes.**

Q. **And one of the issues is that they're fragmented, so they're smaller; is that correct?**

A. **Yes. In some instances, working with it being it's smaller and fragmented.**

Q. **And there's another in that they're not random; is that correct?**

A. **In some applications, yes, they're not random.**

Q. **And a skilled artisan would have known that just because a technique is designed for cellular DNA does not necessarily make it well suited to cell-free DNA; correct?**

A. **For example, yes. There are techniques for amplifying**

the whole genome that wouldn't work well for cell-free DNA.

Q. **And at least in some aspects, cellular DNA samples and cell-free DNA samples are fundamentally different sample types; correct?**

A. **Fundamentally not in the sense that they're DNA. They are still DNA but they are different sample types. They have different physical characteristics.**

Q. **And you would agree that unlike cellular DNA, cell-free DNA is typically present in such low concentrations, that detection analysis is difficult with techniques prior to 2009; correct?**

A. **In some contexts, that's true, and I believe you're referring to testimony I gave in response to a line of questions about specific molecular biology techniques.**

Q. **And absent information to the contrary, a person of ordinary skill would not expect a method designed for cellular DNA to be applicable to cell-free DNA; is that correct?**

A. **So I said that and that was in the context of discussing certain methods. I think the other important thing to recognize is the patents in the claims and in their written description don't tell us how to overcome any limitations that might exist.**

Q. **All right. But just to be clear, if you could just answer directly my question. Absent information to the**

contrary, a person of ordinary skill in the art would not expect a method designed for cellular DNA to be applicable to cell-free DNA?

A. **For certain methods.**

Q. **When you say for certain methods, I would like to direct you to C1 at 12.**

A. **That's binder 2?**

Q. **Yes. It should all be in one binder.**

A. **No. I have two binders.**

Q. **All right. Do you see paragraph 28?**

A. **Yes.**

Q. **All right. You would agree that cell-free DNA is typically present in low concentrations; right?**

A. **Low is a relative term and I can't see my testimony any longer in this deposition, so I don't know the context in which you were asking it or which the questions were being asked at the time.**

THE COURT: Doctor, what you should do is answer the question.

THE WITNESS: Okay.

THE COURT: Don't worry about your deposition. Just answer his question today. He'll bring up the deposition. Don't anticipate, in other words.

THE WITNESS: Okay. I thought low concentration was in there, so...

THE COURT: Well, anyway, let's start over. Just ask the question. Listen to the question. Answer the question.

MR. REINES: Thank you, Your Honor.

BY MR. REINES:

Q. **Cell-free DNA is typically present in low concentrations; correct?**

A. **Low is a relative term, but, yes, low concentrations.**

Q. **In your report you relied on the Helicos 10-K to explain the state of the -- the state of the art say in the industry at the time; is that correct?**

A. **I wouldn't say I relied on it. I cited to it in a number of other references as well.**

Q. **But by relied on it, you identified and you said this shows the state of the art and then you put a chart that we looked at during the opening in your report; is that correct? In this case?**

A. **I used that chart in my report, yes.**

Q. **Okay. And you were on the scientific advisory board of Helicos; is that correct?**

A. **Yes, I was.**

Q. **Why don't we go to the Helicos 10-K, which is B46 at nine. And if we could blow this up where it says NDS. Thanks.**

All right. And in that right column --

A. **Excuse me, Mr. Reines.**

Q. **Oh, sorry.**

A. **That's not in my -- I have B40 and then B52, so I don't have this document.**

MS. HABERNY: Your Honor, I object. We don't have it in our binder either.

MR. REINES: Okay. I can just go --

THE COURT: I will tell you what. Let's just do this, because you do get it under the rules, fair enough, but we're also not in front of a jury, so why don't we just take the questions and then if you need the whole document to answer questions, you can ask for it.

THE WITNESS: All right.

THE COURT: Are you familiar with the document?

THE WITNESS: I'm familiar with it, yes.

MR. REINES: We can look at the report, his report if we need to do it.

BY MR. REINES:

Q. **On the right column, that's the limitations; is that correct?**

A. **I believe they describe the -- I can't quite see the header. I believe they describe these as limitations. Okay. They are talking about different sequencing technologies and they say there are certain disadvantages in this case for what they describe as next generation**

sequencing.

Q. **Okay. And you'll agree that the disadvantages there is that those were known by those skilled in the art that at least knew about the Helicos systems; right?**

A. **So the Helicos -- I don't know if they call this document, they call these limitations of their system, but you could call -- or you could --**

Q. **Let me withdraw the question because that wasn't a good one.**

Persons skilled in the art in 2009 were aware for next generation sequencing of the disadvantages of that approach that are in the right column -- complex sample preparation, limited scalability, high cost of sample prep and limit quantitation; is that correct?

A. **So I think this is kind of a marketing document. They are pointing out limitations of other technologies. I don't think everyone in the art would agree these are next generation sequencing. I don't know what year this was filed, whatever year it was filed.**

Q. **Is it a security filing?**

A. **I assume so, yes.**

Q. **That's where you got it when you took this and excerpted it and included it in your report when you stating what the state of the art was?**

A. **I would have to look at how I cited to it in my**

report, but, yes, it was a document that I cited in my report.

Q. **Okay.**

A. **I don't recall exactly what I said.**

Q. **The purpose for citing this was to describe the state of the art; is that correct? You testified to that earlier?**

A. **It was a reference. I would have to look back at my report. I honestly don't recall at this moment why I used this. I think it was to indicate that -- I don't recall why I used this. It was probably talking about the state of the art and the fact there were existing technologies.**

Q. **All right. Let's go to Exhibit C29, which is the Helicos follow-on 10K and specifically page 9. I want to, since we had that imperfection in the binder, I want to make sure you have it. So C29 at 9?**

A. **That I do have.**

Q. **Okay. And here if we could pull up the sentence with moreover. Here it says, moreover, many NGS technologies appear to possess biases and are hampered by their lack of absolutely quantitative accuracy if may limit their applicability to the broader genetic analysis space.**

Do you see that?

A. **Yes.**

Q. **And this from Helicos was after -- this was a 2011 securities filing?**

A. **I will take your word for it, yes.**

Q. **Okay. All right. Earlier you discussed that you acquired sequencing equipment-- NGS sequencing for the first time in 2008/2009; is that correct?**

A. **Yes.**

Q. **And why didn't you get next generation sequencing equipment before then?**

A. **So the instrument costs about $750,000. We had a number of sequencing instruments available at Harvard. I think there were even core facilities that had some of these instruments, so if you had samples, you could send them out. But it was largely the cost of the instrument that prohibited us from buying one.**

Q. **Okay. And you received funding to purchase the Helicos sequencer; is that correct?**

A. **No. I received funding to purchase an Illumina sequencer.**

Q. **Okay. So you never -- you never had any funding to acquire a Helicos sequencer?**

A. **Not to my knowledge, no.**

Q. **Okay. Regardless, you never received the Helicos sequencer; right?**

A. **I never placed an order for one.**

Q. **So in terms of the documentation that came with it that said like, you know, how much what you call the**

manufacturer was telling you to use or not, you don't know? You never saw the Helicos literature, did you?

A. So I didn't see these 10-Ks. I did see the -- when I was on the scientific advisory board, we reviewed the protocols. We would look at the instruments, its performance characteristics. We gave advice about -- I gave a lot of advice about data analysis, but I also have a background in chemistry, so I talked with them about the chemistry and how they might want to improve their chemistries and detection. So I may have seen the -- the manuals they provided with the instruments. I probably did.

I also worked with a group in Riken, in Japan. Mr. Reines earlier said they only sold one instrument. They actually sold a number of them to Riken in Japan and Riken used these for sequencing mouse genes. So they had a project that was to try to create an entire C.V. of all the genes in mouse and they were using this technology.

Q. Do you know if those were returned?

A. They were eventually returned. The company eventually went bankrupt.

Q. And Riken returned them; is that correct?

A. Actually, I don't know if they returned them or just retired them. I know even after the company was bankrupt, it wasn't selling machines anymore. They were still using

them, and they were trying to get the reagents, right.

So you can run an instrument, right. It's like if you have a VHF player, it's not much good unless you can put the tapes in, and the same way they had the instrument and the company wasn't selling the kits any more used to run it.

Q. And in terms of the documentation, there was a back and forth on direct examination, including questions by the Court about the extent of guidance that was received in the manual about how to use this $750,000 or million dollar piece of equipment, like, different ways and what would be configured and what you would have to do yourself.

You referred to protocols and documentation; is that correct?

A. Yes, I think I did.

Q. But you didn't cite any in your examination, did you?

A. No.

Q. So you didn't actually have what those protocols are or not, did you?

A. I don't have them today. I didn't cite them in my report or my -- in my presentation today, my testimony today, but manufacturers routinely provide documentation for the instruments and the kits that they sell.

Q. Okay. And in terms of what is configurable by user and what judgment the user has versus what advice is given

by the manufacturer, you would need to look at those documentations for that; is that correct?

A. **Most of these instruments don't allow you to adjust very many parameters because the manufacturers, they're very complex instruments, and manufacturers don't want you messing it up and having to send service technicians in to fix it.**

So there's usually a standard set of settings. Some you can adjust. Many of these sequences, you can adjust the read length, how many bases you read. But the way you adjust them is to set fixed many parameters and they come with kits, and the kits are designed to work with a specific set of parameters.

So it's not kind of like the Wild West where you can tune everything, you know. They're fixed applications, fixed kits and fixed settings on the instruments with some latitude to adjust them.

Q. **Beyond the latitude to adjust them, there are different kits; right? It's not just one kit that you get with the sequencer; right?**

A. **So if I were to run a different type of assay, if I were to look at messenger RNA, which is what genes it turned on, I would need a different kit than if I wanted to look at mutations in the BRCA1 gene.**

Q. **And in terms of the kits and what kind of kits that**

were available in 2009 and what instructions that you had, that's nothing you addressed on direct examination; is that right?

A. **No, I didn't.**

Q. **In terms of Sanger sequencing, there was reference to the patent that I think was underlined by counsel saying it was conventional technology. You understand the claims here don't cover Sanger sequencing; is that right?**

A. **So the claims talk about high-throughput technology and the patent itself refers to high-throughput technology and cites to the inventor paper in 2001.**

Q. **Okay. And you would agree that in 2008, high-throughput sequencing was a new technology?**

A. **So high-throughput, it depends on what you define as high-throughput sequencing. High-throughput sequencers were relatively new technology, new being that the first sort of successful high-throughput sequencer was the '454 sequencer, which was introduced, marketed as a commercial instrument in 2005.**

Q. **All right. Why don't we put up B18, which is the -- and excuse me. It's the Kahvejian paper. You're an author on this paper?**

A. **Yes.**

Q. **If you could sequence everything, what would you do. I think that's what the title session; is that correct?**

A. **Yes.**

Q. **All right. If we could turn to the second paragraph. And it says, now, a new generation of high-throughput sequencing technologies promises to again transform the scientific enterprise.**

Do you see that?

A. **Yes.**

Q. **And that's referring to NGS, the new generation?**

A. **So, yes. It's referring to next generation sequencing instruments.**

Q. **All right. And if we can go down to the second paragraph where it refers to the new and unfamiliar world. And what you wrote here was that although we have not quite reached the point where cost and technology are no object, new sequencing techniques have not simply changed the landscape but have placed basic, clinical and translational research scientists into a new and unfamiliar world in which entire different types of questions can be addressed.**

A. **Yes.**

Q. **Correct?**

A. **Yes.**

Q. **That was something you included?**

A. **Yes.**

Q. **All right. And you state on the right column that high-throughput sequencing is not without its issues. We'll**

get that pulled up. All right.

One thing that you believed in 2008 was that the various sequencing technologies generated different read length, different error rates and different error profiles relative to traditional data and to each other; is that correct?

A. **I'm sure it says that.**

Q. **And also that in addition to simply analyzing the sequence data, new methods will be needed to analyze and integrate the mass of data sets and apply those to various sets of biological information. That's another thing you said in 2008?**

A. **Yes. I would say that's still true today.**

THE COURT: What are you quoting from when you said that? The new method, what exhibit?

MR. REINES: Oh, it's Exhibit 18. B18. I'm sorry.

THE COURT: The same article?

MR. REINES: Yes. It's the same article, yes.

BY MR. REINES:

Q. **All right. You would agree that in 2009, next, generation sequencing would have been in its infancy?**

A. **You know, in some definitions, yes. As I said earlier, the technology was established in -- the first commercial instrument was in 2005. There were a rapid**

succession of instruments. They were rapidly adopted. They were being widely used.

The paper Mr. Reines is talking about had 112 citations, many of which are applications to this technology and it was proliferated quickly, so it was still relatively new.

We were facing challenges with data analysis. If the first genome took ten years and the next took a year and I could sequence a genome in two weeks and I sequence a collection, figuring out what's there is going to present some interesting challenges and opportunities. So, yes, there were challenges. It assumed that it was in its infancy in the sense that it was still relatively new.

Q. All right. Try to stay with my question. I would like to show you the Taub article, which is at, hopefully in your binder, called overcoming bias and systemic errors in next generation sequencing data.

Now, you know Rafael Irizarry. He's a colleague of yours; correct?

MS. HABERNY: Objection. What exhibit number?

MR. REINES: This is in your binder.

MS. HABERNY: Which exhibit number?

MR. REINES: It doesn't have a number. It's in your binder.

BY MR. REINES:

Q. **Rafael Irizarry, he's a colleague?**

A. **Can you tell me where I can find this, please?**

MS. HABERNY: Your Honor, I apologize. We had an agreement with counsel that no new exhibits outside the summary judgment record --

MR. REINES: Except for cross.

MR. JOHNSON: We had that agreement.

MR. REINES: No, we expressly didn't.

MR. JOHNSON: We specifically talked about that. No new exhibits.

MR. REINES: I have one document. It's a publication at the time.

THE COURT: So in case both of you are before me in the future, I do not require disclosure before a hearing to cross-examine a witness with an article. The whole purpose of cross-examination is to test the mettle of the witness, see the truth, and sometimes that happens when you are not ready for an article.

Now, counsel worked out, and I don't know what's reflected on the record, but what I just witnessed was the vehement disagreement between the two sides about whether there was an agreement. I can't adjudicate that, so I'm going to let the questions go forward and if the defendants feel like there was some article they wanted to cross-examine the plaintiffs' expert and they didn't provide

it. But they have it available and want to use it, I will allow you to do that. Okay?

So I will permit this particular line of questioning. Now, if you want to object on different ground, if it turns out it's not relevant, something like that, we'll allow it.

So having said that, you know, you're just going to show him an article? You actually know this person, so presumably that, and let's see.

MR. REINES: Let me lay more foundation.

THE COURT: All right.

MR. REINES: And I think one thing, it's enlightening and it's not complicated.

THE WITNESS: He's a faculty member of my department at Harvard.

THE COURT: Okay.

BY MR. REINES:

Q. **So he's in your same department; is that correct?**

A. **He's in my academic department. He's also now chair, he wasn't at the time, of our systems department at Dana-Farber where I was moved to. I know Rafael well.**

Q. **Right. You've co-published a number of publications with him?**

A. **Yes.**

Q. **I would like to direct you to the right column of this**

article, which is a 2010 article. At the top it says, with high-throughput sequencing still in its infancy, many questions remain to be addressed before any hope of achieving approval for clinical applications is warranted.

Do you see that?

A. **Yes.**

Q. **And that's something you agree with; correct?**

A. **I didn't make this statement, but I can tell you from my understanding that clinical applications require a variety of steps to become clinically approved for use and so some of that has to do with robust data analysis platforms. That's what Rafael does.**

So I would agree there were some questions to be addressed and hurdles to be overcome before a technique to make their way into a clinic.

Q. **All right. And an organ rejection test, that's a clinical application; is that correct?**

A. **I said would be, I would hope.**

Q. **Yes.**

MR. REINES: Your Honor, that's what I have for cross.

THE COURT: Okay.

MR. REINES: Thank you.

THE COURT: Any redirect?

MS. HABERNY: Thank you, Your Honor. I have

just a few questions.

REDIRECT EXAMINATION

BY MS. HABERNY:

Q. **Dr. Quackenbush, do the claims or written description of the patents at issue recite any special genotyping procedure for cell-free DNA as opposed to cellular DNA?**

A. **No. They simply tell us to genotype and the written description refers to existing technologies, commercial instruments.**

Q. **And do the claims or written description of the patents at issue recite any special procedure for sequencing nucleic acids from the cell-free DNA sample as opposed to a cellular DNA sample?**

A. **They don't recite any methods for any kind of sequencing either with cell-free DNA or cellular DNA other than pointing us to manufacturers of the commercial products.**

Q. **Now, you were asked some questions about a Helicos 10-K and you were asked specifically about some limitations that were listed in that 10-K.**

Are any of those limitations that were in the 10-K claimed, or solutions to any of those limitations claimed in the patents at issue?

A. **No, they're not.**

Q. **Are solutions to any of those limitations in the**

Helicos 10-K described anywhere in the written description of this patented issue?

A. **No, they're not.**

Q. **Do the patents at issue purport to overcome those limitations stated in the Helicos 10-K in any way?**

A. **No, they don't.**

Q. **And are the claims limited to Helicos high-throughput sequencing?**

A. **No. They list a number of other high-throughput sequencing manufacturers and they also point to the Venter 2001 paper that practices high frequency throughput, and that was the group that actually sequenced a human genome.**

Q. **So according to the patent, could a person of skill in the art use a sequencer from a manufacturer other than Helicos to perform the claims?**

A. **Yes.**

Q. **You were also asked about questions about the Kahvejian article, which is Exhibit C18, and you were specifically asked some questions about limitations to next generation sequencing that were discussed in that article.**

Do the claims of the patents at issue resolve any of those limitations?

A. **No. They simply recite the use of established technologies and conventional ways to detect -- to detect**

transplants.

Q. **And does the written description of the patents at issue describe any solutions to any limitations of next generation or high-throughput sequencing?**

A. **None whatsoever. Only they only tell us to use high-throughput sequencing.**

Q. **And is next generation sequencing recited in the claims?**

A. **No, it's not.**

Q. **Mr. Reines also asked you some questions about the availability of clinical tests using cell-free DNA with patients earlier.**

Do you recall that?

A. **Yes.**

Q. **Does the availability of a clinical test performed on patients change your opinion as to whether the claims as recited in the patents at issue were conventional as of November 2009?**

A. **No. Getting a clinical test certified takes a long time and so when a method is invented to actually get into the clinic takes -- you have to go through a process and you have to get certified. It's a process called CLIA, clinical laboratory -- something amendment. Improvement Amendment. And that sets a set of standards for getting a laboratory developed test approved. And then you have to get it**

approved by the payers because you are not going to offer it unless Medicare and Medicaid and the insurance companies provide it. So getting from an investigational study to a clinical test is challenging, so it wouldn't have changed my opinion at all.

Q. **And do you know whether or not CareDx's own cell-free DNA test was launched in 2017?**

A. **I believe that's when it was finally launched.**

Q. **And how many years after the priority date of the patents at issue today is that?**

A. **So eight years.**

MS. HABERNY: Thank you. No more questions.

THE COURT: Mr. Reines, can you do me a favor? Can you pull up D18 on the screen?

THE COURT: Yes.

MR. REINES: And I don't know if it's possible to do a word search. Can you be in control of that, find a word? I want to find the language in the article that refers to new and familiar.

MS. HABERNY: I apologize, Your Honor. Which term?

THE COURT: New and familiar. Is it possible to put it on the screen? I'm sorry?

MR. WALTER: Unfamiliar.

THE COURT: All right. So, Doctor, you're one

of the co-authors of this; right?

THE WITNESS: Yes.

THE COURT: And you've got this sentence that you were cross-examined about, referring to -- well, I will just read it. It says, although we have not quite reached the point where cost and technology are no object, new sequencing techniques have not simply changed the landscape but have placed basic, clinical and translational research scientists into a new and unfamiliar world in which entirely different types of questions can be addressed.

So what do you mean by that?

THE WITNESS: So the easiest way to think about this is the first human genome was sequenced in 2000, published in 2001. Okay?

There was some controversy about how many genomes there were. It was one or two. Craig Venter and some other people invented other genomes. So we basically had one or two genomes in 2001. The cost of sequencing those genomes was hundreds of millions of dollars. All right.

The cost started falling, and you can find this data even today at the National Human Genome Research Institute website, and they compare it to Moore's law, the law in computing that the cost of computing drops by a factor of two or the processing power doubles by a factor of

two every 18 to 24 months.

And if you look at the slope, the cost of sequencing was falling basically equivalent with Moore's law until about 2007 at which point it took a sharp turndown. The reason it took a sharp turndown was technology from '454, Illumina, Helicos, other manufacturers, Applied Biosystems introduced it that also failed. They introduced these new technologies.

From about 2007 on, the cost was falling by 33 percent per quarter. Okay? And the speed at which you can generate data was falling at about the same rate. It was just -- it was dropping dramatically.

And so when the first genome was sequenced, you start to ask questions like, if we look at a huge population and we wanted to find genetic variance, polymorphisms that correlate with particular diseases, cancer risks, diabetes, heart disease, right, how do you find them? Well, if you only have one or two people, it's hard.

By the time that we got to the new instruments being introduced, we were starting to seeing more and more genome sequence, and when the costs started to fall, we recognized more and genome. Right?

I used to give lectures about this phenomenon when I'd discussed it publicly. In 2009, the cost of a genome had dropped from $100 million in 2000 to $100,000 and

I used to say, this is the whole genome. It's not the little kind of piece we're talking about today. It's the whole genome.

I would say at this point, it was September of 2009. If my wife or son had a rare tumor, I would mortgage the house and sequence the genome because we've learned enough about mutations that might help direct therapy.

Within a few years it had dropped to a thousand dollars at which point I could pay for it on my credit card. Okay. And we were in that rapid -- at the time he wrote this article, it was a rapid decrease in cost.

You sit back and say, oh, my God, I can generate data at just unprecedented rates in increasingly large populations. What can I do with this? And there was just an explosion of innovation at the time.

And so we are we're talking about here is really this fact that we were discovering new things because we had these technologies that were now in widespread use and this article is saying, these technologies are poised to really supplement almost all the other technologies.

There's a nice graphic in there showing existing technologies. I think these are two -- showing existing technologies and how these sequencing technologies really encompass all of them. There's also a graphic just showing the explosion of publications that use these now.

THE COURT: And, you know, do you think the patents that have been asserted in this case, do they disclose new sequencing techniques?

THE WITNESS: No, they don't. The sequencing techniques this they refer to are the instruments that I was talking about here.

THE COURT: Okay. Can you please search for in the same article new method, please?

All right. So in this article, you and your co-authors said, the various sequencing technologies generate different read lengths, different error rates and different error profiles relative to the traditional data and to each other. In addition to simply analyzing the sequence data, new methods will be needed to analyze and integrate the massive data sets and then apply those results to various types of biological information.

What did you mean by that sentence that begins with, in addition?

A. **So I know you were going to ask me about the first sentence.**

Q. **To the extent you need to read it -- what did you mean about what we read, those two sentences? What are you talking about there?**

A. **I'm glad you asked me to talk about the two because they're talking about a slightly different thing.**

The first is that various sequencing technologies generate different types of data, each of which has its own bias. Every measurement you make has its own bias. You have to integrate those biases together. I will give you a different example. Francesca Dominici and Rachel Nether use to work with me at Harvard. They studied air pollution and they have ground sensor monitor. They have satellite data. They have other sources of data. And if you take all of those data sources, they all have their own biases. So if you want to put them together to get a unified picture, you have to develop methods that allow you to integrate both data.

In the same way, each one of these sequencing techniques was different. So when the Illumina sequencer started, it could only read 36 bases. Sanger sequencing could read a thousand bases. So if you want to put those data types together, right, people that had been working with only one, now you have to think of ways to put the data types together, and you want to do that because you want to look at as large a population as you can.

So the first one just refers to the fact we really need to understand how to put these data types together for different instruments.

The second sentence, and the work I do is -- my research is really focused on the second piece, and in

addition to simply analyzing the data. So by that what I mean is just looking at the data, the way we analyze it after the first genome, map it back to the reference. Right? It's like having a scaffold, or if you are putting together a jigsaw puzzle, right, you look at a piece, you see where it goes in the image on the cover, on the box, and you put it down. Right?

So the original genome gave us a framework on which to map other genomes. So in addition to simply analyzing, we matched it back when we looked for how a genome would different from the reference genome.

New methods were needed to analyze and integrate massive data sets. Right? So earlier I talked about going from sequencing from years to months to weeks. Right? I used to be able to store -- I could store data from the first human genome on my laptop. I have a thousand genomes.

Before 2008, a project called A Thousand Genomes was launched. I couldn't store that on my laptop? All right? So accessing that kind of data, even accessing it is a challenge. Then when you have these new quantities of data, you knew you need new ways to look at them.

This is in a research study. A lot of this is for discovery. In clinical applications it's often different, right, because you're not looking at a large population. Right?

So, again, I do a lot of work in cancer, and when you think about sequencing cancer genomes, and if I wanted to find my new mutation of a cancer genome, that would be a really challenging problem, right, because I would have to look at the genome. I would have to understand what each one of these individual genomes do. I would have to look at the methods and pathways that were potentially affected by mutation. On the other hand, if I had a patient with colon cancer as of 2009 and I sequence their genome and I knew they had a KRAS mutation, it means nothing other than looking at that one gene and asking, is there a mutation. If I know they have a KRAS mutation, I could tell the treating physician not to use a whole class of drugs called EGFR inhibitors because they won't work. Right?

And so in some applications, like these research applications in discovery, we need new methods. In other applications, you don't, you can use the existing data.

So this article --

THE COURT: So when you say new methods will be needed to integrate the massive data set?

THE WITNESS: Yes?

THE COURT: What are you referring to like data sets within that are -- I mean that consist of genomes of many, many individuals? You are not on a patient basis at

that point?

THE WITNESS: No. We're talking about these research applications that have hundreds, if not thousands of individuals.

THE COURT: All right.

THE WITNESS: And, you know, the opportunity for discovery there is amazing. Right? And some of my research today is looking at a simple question that we know is clinically relevant, and that question is, how does male disease differ from female disease? And we know I published opinion a few years ago in colon cancer. Males to females have a different natural history of disease. They respond differently to chemotherapy. Why?

We can't answer that question. We couldn't even ask that question until we had genome scale data on large populations. And those are the kind of things we're thinking about doing.

THE COURT: Okay. All right. Thank you.

MS. HABERNY: Thank you, Your Honor.

THE COURT: All right. Thank you very much.

THE WITNESS: Thank you.

THE COURT: Do you want to begin the next witness real quick or do you want to take a break? I was going to break about a half-hour for lunch. Can we get through it in two hours, direct and cross?

MR. REINES: Counsel and I spoke. I think we want to keep the lunch quick.

MR. JOHNSON: We can eat quickly.

THE COURT: Why don't we start at 1:15. We'll go straight through and complete it.

MR. JOHNSON: Thank you.

MR. REINES: Thank you.

(Luncheon recess taken.)

- - -

(Proceedings resumed after the short recess.)

THE COURT: All right. Please be seated.

... BRIAN VAN NESS, having been duly sworn/affirmed as a witness, was examined and testified as follows...

MS. HABERNY: Your Honor, quickly, may I hand up the slides I used with direct examination?

THE COURT: Sure.

MS. HABERNY: May I approach?

THE COURT: Sure.

(Slides handed to the Court.)

MR. WALTER: Good afternoon, Your Honor.

DIRECT EXAMINATION

BY MR. WALTER:

Q. **Good afternoon, Dr. Van Ness. I would like to start out by having you introduce yourself to the Court.**

A. **My name is Brian Van Ness. I'm a professor in the pharmacokinetic cell and development at the University of Minnesota. I served as department head from 2000 to 2009.**

I also serve as the chair of our scientific advisory committee that oversees the development of our genome center. I've been doing that for about 12 years. And I currently serve as the chair of the National Cancer Institute's network on cancer drug resistance and sensitivity, which is mostly directed at genetic analysis of cancers.

Q. **All right. I'd like to get right into the substance of the opinions. So let's start to talk about some background on the technology. What do the claims generally cover at a high level?**

A. **Well, it's my opinion that they are covering material that is not directed at natural phenomenon and/or ineligible material and that they cover material that was not conventional or routine in the art in 2009.**

Q. **Okay. And what is the general process that's in the claims?**

A. **What do you mean by process?**

Q. **In terms of the claim steps, in terms of the technical steps?**

A. **Oh, so the steps themselves involve determining the sequence, genetic differences between the donor and**

recipient in an organ transplant, identifying those sequence differences, obtaining a sample from the recipient and using those sequences that distinguish the donor, determine the amount of donor sequence in the cell-free fraction of the DNA as it was associated with the potential for rejection.

Q. Okay. And prior to the patents, how was organ transplant rejection usually monitored?

A. Prior to that, some of the most common ways of doing it were biopsies, invasive biopsies. There were also creatinine levels that were looking at in kidney transplants, for example.

Q. And what were the challenges that were associated with using those techniques to monitor organ transplant rejections?

A. The challenges would involve probably, mostly significantly, they were invasive procedures, they had their own morbidities that could occur with that. Obviously, it was uncomfortable for the patient. The creatinine levels were also demonstrated many times to not be very accurate reflecting the status of rejection. And in those cases where there was rejection that was noticed, oftentimes it was so late in the process that even though you could identify rejection was occurring, those methods were very late in the process when oftentimes there was little you could do to reverse that.

Q. **Okay. Now, one of the issues that has been mentioned many times today is the concept of donor derived cell-free DNA. Can you briefly describe what that is?**

A. **Yes. Donor derived cell-free DNA reflects the fact that the donor organ, when cells will lyse, and sells will lyse in the donor organ, they will spill DNA out into the bloodstream and that results in DNA that's in the cell-free fraction or donor DNA in the serum.**

Q. **Were there early attempts to try to utilize donor derived cell-free DNA to detect organ transplant rejection?**

A. **Yes.**

Q. **And how did those early technologies attempt to exploit donor derived cell-free detection?**

A. **The early technology we've heard about, and that's oftentimes there was a gender mismatch where you would have a male with a Y chromosome organ being transplanted into a female, and in that case the idea was to look for a Y chromosome DNA in the cell-free fraction. Another way of doing it was to look at HLA, which is a cell surface marker that distinguishes many people's different DNA. They have variations in their protein expression and there are ways to look at different HLA markers that would distinguish the donor from the recipient, and you would look at that in a serum as well.**

Q. **Now, what were the deficiencies with those approaches?**

A. **Well, first of all, we've also -- we've heard some of this and that is in detecting Y chromosome DNA, this whole idea of this microchimerism, that there's this background of level of Y chromosome DNA that often is present in women that would complicate measuring whether it came from the donor organ or not.**

The HLA material oftentimes, even though there was variation between people, oftentimes they had very similar HLA and couldn't distinguish donor from recipient just based on HLA, And then most significant limitation is that these technologies were based on gender mismatch, which only covered a portion of the organ transplants and was certainly not universal.

Q. **Now, based on these challenges that were in the art, is it your you'd go that in 2009, there was a need for improved method for monitoring?**

A. **Yes. There was clearly a need for improved method to monitor organ transplant.**

Q. **Can we bring up C5? What is C5?**

A. **This is a paper from the Vymetalova Group, clinical medicine, and this is a 2008 paper, I believe, in which she was discussing some of the difficulties in using Y chromosome as a marker.**

Q. **And you mentioned the year 2008. How does that year pertain to the priority date of the patent--**

A. **It's the year before, a little less than year before, but it's concurrent with about that time frame when the patent was being developed.**

Q. **Okay. And then could we bring up C5-3, which is the conclusion, and blow up that conclusion for us.**

What did the authors of this publication conclude in 2008?

A. **Well, it's written there, which is they said there was this high prevalence of chimeric DNA in different ratios in female recipient cell-free fractions of plasma. As a result, it would be difficult to differentiate where the Y chromosome DNA was coming from in patients undergoing, for example, a heart transplant.**

So the conclusion from this paper in 2008 was the use of DNA in cell-free fraction might well be impractical for detecting organ rejection.

Q. **And is that consistent with your understanding of the state of the art at the time?**

A. **Yes. That basically would say based on this kind of presentation, one wouldn't necessarily consider using cell-free DNA to look at DNA from the organ as routine and conventional.**

Q. **All right.**

THE COURT: I forget. What's the date of this article?

THE WITNESS: 2008.

THE COURT: 2008. Thank you.

MR. WALTER: Yes.

BY MR. WALTER:

Q. **All right. I would like to start talking about the patents now.**

MR. WALTER: If you can bring up, Ms. Woo, claim 8 of the '607 patent, which is B3.

BY MR. WALTER:

Q. **All right. So I've put up here claim 1 of the '607 patent. What I'd like you to do, Dr. Van Ness, is the describe the steps that are in this claim.**

A. **In this claim they're quantifying kidney transplant derived circulating DNA as a measure of potential organ rejection. So they're obtaining a genotype, if you will, the SNPs that we talked about previously. Determining the difference between the donor and the recipient in areas of their chromosomes that distinguish them, doing that with a thousand polymorphic sites and then utilizing that material to look to cell-free DNA after transplant and measure the quantity of the organ transplant filled DNA based on those generic markers as it related to the potential for organ rejection.**

Q. **How are the inventors of this patent able to overcome the challenges that were associated with donor derived**

cell-free DNA that we have discussed?

A. **Well, it really -- it really became this combination of methods where they went through methodically in each of of these claim steps describing how you first determine multiple sequences to distinguish the donor and the recipient.**

You then harvest the cell-free DNA and then you quantitate it, and so they -- in this patent, put through a whole series of novel steps that resulted in the ability to detect the quantity of cell-free DNA from the organ transplant.

Q. **Okay. Now, was this combination of steps A, B, C, D, and E and F in human conventional prior to the invention of the patent-in-suit?**

A. **No. I wouldn't talk about these individually. Many of these steps had inherent limitations and issues that limited their ability to achieve what I think this patent did, which was the accuracy by virtue of its specificity and its sensitivity.**

Q. **What about the overall combination of steps? Was that routine and conventional?**

A. **There were really no reports on that combination of steps that would lead me to believe that it would be considered routine and conventional.**

Q. **All right. Why don't we bring up claim 1 of the '652**

patent, which is D-1.

All right so we're now showing claim 1 of the '652 patent. The same thing as before. Can you briefly walk through the steps that are present in this claim?

A. **This is very similar to the previous patent. The claims are very similar, it is, in fact, determining the sequence that distinguishes the donor from the recipient. Developing a SNPs profile and then using that SNPs profile to quantitate the amount of cell-free DNA as it related to the status of the organ being transplanted.**

Q. **And how did this patent overcome the challenges that were associated with prior art attempts to use donor derived cell-free DNA to monitor organ rejection?**

A. **The same thing. I think it would -- it recognized the need for multiplying different sequences, this is the donor/recipient. And I think what they did, they provided a series of steps that gave them the accuracy and specificity to accomplish that goal.**

Q. **Okay. Prior to the invention of the '652 patent, was this combination of steps routine or conventional?**

A. **No.**

Q. **Let's bring up B2 now, claim 1 of the '497 patent.**

Okay. I'm showing you claim 1 of the '497 patent. Can you please describe the steps in claim 1 of the '497 patent?

A. **This again, very similar to '607 and that is that it's a method for detecting the circulating DNA in which the organ donor's genotype is determined with this SNP profile. The SNP profile was then subsequently quantified that was unique to the donor sequence, so identified the quantity of spilled DNA into the cell-free fraction and determining the amount of that DNA as it related to the status of the organ transplant.**

Q. **How did this combination of steps overcome the challenges that were associated with using donor derived cell-free DNA to monitor organ transplant rejection?**

A. **Again, it basically was a series of steps and, importantly, not only did it provide the sensitivity and specificity, but it did the one thing that the other techniques didn't do. It was universally applied, that it wasn't dependent on a gender mismatch. This was universal. It could work with any of the male/female generations of transplants. It was not dependent on a gender mismatch.**

Q. **Now, prior to the invention, was this combination of steps in claim 1 of the '497 patent routine and conventional?**

A. **No, there were no reports on this being routine and conventional.**

Q. **Now, you testified for all the patents that the combination of steps were not routine and conventional.**

What evidence do you have for that?

A. **Well, I think one piece of evidence is that despite, which I think is a real recognized need to improve detection of rejection, there really were no reports in using cell-free DNA to achieve that goal prior to 2009. And then subsequent to the patent, Quake and colleagues then published a paper in PNAS saying we're going to take the methods of this patent, we're going to apply it, and they demonstrated it in the proceedings of the National Academy of Science Paper that it really was quite successful.**

Now, I think the reason that's important is because a journal like PNAS, which is one of the high profile journals in the field, doesn't just accept papers that provide routine and conventional technology. They recognized it as a novel approach that had the sensitivity and specificity that nobody else had reported.

And then subsequent to that paper, there were well over 260 citations that referred back to this method of saying, this is a really important method because it was cited so many times by other people that were now implementing this method.

So prior to the patent date, none of that had happened. This was all as a result of that patent demonstrating this novel approach.

Q. **Okay. And I'm showing you C20. Is this the PNAS**

article you were just describing?

A. **It is.**

Q. **All right. Do you recall Dr. Quackenbush testifying regarding a portion of the passage, patent at column 5 that talks about certain steps being conventional for use in the invention?**

A. **Right.**

Q. **And do you recall they also talked about that -- excuse me. When I say they, I mean Natera and Viacor during their opening presentation.**

A. **Yes.**

Q. **I would like to ask this questions about that and bring that up. Let's bring up B-112, column 5, 36 to 49.**

Okay. This is the passage they relied upon that has been much discussed today, and I want to ask the basic question: In your opinion, does this disclosure mean that the techniques that are used with the claimed invention are routine and conventional?

A. **No. This is a disclosure you find in other patents. It's basically a general disclosure that says that in order to practice the claims, there needs to be an understanding of some of the basic chemistry that's involved in doing molecular biology, making up buffers and analyzing quantities of DNA in a test tube by spectrometric methods.**

So these are general laboratory procedures, and

they did qualify this and say in addition to these conventional techniques that everybody should know about, they have others where they say, unless otherwise indicated.

Q. All right. I want to follow up on otherwise indicated now.

MR. WALTER: And, Ms. Woo, if you could bring up B-113 and bring up column, lines 47 to 66.

BY MR. WALTER:

Q. All right. What is this describing?

A. This was basically describing part of the need. It basically said there were some real limitations not only in that you are limited only male/female in doing gender mismatch, but even the detection of Y chromosome as a measure of organ transplant rejection. It had its problem.

Q. Okay. Now, earlier you talked about Y chromosome and HLA. How does this description relate to those prior art techniques that you mentioned at the beginning of your testimony?

A. Well, it basically puts into question the accuracy of those methods in detecting organ rejection because of some of the problems they face.

Q. Okay. Let's bring up B1, column 8, line 23 to 44.

THE COURT: I'm sorry. Can you go back to that last passage?

MR. WALTER: Sure. It's B1, column 47 to 67.

THE COURT: Give me one second. All right. Thank you.

BY MR. WALTER:

Q. **All right. Let's go on to B1, column 8, line 23 to 44. What's being described here, Dr. Van Ness?**

A. **Well, again, there's very additional description, problems with the strategy because of this microchimerism. It says, women might frequently have Y chromosome DNA that would complicate determining the origin, so they talk about these further problems, again indicating that this strategy was not routine and conventional.**

They go on to say in the remainder of the paragraph that HLA is also an approach that was taken, but that strategy, as they point out, is also limiting, because it doesn't distinguish HLA alleles, those are the differences, between all donors and recipients. So there were limitations in these types of assays.

Q. **How would you describe this approach in terms of universality?**

A. **Well, it clearly wasn't universal because it wasn't useful in every circumstance, and it was only in terms of the Y chromosome, was only limited when you had a gender mismatch, and it had to be a directional gender mismatch, male/organ into female recipient.**

Q. **All right. Let's take a look now at B1, column 8,**

lines 45 to 54.

All right. What is being described here, Dr. Van Ness?

A. **So this is where I think you really have some of the novelty of the approach here, which is that prior to this, nobody could really say this, and that is that in the embodiments of this particular patent. And claim, this invention provides a universal approach to the detection of graft rejection and circumvents the problems that we just talked about.**

Q. **Okay. Now, how does this pertain to the passage that we started out by looking at in column 5?**

A. **This basically refers to otherwise noted technology. That is basically, this is starting to generate THAT unless otherwise indicated, part of the otherwise indicated, we have a universal method. That would not have been in the general descriptions of conventional methods in that first paragraph you discussed.**

MR. WALTER: Okay. Now, Ms. Woo, if you could bring back up B1-12 at 536 to 49.

BY MR. WALTER:

Q. **Now, I don't know if you recall, but during Mr. Woo's opening presentation, he referred to this passage and described it as an unusual situation and that it referred to these conventional techniques.**

Do you agree with that assessment that this is unusual?

A. **No, not at all, because this -- this statement is used essentially verbatim in many other patents.**

Q. **All right. Let's bring up C26. What is C26, Dr. Van Ness?**

A. **Well, it is a patent, a method for generating sequencing libraries prior to the actual sequencing of generating what are called libraries.**

Q. **If you could bring up C26-5, paragraph 17. What is this teaching, Dr. Van Ness?**

A. **Well, this discloses in the patent the exact same phrase, which is the invention employs, unless otherwise indicated, conventional techniques with those particular references cited.**

Q. **Okay. Let's go to C23 now. What is C23, Dr. Van Ness?**

A. **This is a patent in 2020 from the Broad Institute on mapping of biomolecules in situ using high-throughput sequencing technique.**

MR. WALTER: All right. And let's go to C25, C23 at -- C23-21, I think. Yes. C23-28, column 21, lines 60 to 62. Can you blow that up?

BY MR. WALTER:

Q. **All right. What is this showing, Dr. Van Ness?**

A. **The same phrase, and that is that they are disclosing that there are some conventional techniques that might be used in the practicing of the patent unless otherwise indicated.**

Q. **Okay. And how does this language compare to the language that appears in the patents-in-suit?**

A. **As far as I can tell, looking at this, it's absolutely verbatim.**

Q. **Okay. Let's bring up C24. What is C24?**

A. **It's another application of 2012. It's a patent application that is looking at the enzyme detection using some chemical dye.**

MR. WALTER: Okay. If you can take a look at C24-12 and bring up paragraph 22, Ms. Woo.

BY MR. WALTER:

Q. **What is this showing, Dr. Van Ness?**

A. **This is the same phrase that's basically saying that as part of this patent, we're disclosing the fact there are some techniques that are conventional found in these kind of publications unless otherwise indicated.**

Q. **All right. Let's go to C25. What is C25?**

A. **This is a method for mapping gene copy number, variations in copy number. Not just individual sequence, but oftentimes people have variations in actual copy number that can be detected, and this is a patent that's looking at**

identifying and quantifying gene copy number.

Q. All right. And if you can look at --

MR. WALTER: Ms. Woo, if you can bring up C25-18. There you go. Thank you.

BY MR. WALTER:

Q. What is this showing?

A. The same thing. That as we discussed in all the others, this is a common phrase verbatim that's used in many patent applications to simply indicate that there is some common molecular biology or chemistry techniques that can be found in these journals that a person of skill in the art might have access to.

Q. Okay. Let's take a look at C22 now. What is C22?

A. This is looking at cell death. It's an application of cell death targeting.

Q. All right. Let's bring up C22-18, column 8, line 58 to 94.

What's being shown here, Dr. Van Ness?

A. So it's the same phrase. We're reaching a point where we're identifying multiple patents with a whole variety of techniques, not all of them directed to necessarily high-throughput sequencing, but the common theme here is verbatim. They all put in this phrase that says a person of skill in the art would be -- would use some common techniques unless otherwise indicated.

Q. **Let's bring up one last one, C21. What is C21?**

A. **This is treating demyelination disorders and it's a patent that was filed in 2006.**

MR. WALTER: And let's bring up C21-47, column 13, lines 30 to 43.

And can you actually bring up the header for this, too, just above this? Sorry about that. The header to this paragraph that you've got blown up. You might have to kill this paragraph.

BY MR. WALTER:

Q. **All right. What are you showing here, Dr. Van Ness?**

A. **It seems disclosed in the description there are some general techniques that they're disclosing which says, yes, there are some general techniques you might want to know about that are present in these publications.**

Q. **All right. Do you see the publications that are listed there, molecular cloning, the laboratory manual, current protocols in molecular biology?**

A. **Correct.**

Q. **Methods in enzymology?**

A. **Yes.**

Q. **What kind of resources are those?**

A. **They're basically a standard manual of chemical -- how to make compositions and some basic techniques.**

Q. **Okay. Now, we've seen this language that appears in**

column 5 in the patents-in-suit in many patents across many different fields of the biological sciences.

What does that tell you about whether this kind of language in the patents means that all of the techniques used in a particular patent are routine and conventional.

A. **It's clear, not all the techniques listed in the patent are encompassed in this. They also indicate, unless otherwise indicated. So as has been demonstrated by all of these patents in multiple areas of science, acknowledging that there are some standard techniques does not compromise the novelty of the patent.**

Q. **All right. I want to follow up some more on the other case indicated point that's in the patent and I would like to bring up B1-17 and I want to focus on generation sequencing.**

So I'm showing you B1-15. You've got column 16 and this passage continues on to column 17.

MR. WALTER: Why don't you just blow up the first few paragraphs of this.

BY MR. WALTER:

Q. **All right. So this is a discussion here of some of the next generation sequencing instruments that Dr. Quackenbush discussed on direct.**

Do you recall that testimony?

A. **I do.**

Q. **Okay. What do these passages in the patent tell you about whether the sequencing platforms discussed in these sections were routine and conventional?**

A. **I think the fact there's multiple paragraphs throughout this whole section, that basically describes in detail each of these platforms.**

If the technology was routine and conventional, you would just say do a next generation sequence and be done with it, but they spent a significant amount of space in this indicating as otherwise indicated, these are the other technologies that are needed to support a claim.

Q. **Now, what kind of resources does the patent point the reader to describe the design and operation of that technology?**

A. **In terms of supporting documentation?**

Q. **Yes.**

A. **Yes. The supporting documents primarily, there were a couple of papers in that, but they're primarily patents.**

Q. **And what does that tell you about whether that next generation sequencing technology was routine and conventional?**

A. **Well, because the pat patents in and of themselves are directed towards new and novel approaches. That in itself was saying that each of these patent technologies were**

revealing new and novel approaches. Therefore, you couldn't conclude that everything was routine and conventional.

Q. **Now, I want to start talking about some of the specific instruments a little bit more that Dr. Quackenbush mentioned and I want to go through some of the evidence that's outside the patent regarding the state of the art at the time.**

In your opinion, does the availability of some of the sequencing instruments that are mentioned in the patent demonstrate that those platforms were routine and conventional as of 2009?

A. **I really think this is probably one of the key elements of the distinction of opinion. That is that just because these technologies had launched and they were available, understanding that they were coming and going, some were successful, some were not, all of them had limitations, and as a result of that, this was an emerging technology. Yes, there were platforms available, but it was an emerging technology with a recognition that they weren't routine and conventional in 2009.**

Q. **Okay. I want to ask some questions about that now and I want to point you to some evidence.**

MR. WALTER: Please bring up C14. And if you can go to --

BY MR. WALTER:

Q. **First, what is C14?**

A. **This is a paper published in 2009 by Harismendy, basically evaluating the platforms for sequence, DNA sequencing.**

Q. **And what kind of sequencing is being evaluated?**

A. **High-throughput. Basically, they were looking at high-throughput sequencing.**

Q. **Okay. When was this published?**

A. **2009.**

MR. WALTER: All right. Go to C14-8. And if you can blow up that discussion.

BY MR. WALTER:

Q. **What's being disclosed here, Dr. Van Ness?**

A. **Well, the whole article was highlighting the new technologies that were being developed in high-throughput sequencing, and in the discussion they made a significant point in saying that there are biases in how you generate the library. These are the components that make up the segments of DNA that you will ultimately actually do the sequencing on. There's difficulty in mapping short segments of DNA. There are different difficulties in the variations and the error rates, if you will, of the coverage, so sometimes you would get a unique sequence, sometimes repetitive elements.**

One of the things that happens in DNA sequence

is you often get repetitive sequences. These are the sequences that just anywhere from 4, 8, 10, 15, sometimes hundred of bases that just repeat themselves, and those are repetitive elements common in the human genome. And sequencers had a problem with that, because they would fly through there and run through errors in those kind of sequence.

So there were, as they indicated here, there were just some inherent systematic errors that you had to deal with in next generation sequencing in 2009.

THE COURT: When you say slide through, how do they slide through?

THE WITNESS: Well, it's by synthesis, and so what happens is the polymerase is recognizing a sequence and because the existing sequence is aligning, being synthesized, it can align in multiple places because the sequence is exactly the same.

THE COURT: But because of technical limitations, the machine is not able to do it?

THE WITNESS: There are technical limitations.

THE COURT: Is there anything other than technical limitations when that enables it to slide through?

THE WITNESS: It's inherent in the technology that is being used that there are those limitations.

THE COURT: All right.

THE WITNESS: In fact, to be honest with you, even in normal biologic functioning of DNA polymerase, which does this synthesis, there are examples where in a normal biologic, the DNA polymerase has problems with repetitive sequences and you'll find that it makes error in those repetitive sequences in the normal process of replicating DNA themselves. It can be a problem.

THE COURT: Is it a biological problem.

THE WITNESS: It's can be a biological --

THE COURT: You're saying it's both. Is that right?

THE WITNESS: It's both.

THE COURT: It's the biology does it, but then there's this technical inability to detect it?

THE WITNESS: There's a common theme here. When you are doing it in the test tube, you're using DNA polymerase and the DNA polymerase is the enzyme that does the synthesis. In the cell, the DNA polymerase is the enzyme that copies the DNA and the cell is replicated. So that's an inherent potential problem for the DNA polymerase in the biology and in the technology.

Q. **Let's go to C14-9. And if you could bring up the conclusions, Ms. Woo.**

What do the authors conclude based on these issues that we discussed?

A. **Well, they're saying that this is -- this is sort of inherent in this time period of 2008, excuse me, 2009, that it's an emerging technology, and as an emerging technology, there were limitations, there were issues. And as I point out here, recent improvements acknowledge there's still aspects of the platforms that contribute to problems and the last statement there. Therefore, need to be simultaneously optimized.**

Q. **Okay. What does this kind of a disclosure and this kind of an article tell you about whether next generation sequencing was routine and conventional as of March of 2009?**

A. **At the time of this and recognizing that there are issues, there are problems with the technology, it says that one wouldn't necessarily consider this routine and conventional.**

Q. **Okay. Now, I want to ask some questions about Helicos. What was Helicos?**

A. **Helicos was one of the earlier next generation sequencing platforms.**

Q. **Okay. And is Helicos one of the platforms mentioned in the patent?**

A. **It is mentioned in the patent, yes.**

Q. **Why don't you bring up C29-9.**

What are we slowing here, Dr. Van Ness?

A. **Is this from the 10-K, because I'm missing --**

Q. **Yes.**

A. **Yes. This is the 10-K document, which was the company report document, the 10-K document.**

Q. **Okay. What does this passage disclose regarding next generation sequencing?**

A. **It basically also talks about the limitations -- thank you. There's a cost to it, there's a complexity to it, and it basically raises the issue of a cost analysis that says, if I'm going to spend a lot of money on a technology and it has got some inherent problems and complexities, would I want to spend that money if it is not routine and conventional.**

So this paragraph would lead me to believe that there's a need to overcome these limitations, making it not routine and conventional.

Q. **Take a look at the last sentence, which reads, additionally, the practical application of sequence data for molecular diagnostics is still heavily burdened by the costs associated with NGS sample preparation workflows.**

Do you see that?

A. **Yes.**

Q. **What does that tell you about whether next generation sequencing was routine and conventional for diagnostic applications?**

A. **I think in that kind of application for a person**

skilled in the art there's still some real limitations as it points out. I mean, it's a fairly significant point to say heavily burdened by the cost and the preparation and the workflows. This is not -- these machines are not taken out of box, plug it in and play. There's preparation for materials that go into these machines and each of those steps have to be performed accurately and every one of those steps was recognized to start contributing to some of the limitations in the accuracy and specificity that one would need, for example, to perform the methods in the patent that are being asserted.

Q. Okay. Now, was all of that sample preparation work you just described routine and conventional in 2009?

A. You know, I would say that it was -- there were people that were doing it and that's again one of the distinctions. There were a lot of people that were doing it and there were people that were doing it better than others, and the whole idea was this was not yet established as a routine and conventional workflow.

Q. All right. I would like to talk about Solexa now. You heard Dr. Quackenbush testify about Solexa.

A. Yes.

Q. What was Solexa?

A. Solexa was another high-throughput sequencing system, ultimately became Illumina. It became the Illumina

technology. It started off as its own company, the high-throughput sequence.

Q. Okay. Can you just clarify how Solexa was related to Illumina, because there was a lot of discussion about the two things earlier and I don't want to have any confusion?

A. Okay. So Solexa was launched in about 2006. I think it wasn't until 2008, 2009 -- I'm not sure that I got the dates exactly right -- that Illumina basically bought Solexa.

Q. Okay.

A. Now, if I could, interestingly, importantly, as Illumina bought Solexa, they recognized some of those limitations and started working on improvements to overcome some of those limitations in the 2008/2009 time frame.

Q. Now, you heard Dr. Quackenbush testify about his acquisition of I think one of those sequencers in that time frame. Does the availability of those sequencers in that time frame suggest that it the sequencer was routine and conventional?

A. Well, I think you have to sort of ask the question about availability. If I want something to be routine and conventional, I would want to make it readily available. It turns out in 2006, as I understand it, there was a very limited release of those instruments, the Solexa instruments. It's a very limited release. I think ten

companies worldwide, or ten installations worldwide in 2006, so it was not a widely available platform.

Q. All right. And can bring up C30-1.

What is this document, Dr. Van Ness?

A. This is basically a technical or, I'm sorry, a business newswire, a business report.

Q. Okay. What is it disclosing regarding the commercial release of Solexa?

A. It's exactly what I said, was that this was written in 2007 and they indicated that the Solexa form was distributed to about ten different sites around the world.

MR. WALTER: Now, if you can bring up C17, Ms. Woo.

BY MR. WALTER:

Q. What is C17, Dr. Van Ness?

A. Okay. This is an article by Auer. Published in 2008 I think it was. Down on the bottom left, 2008.

MR. WALTER: If you can bring that up?

THE WITNESS: 2009.

BY MR. WALTER:

Q. What's the publication?

A. Contemporaneously with the patent filing, this paper was published, and discussed again additional limitations in next generation sequencing in terms of physical analysis of base calling.

Q. **All right. Now, I think you heard Dr. Quackenbush testify about how the error rates and the technical capabilities were all standardized and well understood when these instruments were available. I want to ask you questions about that.**

MR. WALTER: Let's take a look at C17-9. Okay. If you can blow up that paragraph.

BY MR. WALTER:

Q. **What does this disclose, Dr. Van Ness?**

A. **I think there's a key term here and that is that it kind of reiterates the idea that there were technical variations in these next generation platforms, but really I think the significance statement was there was no consensus as to the magnitude of that problem. So how do you generate routine and conventional if you can't even agree on a consensus of what the magnitude of the problem is, partly because different platforms had different problems.**

Q. **Okay. What else does it disclose about the replication, the ability to replicate sequencing data?**

A. **Well, again, it was a cost benefit analysis, saying the expense of doing these kind of things outweighs the worth of the information you get. This was their opinion. That might be somewhat simplistic, but I think it does raise the issue that there is a question of do you want to spend all of this money for information that at this time, during**

2009, hadn't really worked out a consensus of what is the best accuracy you need to achieve.

Q. **Okay. Let's take a look at C17-8.**

What is this disclosing regarding those issues you just identified?

A. **Well, it's an economic opinion that basically says, given the limitations and given the lack of consensus on how to solve all of these limitations and given the cost at that time for the Solexa machine and for the runs for Solexa, given that expense, they concluded that they considered it an unaffordable luxury.**

Q. **Now, you also heard Dr. Quackenbush testify, you mentioned in passing, a platform called the '454 high risk sequencing instrument?**

A. **Yes.**

Q. **Do you recall that testimony?**

A. **Yes, I do.**

Q. **Okay. And he testified about that being commercially available at a certain time frame.**

Do you recall that testimony?

A. **I do.**

Q. **Okay. Do you agree with Dr. Quackenbush, that the availability of that instrument demonstrates that next generation sequencing was routine and conventional in 2009?**

A. **I don't, and if I could just elaborate a bit. And**

that is at that time frame, the ability for that platform to be routine and conventional in its application to small cell-free of small amounts of DNA derived from a donor. That instrument was not routine and conventional. In fact, as I was directly working with the director of the genome center, we really did consider the four or five platforms. And with all the reports we got, we made a decision it was not an acceptable platform because of some of its inherent limitation which caused error rates that were too high to be acceptable.

Q. Okay. Now, you must mentioned your experiences at your university. One of the things we heard from Dr. Quackenbush was a lot of testimony about his personal experiences at Stanford, and I think at the Dana-Farber institute.

What, if anything, do Dr. Quackenbush's personal experiences at Stanford and Dana-Farber tell you about whether next generation sequence goes was routine and conventional as of the 2009 time frame?

A. Yes. I think that Dr. Quackenbush, no question, is an exceptional researcher. I don't impugn his qualifications at all. He has done exceptional work. But I think you have to put that in the context as well that as these platforms were being developed, and as they were emerging, it was the institutions that had endowments

that allowed them to purchase the early -- the early versions of these platforms.

And Dr. Quackenbush had I think worked very well with the companies, but he had the good fortune of being at these institutions that had limited releases of this developing commercial launches of these technologies.

Q. **Okay. And how did that compare to your experience at the University of Minnesota?**

A. **We don't have the endowments that Harvard or Dana-Farber has, so we had to be a little built more circumspect in what kind of technologies we would be implementing because it was expensive.**

We wanted to make sure we chose correctly. In fact, it was in 2009 where we went through this evaluation of technology and recognizing that a lot of these platforms, Helicos and '454 had some real limitations, and we started migrating towards we think the development of the Illumina system at that time seemed to be the one that we wanted to focus on to help develop it.

Q. **At the time you were making that decision, was it -- was the type of next generation sequencing technology you were evaluating deemed to be routine and conventional?**

A. **No. I think that was the whole point of the conversation of trying to assess all of these platforms, is recognizing that, number one, it was not routine and**

conventional, but just as importantly, it was not routine and conventional in some applications that became a real problem.

Q. **All right. I want to shift gears now and talk about multiplex amplification.**

THE COURT: Before you go, I have to write these things up. Sometimes it's hard to find a definition. What's a definition I could used for next gen sequencing?

THE WITNESS: I think it's -- the synonym for that is high-throughput sequencing. So this is --

THE COURT: So you think that's the way you would treat it?

THE WITNESS: I would treat it next generation as high-throughput sequencing.

THE COURT: Give me a definition of high-throughput sequencing.

THE WITNESS: It's basically a methodology, because a lot of these platforms that had sequencing by synthesis, but what they were able to do is they were able --

THE COURT: I want you to understand, at the end of the day, I want you to give me your Merriam Webster. You give me a little background.

THE WITNESS: Okay. So the reason they were high-throughput sequencing is that you could sequence

simultaneously thousands and thousands of fragments of DNA at the same time. And so my Webster definition is next generation sequencing is high-throughput sequencing in which thousands and thousands of sequences are being developed simultaneously. They often refer to this, and this is another phrase, massive parallel sequencing.

THE COURT: But in a way, I mean high-throughput there is just redundant, right, because you're just basically saying it's sequences in which thousand and thousands of sequences are being what?

THE WITNESS: Created.

THE COURT: Created?

THE WITNESS: So there's a detection system that is detecting thousands of sequences being generated all at the same time.

THE COURT: Created and detected?

THE WITNESS: Correct.

THE COURT: All right. So just to make sure I've got it right, next gen sequencing is sequencing. I mean, I can call it high-throughput. It sounds like that's the same definition.

THE WITNESS: All right.

THE COURT: I'm asking. I'm not trying to dictated. Sequencing in which thousands and thousands of sequences are being created and detect it. Is that a fair

definition?

THE WITNESS: At the same time.

THE COURT: At the same time.

THE WITNESS: And you can imagine that's high-throughput because you're not doing one strand of DNA at a time.

THE COURT: Right.

THE WITNESS: Which was in 1990, people were sequencing one sequence at a time. That's why it took ten years to get the first genome of a human.

THE COURT: Right.

THE WITNESS: With next generation sequencing, you can amplify that speed.

THE COURT: But I want to make sure you treat it as a concept.

THE WITNESS: I do.

THE COURT: All right. Thank you.

BY MR. WALTER:

Q. **All right. Let's go to B-324 and let's bring up Step C of claim 1 of the '607 patent.**

All right. I want to ask some questions now about the selective amplification. What is Step C referring to?

A. **Basically, they're -- the claim is that they're generating amplification of at least a thousand**

polynucleotide polymorphism. The generic variant targets that generating through this multiplex amplification, a thousand of these at the same time.

Q. **Now, what does the term multiplex amplification refer to?**

A. **Similar to what I was discussing with sequencing. That is the ability to amplify with the primers and PCR, to deal the ability to amplify not just one target sequence, but thousands of sequences all statement at the same time.**

Q. **And what is a single nucleotide polymorphism very briefly, because we've hit it a couple times a day?**

A. **It's basically the sequence variation that you find in a DNA at the single base resolution. It often refer to SNPs as a polymorphic region that is different than most common in the population.**

So we also have a referenced sequence which represents the most common sequence of a human, but we all have variations, and we all have variations on a single bases, and each one of those single base has variations.

Q. **Now, why is multiplex amplification -- I should say why is selective amplification of at least a thousand SNPs an important aspect of this claimed invention?**

A. **We recognized that trying to genotype using one, one target is not nearly as good. If you can identify a thousand differences between the donor and the recipient,**

you can now query and -- forgive me, Judge. Instead of having a judge, you have a whole jury now that is giving you a consensus based on a thousand pieces of data in instead of just one.

Q. **Now, you heard Dr. Quackenbush testify that this step was routinely conventional in 2009.**

Do you agree with that testimony?

A. **No.**

Q. **All right. I'd lied to follow up on that now.**

First, to your knowledge, had simultaneous selective amplification of more than a thousand SNPs ever been used in the process of mass plant rejection?

A. **There again, that's an important consideration. That is that this technology was not necessarily routine and conventional and it certainly hadn't been reported in applications to detecting small amounts of DNA in an organ transplant.**

Q. **Now, let's talk about the concept of multiplex amplification, which you mentioned earlier. What were some of the challenges associated with doing multiplex amplification?**

A. **So the problem is that not every pair of primers that then is used to synthesize the sequence between them and amplify it, they don't all work as efficiently as each other. There' variation in that efficiency.**

There are some cases they work well. Some cases they don't. There are some cases where a primer may have its recognition sequence, but it may have a close match somewhere else in the genome, and as a result of that, it will misprime. So there's a misprime with them.

The other thing that can happen, when you start mixing in your primers, the primers are supposed to anneal to the DNA by a complementary to the DNA and synthesize. It's not uncommon for sometimes those primers to anneal to each other and they amplify two primers and you get what are called primer dimer.

Once that happens, you get this jackpot effect where once you get mispriming or incorrect priming and PCR starting, that amplification then grows, so you get what's called jackpot where you get a sequence that comes out of that amplification, that's way overrepresented compared to what it should have been if every priming event was equal.

Q. **Now, were skilled artisans aware of these types of issues in 2009?**

A. **Yes. Those of us doing PCR were well aware of mixing primers and having primer dimer problems, yes.**

MR. WALTER: And could we bring up C 12-one, Ms. Woo?

BY MR. WALTER:

Q. **What is this document?**

A. **This is a paper published in 2002 discussing quantification of sequences that were amplified.**

Q. **Okay. What does this article disclose regarding multiplexed amplification?**

MR. WALTER: You might need to zoom back and highlight this. There you go. Thank you, Ms. Woo.

THE WITNESS: It's basically a description of some of the problems that I've discussed a little bit more concise than I said it, but it was the presence of these multiple primers that reduces the robustness of this PCR and the reliability of quantification.

Q. **Okay. Are you aware that Natera has filed patent applications directed at the use of multiplex PCRs to amplify DNA fragments for DNA in the context of cell-free DNA?**

A. **Yes.**

Q. **All right. Please bring up C-31, Ms. Woo.**

What is this document, Dr. Van Ness?

A. **This is an amendment to a patent filed in 2017 on methods for noninvasive prenatal.**

MR. WALTER: Okay. If you can bring up C-31-8, Ms. Woo. And I guess you have to bring up the next part of the paragraph 2.

BY MR. WALTER:

Q. **What is this disclosing regarding multiplexed PCS?**

A. **This again, it's highlighting it, and I think it's important to note that this wasn't just one person's opinion or one person's experience, but this is -- this again is highlighting that multiplex PCR can have problems in amplification because of this mispriming event.**

MR. WALTER: Please bring up C32.

BY MR. WALTER:

Q. **What is C32, Dr. Van Ness?**

A. **This is also a patent application for looking at ploidy. That's a chromosome copyright number on prenatal testing filed in 2017.**

MR. WALTER: And now let's go to C32-8.

And if you can highlight the, or blow up the paragraph at the top that's highlighted.

BY MR. WALTER:

Q. **What is being disclosed here?**

A. **Again, it's this whole idea of primer mismatching, interprimer interaction that gets worse the more primer you put in, and even say there if you go from 90 to a thousand, one of ordinary skill in the art would expect failure.**

So this simply would say amplifying a thousand multiplex reactions, a thousand SNPs, not only is it not conventional or routine, these people are predicting a failure.

Q. **Okay. And by these people, who are you referring to?**

A. **This is Natera.**

Q. **Okay. Let's go to C42. What is C42, Dr. Van Ness?**

A. **This is an am indication from Bernard Zimmermann, who was employed by Natera, filed in 2013 on using multiplexed PCR methods.**

Q. **Okay. What is the earliest priority date for this patent?**

A. **The priority date is 2013. Oh, wait a minute. The priority date on this is 2011.**

Q. **Okay. How does that pertain -- how does that relate to the priority date for the patents in this case?**

A. **It's two years after the priority date of the patent.**

Q. **Okay. If you go to C42. There you go. Kindly bring up that paragraph, the highlighted material.**

What is this disclosing, Dr. Van Ness?

A. **Well, again, they comment that when you start getting multiple primers, you can guilty primer dimers, and that increases -- as you increase the number of multiplex reactions that you are trying to achieve.**

So they conclude by saying improved methods are needed to reduce the formation of non-target amplicons, those are the amplified products, during multiplexed PCRs. And, in fact, it would be useful, as I point out, to get these things approved if you are going to do multiplexed

reactions in prenatal diagnostics.

Q. **Okay. Now, what does this tell you about whether multiplexed amplification of more than a thousand SNPs was routine and conventional in 2009?**

A. **It does raise into question that there are, as we pointed out in several of these articles, that would certainly, one would conclude that it's not routine and conventional.**

Q. **Now, one of the things that Dr. Quackenbush mentioned I think was the possibility of not doing the PCR in a multiplexed fashion, but doing it in a thousand separate PCRs all at once.**

Was that routine and conventional in 2009?

A. **It was not. Setting up multiple PCR reactions was not particularly practical if there were way to do it in a single tube or to do it in a multiplex reaction. That would be preferred, but doing it in a thousand tubes was not a very practical way of doing PCR amplification.**

Q. **Now, I think Dr. Quackenbush mentioned how he was doing 10,000 PCR reactions overnight when he was at Stanford.**

Do you recall that testimony?

A. **I do.**

Q. **Did he give any detail on how he was doing that?**

A. **No, I don't. I don't know if he was doing it in**

separate tubes, 10,000 separate tubes or 10,000 separate wells or all in one tube. I don't know the details of that.

Q. **Okay. Now, one of the things that Natera has raised in this case is that you could use a device that was sold by a company called RainDance to do more than a thousand PCR reactions in different droplets.**

A. **Yes.**

Q. **I don't recall if they raised it on direct, but they raised it in this case. What's your understanding? Well, what is that droplet technology briefly?**

A. **So the RainDance technology is, basically what they are doing is they're dividing the samples into very small high dilution, and then every segment of DNA is encapsulated in a very, very small liquid particle. And so that liquid particle then would isolate that particular segment of DNA to be amplified. So you could have lots and lots of and lots of these small liquid particles, each of them containing a DNA molecule. And that technology was based on a whole platform of microfluidity.**

Q. **Okay. Was that microfluid droplet technology routine and conventional in 2009?**

A. **Actually, my understanding is RainDance was launched in 2009, so number one, many laboratories were not terribly familiar with microfluidics. And, number two, the fact that**

it was launched in 2009, at the time of the patents that are being asserted, I would say that that would suggest the RainDance technology in 2009 was not routine and conventional.

Q. **Let's bring up B15. What is B15?**

A. **This is basically a report, a technology report on the RainDance technology indicating its launch.**

Q. **Okay. And when is this press release dated?**

A. **2008.**

Q. **Okay. What does that tell you about whether this type of technology had become routine and conventional as of the filing date of the patent?**

A. **Okay. Again, this is very close to the timing of the filing of the patents with a new technology of microfluidics, and I would argue that it didn't reach the level of routine and conventional in a real short period of time.**

MR. WALTER: All right. If you can bring up claim 1 of the '497 patent, Ms. Woo.

BY MR. WALTER:

Q. **If you look at Step D, there is a reference to digital polymerase chain reaction.**

Do you see that?

A. **I'm sorry. D. I was looking at the wrong one. Yes.**

Q. **All right. I'm not going to ask you to explain**

digital polymerase chain reaction again, but I want to ask you --

THE COURT: How much time do you have left?

MR. WALTER: How much time do I have left? Probably about five minutes.

THE COURT: Oh, that's it? Okay. I just want to be conscious and be fair to everybody.

MR. WALTER: Okay. All right.

BY MR. WALTER:

Q. **So I want to ask a few questions about digital polymerase chain reaction. If we can bring up C13. What is C13?**

A. **This was a paper published in 2008 by Zimmermann.**

Q. **Okay.**

A. **Who is an employee -- who became an employee of -- well, Fluidigm that produced it.**

Q. **And is Mr. Zimmermann associated with Natera?**

A. **He was involved in some of the patent applications for Natera.**

Q. **Okay. Let's take a look now at -- I believe it's C13-8. No. Five, I think. There you go.**

What is this disclosing regarding digital polymerase chain reaction and its use in connection with cell-free DNA?

A. **So they indicate here that there's a barrier for using**

digital PCR for prenatal diagnosis, that application. Because the fraction of fatal DNA is very low and they also, again, say that the problems with multiplex reaction is a major challenge and they go as far as saying it's not possible to use the SNP-based approach.

Q. I think if you can look at the conclusion of this article. If you can bring up the diagnostics or screening. If you can bring that up.

All right. And, Dr. Van Ness, what is this disclosing about the use of digital PCR as a diagnostic tool in 2008?

A. Well, it basically does raise the issue whether this method will be a screening tool or whether it's going to pass. I acknowledge that clinical applications taken longer time, but you have to have a basis of scientific method and technology that has to be routine and in a laboratory that's doing clinical diagnostics.

So they are questioning, saying if these techniques have the problems we've been discussing, then it would probably be difficult and create regulatory hurdles to permit using it diagnostically if it can't a routine technique.

Q. Okay. So what does this kind of disclosure tell you about whether digital PCR was routine and conventional for diagnostic applications such as organ transplant rejection

in 2008?

A. **Yes. So I think you said a mouthful, but the commonality of that is for that application given the limitation, the technology would not be considered routine and conventional.**

MR. WALTER: Okay. I will pass the witness for cross-examination.

THE COURT: Thank you.

MR. JOHNSON: Your Honor, may we approach since we have a cross binder?

THE COURT: Sure. Thank you.

(Binders handed to the Court and to the witness.)

MR. JOHNSON: Your Honor, may I proceed?

MR. WALTER: Can we get a copy of the cross-examination binder?

THE COURT: Are you good? You may proceed.

MR. JOHNSON: Thank you, Your Honor.

CROSS-EXAMINATION.

BY MR. JOHNSON:

Q. **Dr. Van Ness, I'm Kevin Johnson. We have not met before; right?**

A. **Good afternoon.**

Q. **Good afternoon. So I want to start with sort of where you began. Throughout your testimony, I heard you refer to**

a number of articles, patents by Natera, the Zimmermann article. You understand those articles and those patents to be extrinsic evidence; right?

A. **There were a number of articles I did describe that were intrinsic evidence, so some of those articles are extrinsic.**

Q. **A significant number of them; right?**

A. **Again, when I say significant, I'm not sure how you want to define it. I will acknowledge some of those articles were extrinsic.**

Q. **I heard you talk about, and I heard you in response to the question from the Court, you said that NGS and high-throughput systems are the same thing; right?**

A. **I consider those equivalent things, yes.**

Q. **So let's go to the intrinsic evidence, the actual patents. The patents say they're different, don't they?**

A. **I'm not aware of where it says that in the patents.**

Q. **Okay.**

A. **If you could point that out.**

Q. **Sorry. Let's look at the '497 patent. This is Exhibit B2 and let's look at claim 1. You've read the claims, the asserted claims?**

A. **I have.**

Q. **And could we put that up, please?**

And the last element there is element D and

we've looked at this before. It says, comprises high-throughput sequencing at the bottom.

Do you see that?

A. **Correct.**

Q. **Okay. And if we turn to claim 4 of the '497 patent, the '497, claim 4, says, the high-throughput sequencing assay comprises a next generation sequencing assay.**

Do you see that?

A. **Yes.**

Q. **And you understand dependent claims are narrower than independent claims; right?**

A. **Okay. Yes.**

Q. **Do you have that understanding?**

A. **I do.**

Q. **Okay. And so, and different terms in the patent mean different things; right?**

A. **Well, again, you're providing generality. Different terms can have equivalent meaning, too.**

Q. **Well, a person of ordinary skill would need claim 4 and understand that to be a more narrow definition of a high-throughput sequencing assay; right? NGS is a more narrow definition of high-throughput sequencing, isn't it?**

A. **I'm not sure -- I mean, to be honest, with reading that, I'm not sure I would necessarily interpret that as a distinction. High-throughput sequencing comprises next**

generation sequencing assay. I would look at that as saying one is comprised of the other. They're equivalent statements.

Q. **Sir, you're aware in the patents-in-suit that there are, in fact, systems that are defined as high-throughput sequencing systems that are not NGS systems; right?**

A. **I would -- I guess there are multiple platforms that have been described as high-throughput sequencing.**

Q. **Sir --**

A. **The idea, the idea of next generation sequences is, to be honest with you, is kind of a colloquial term that says in the past, sequencing was done one strand at a time. The next generation sequencing took many iterations.**

Q. **Sir, I asked --**

A. **There are many directions that that took.**

Q. **I asked a very specific question. There are high-throughput systems, high-throughput sequencing systems disclosed in the patent that are not NGS systems; right?**

A. **I'm not aware of that distinction.**

Q. **Let's look at it.**

A. **If you would like to point it out to me.**

Q. **Let's look at column 16, line 29, please, of Exhibit B2.**

A. **Okay.**

Q. **B2, the '497 patent.**

A. **I'm actually looking at the '497 as well.**

Q. **Line 29. Do you see it? It says, other high-throughput sequencing systems include those disclosed in Venter, we've heard that reference to the Venter article, in 2001; right?**

A. **Yes.**

Q. **You've read that article?**

A. **It has been some time.**

Q. **That's not an NGS system; right?**

A. **As I understand it, it's primarily a Sanger.**

Q. **Sir, it's not an NGS system, is it?**

A. **Sanger sequencing is not high-throughput next generation sequencing.**

Q. **Okay. So, again, what's described in the Venter article is not an NGS system yet it's disclosed in the patent as being a high-throughput sequencing system; is that right?**

A. **You know, I might modify my --**

Q. **Sir, yes or no?**

A. **Well, I guess I'm going to modify by saying no, and the reason is -- well, I'm going to modify that they're not suggesting there's a lack of equivalents, because if you look at Sanger sequencing, Sanger sequencing was done manually for many years and then it was automated, so it became higher throughput because of the automation. So now**

you're distinguishing high-throughput from higher throughput in next generation sequencing.

So one could make the argument that based on the terminology and the words you're putting in here that when Sanger reached the point where it became automated, it was a higher throughput system than when we were doing it manually. The next generation sequences were even higher throughput.

So --

Q. **So it's relative in your view then?**

A. **It is relative.**

Q. **Okay. So, again, the Venter article does not disclose an NGS system; right? Yes or no?**

A. **I don't know whether it uses that term.**

Q. **All right.**

A. **I don't know whether the term next generation system was being used by Venter in 2001.**

Q. **Let's see if we can agree on another aspect. You heard Mr. Reines in his opening refer to high-throughput sequencing and he said it was new.**

Do you remember that?

A. **Yes.**

Q. **And, sir, all of the asserted patents include an element that requires high-throughput or multiplex sequencing reactions to detect donor derived SNPs; right?**

A. **Correct.**

Q. **The inventors didn't invent high-throughput sequencing in the patent, did they?**

A. **They did not invent high-throughput sequencing. No, they did not.**

Q. **In fact, there were high-throughput sequencers that were commercially available in November 2009; right?**

A. **Their existence was present. It doesn't mean that they were routine and conventional.**

Q. **I didn't ask that question. I asked very specifically, there were high-throughput sequencers that were commercially available as of November 2009; right?**

A. **Such systems were available, correct.**

Q. **Commercially available?**

A. **Commercially available, correct.**

Q. **And by 2000, November of 2009, high-throughput sequencing instruments were being used for a wide variety of applications; is that right?**

A. **They were being used? I believe they were being used for a wide variety of applications, but you can't equate every application equivalently in terms of their use and routine conventional use for every application. There were some applications they were being used. Others were more problematic.**

Q. **Sir, do you remember being asked this question at your**

deposition? Do you remember being asked: Sir, by November 2009, high-throughput sequencing instruments were being used for a wide variety of applications, correct?

A. **I believe they were being used for a wide variety of applications.**

Q. **And you answered, sure?**

A. **Yes.**

Q. **Was that your testimony?**

A. **I stand by that and that is correct.**

Q. **And, in fact, the patents identify a number of companies that made high-throughput sequencing instruments prior to the patents; right?**

A. **The patent identified companies that had commercial launches of high-throughput sequences.**

Q. **In fact, a number of examples are in the patents themselves; right?**

A. **Yes, there are examples given.**

Q. **And, sir, there aren't any new methods described in the patents for providing high-throughput sequencing?**

A. **Isolated technique, you're right, there wasn't a method of that new technique, but that isn't what the patent was about.**

Q. **I'm asking you if there were any new methods described in the patents for performing high-throughput sequencing.**

A. **That method did not have new methods listed in the**

patent in isolation.

Q. **And the patent's written description doesn't teach a specific method for high-throughput sequencing with cell-free DNA, does it?**

A. **It does teach by pointing to appropriate references that accomplish that goal.**

Q. **Let's put up your deposition testimony. You were asked, the patent's written description doesn't teach how to use high-throughput sequencing specifically with cell-free DNA, correct?**

Answer: A method for using -- sorry. A method for using -- let me start that over.

And then here's the question:

The patent's written description doesn't teach a specific method for high-throughput sequencing with cell-free DNA, correct?

Answer: It does not because it puts it in the context of utilizing the methodologies that were available in the context of other methods described in the patent.

That was your testimony; right?

A. **I agree with that.**

Q. **And the patent claims instruct a person of ordinary skill in the art that there are sequencing technologies that can be applied to the combination of methods that they describe; right?**

A. **That's a little vague. I'm not quite sure. To a combination of methods they describe, I'm not sure what you are accomplishing there. I apologize.**

Q. **I'm tracking again your language from the deposition testimony. Let me put it up to refresh your recollection.**

Question: And the claims don't tell you how to do that, though, correct?

Answer: The claims instruct you that there are sequencing technologies that can be applied to the combination of methods that they describe.

Was that your testimony?

A. **Correct, yes.**

Q. **Now, sir, the patents do not describe individual methods for each of the sequencing platforms; right?**

A. **The patents don't describe. They refer to patented and published articles that do that.**

Q. **Yes. My point is, they don't get into the details and describe the individual methods for each of those sequencing platforms that are described in the patent; right?**

A. **Within the context of the narrowness of your question, that is correct.**

Q. **And it's your opinion, sir, that there were limitations or issues with multiplex or high-throughput sequencing back in 2009?**

A. **Correct.**

Q. **Right? That's what you testified about on your direct?**

A. **Correct.**

Q. **Now, one of those issues that I heard you testify on direct was biases in sample library generation; right?**

A. **Correct.**

Q. **And, again, you talked about that in the context of Exhibit C14, the Mendy article; right?**

A. **Yes.**

Q. **Yes? For the court reporter's benefit, she can't --**

A. **Yes. A head shake doesn't work.**

Q. **Right. But in talking about biases, the patent claims do not provide methods to overcome issues of had biases in sample library preparation for sequencing; right?**

A. **You're asking a yes/no question for which I think there's a more, a more significant answer, which was that through the combination --**

Q. **Sir, I'm asking you if it's in the claims. I'm asking you --**

A. **Okay.**

Q. **-- is it in the claims? Do the patent claims describe methods to overcome issues of bias?**

A. **The patent claims do not.**

Q. **And the patent claims don't require overcoming issues of bias in sample library preparation for sequencing either;**

right?

A. **The patent claims do not, but the description identifies that issue.**

Q. **But the claims don't, do they? In fact, bias doesn't even appear anywhere in the asserted claims, does it?**

A. **The word bias does not appear in the claims.**

Q. **And we heard about repetitive sequences as a problem, but repetitive sequences isn't required by the claims in the patents either; right?**

A. **It's not in the claims, but to perform the claims, you have to be aware of it.**

Q. **It's not in the claims or it's not required by the claims; right?**

A. **It is not specifically required by the claims.**

Q. **And we heard about tandem repeats. Tandem repeats are not required by the asserted claims either; right?**

A. **I don't recall. To be honest with you, I just don't recall the answer to that.**

Q. **Well, I would submit that the term random repeats is not in the claims. But let me ask about NGS. We heard a lot about NGS. NGS is not something that's required by any of the asserted claims, is it?**

A. **Well, they're discussing high-throughput sequencing, which we discussed having an equivalents.**

Q. **I just showed you claim 4. That refers to NGS.**

A. **I agree, and I didn't agree with your interpretation of claim 4. To me, they did, they did claim high-throughput sequencing.**

Q. **Does the term NGS appear anywhere in any of the independent claims or any of the asserted claims?**

A. **I don't have them all in front of me. I don't know.**

Q. **Actually, you do. In front of you is the cross binder. The patents are in front of you in Exhibit 1, 2 and 3, and if you want to look at them and refresh your recollection, that's fine.**

The question, so you have it, is: Does the term NGS specifically appear and is required by any of the asserted independent claims?

A. **I'm looking at patent '497, and as you had pointed out in claim 4, it does use the term next generation.**

Q. **I'm talking about claim 1.**

A. **Now you're back to claim 1. Okay.**

Q. **Let me ask it again. I thought I was clear. Does the term NGS appear in any of the asserted independent claims, claim 1 in any of the patents? By NGS, I mean next generation sequencing.**

A. **That term is not used in claim 1.**

Q. **Of any of the asserted patents?**

A. **Correct.**

Q. **Right?**

A. **Correct.**

Q. **What about multiplex PCR? Strike that. Let me ask it a different way.**

Another one of the critiques about high-throughput sequencing as you identified is that there might be difficulties mapping short reads; right?

A. **Correct.**

Q. **But, again, the claims don't require a solution to the problem of mapping short reads, do they?**

A. **The claims do not. There are skill in the art would recognize --**

Q. **I'm just asking about the claim. Your counsel will have the opportunity to ask you additional questions.**

A. **Okay. The claims do not.**

Q. **Okay. And the patent claims do not require overcoming issues of mapping short reads either; right?**

A. **The claims did not identify that as the problem they were trying to solve.**

Q. **And another issue that you referred to in your declaration is systematic errors in high-throughput sequencing. We heard a little bit of testimony about that; right? Again, is that yes?**

A. **That was a yes.**

Q. **Okay. The patent claims do not solve the problem of errors in high-throughput sequencing; right?**

A. **The patent claims are not directed to solving those problems. They were directed to a different solution.**

Q. **And, sir, you would agree that even methods that are conventional or unconventional have some inherent limitations; right?**

A. **Yes. All methods have some inherent limitation, sure.**

Q. **So technology can be conventional and still have some technical shortcomings; right?**

A. **Well, some is a big term. Forgive me, but some limitations are more important. Some are more egregious. Some are more significant than others and it depends on where you're applying it.**

So if you applying it to where this patent was applying it and solving the problem recognizing that these technologies in the application to cell-free DNA were not routine and conventional, I think it's accurate. They had limitations. They all have limitations.

Q. **And, sir, technology can be conventional and still be open to improvements; right?**

A. **Yes.**

Q. **Now, let's put up, please, that section of the '497 patent. Again, claim 1D.**

And, sir, you've looked at this. There was some discussion in your direct about digital PCR and there was also -- it was also characterized earlier today as the

emerging technique.

Do you remember that?

A. **The RainDance was the emerging technique.**

Q. **That's the testimony. Now, the inventors of the asserted patents don't claim to have invented digital PCR; right?**

A. **They did not invent digital PCR.**

Q. **And they don't recite a specific method of performing digital PCR; right?**

A. **We're talking just the claims now?**

Q. **Yes.**

A. **The claim does not.**

Q. **And the written description of the patent does not describe a specific manner of performing digital PCR; right?**

A. **My understanding is it provides references that refer to documents that perform that method.**

Q. **So let me show your deposition again.**

A. **Okay.**

Q. **And ask you, read the following question and answer. And the written description, and this is line -- this is page 141, lines 9 to 20. And the written description of the patent also does not describe a specific manner of performing digital PCR?**

Again, I'm going to -- I'm going to go back to

the idea that there were -- there were reports on digital PCR, there were approaches on digital PCR, that one skilled in the art could identify and use to apply that method in the combination of methods that are described here. They were not described independently in the description of this patent.

That was your testimony that you gave in your deposition?

A. **That is correct.**

Q. **Now, there were reports, as you point out, on digital PCR and approaches on digital PCR that one skilled in the art could identify and use to apply methods that are described in the patents; right?**

A. **Yes.**

Q. **And you agree, sir, that a person of skill in the art back in November of 2009 could use the same laboratory techniques to perform digital PCR on the cell-free DNA samples from a pregnant woman as on the cell-free DNA sample from a transplant recipient; right?**

A. **One could apply the same methods to both.**

Q. **And let's turn to genotyping. The inventors don't claim to have invented genotyping; right?**

A. **That's an isolated technique, and the patent claims, they do not specify that as an invention.**

Q. **I'm not asking about isolated techniques, sir.**

A. **Well, you did.**

Q. **Do the inventors claim to have invented genotyping in the patent?**

A. **That component of the patent was not described as an invention.**

Q. **Let me put up your deposition transcript, page 43, lines 7 to 9.**

Do the inventors claim to have invented genotyping in the '652 patent? No.

That was your testimony there; right?

A. **Yes. I stand by that. That's correct.**

Q. **Okay. So by 2009 you agree there were known methods for genotyping; right?**

A. **There were no methods for genotyping in 2009?**

Q. **Right.**

A. **I'm not sure. No, that's not correct. There were plenty of methods for genotyping.**

Q. **Known. Sorry.**

A. **I'm sorry. I misunderstood you.**

Q. **By 2009, there were well-known methods for genotyping; right?**

A. **For certain applications, correct.**

Q. **I'm going to put your deposition up again, because in your deposition you didn't have that qualifier about certain applications.**

Let me ask you, question, page 60, line 19, to 61, line 13:

And you don't dispute that by 2009, there were known and conventional methods for obtaining a genotype?

Answer: I do not dispute that. There were no methods. We go on.

MR. WALTER: Your Honor --

THE COURT: Yes?

MR. WALTER: It says they do dispute that.

MR. JOHNSON: I misread that. There were known method. Sorry about that.

MR. WALTER: I think he needs to read the full answer. This is not fair impeachment.

THE COURT: I agree. Let's clean it up.

MR. JOHNSON: Yes. Sorry about that.

BY MR. JOHNSON:

Q. **Sir, you were asked in your deposition that:**

Question: You don't dispute that by 2009 there were known and conventional methods for obtaining a genotype?

"Answer: I do dispute that. There were known methods. The question about whether they were conventional or not I think is one that I do disagree with because the methodologies that were being developed prior to 2009 were all -- a number of the platforms that were being developed.

The platforms themselves had inherent limitations. And so you could generate a genotype, but you couldn't necessarily generate a genotype that had the degree of sensitivity and specificity that would be required to fulfill what's described.

THE COURT: So that's consistent with his testimony today.

MR. JOHNSON: Agreed. Agreed, Your Honor. What I was drawing attention to was to his caveat that he provided there and I'm going to go into the sensitivity now.

THE COURT: It sounds like the caveat is consistent with the testimony before.

MR. JOHNSON: Yes.

THE COURT: You have to be careful.

MR. JOHNSON: I'm going to move on.

BY MR. JOHNSON:

Q. **Sir, by 2009, you agree that one could genotype by number of different methods; right?**

A. **One could genotype -- I've got to qualify that because what could you genotype? One could genotype. The question by a number of different methods, that is correct, but what application and what are you genotyping, there's some dispute on the ability to do that, because I think context is hugely important on that.**

BY MR. JOHNSON:

Q. **Let me read your deposition transcript and answer. Question, page 65, line 1 to 8:**

We discussed this though, that the multiplex sequencing is not required to do the genotyping, correct, in the '652 patent claims? You can do it by something other than multiplex sequencing according to the claims.

Answer: Sure. You could -- you can -- you can genotype by a number of different methods, any individual.

You gave that testimony?

A. **I did.**

Q. **And, sir, the patents recognize that there are multiple ways to do genotyping; right?**

A. **It does recognize that.**

Q. **Now, as far back as 2003, you were using, I believe, the Accumetric platform for genotyping SNPs; correct?**

A. **I was, correct.**

Q. **And obtaining a genotype of donor-specific or subject-specific polymorphisms. That's described in the prior art; right?**

A. **Obtaining a genotype of -- could you repeat the question?**

Q. **Sure. Obtaining a genotype of donor-specific or subject-specific polymorphisms was described in the prior art; right?**

A. **There was prior art that allowed you to genotype any individual. If they happened to be an organ donor, they fit that definition.**

Q. **Okay. So claim 1 of the '607 patent here talks about PCR; right? DNA -- selective amplification of said target DNA by PCR.**

Do you recall that?

A. **Yes.**

Q. **Now, genotyping can be performed by PCR; right?**

A. **Yes.**

Q. **And the inventors didn't invent PCR?**

A. **They did not.**

Q. **By November of 2009, PCR was well-known and being used by a number of laboratories; is that right?**

A. **Well-known in many different types of applications.**

Q. **And being used by a number of laboratories; right?**

A. **Used by a number of laboratories, none of which were doing donor-derived multiplex reactions with respect to donor DNA.**

Q. **And, sir, there were conventional approaches using PCR to generate genotypes, right, by November of 2009?**

A. **As a general statement, you could generate a genotype of bacteria, and so I have to say, yes, there were methods for generating a genotype.**

Q. **But I'm talking about conventional approaches, sir.**

There were conventional approaches using PCR to generate a genotype by November of 2009; right?

A. **That's a very general statement and there were specific examples where that was absolutely true.**

Q. **Sir, were there conventional approaches using PCR to generate a genotype by November of 2009?**

A. **There were conventional approaches to generate a genotype at that time frame in specific examples.**

Q. **And in your deposition testimony you didn't refer to specific example; right?**

A. **I think throughout the deposition I referred to the fact that the patent claim needed to be looked at in the context of all the patents claims and what was being targeted, so in that one statement in my deposition, I put into context what I was describing the deposition as the need to apply this to this application, put different restrictions on it.**

Q. **Sir, it's your opinion that there's some inherent bias in PCR; right?**

A. **There can be, yes.**

Q. **But the claims of the asserted patents don't describe a particular technique for overcoming that bias in PCR; right?**

A. **Actually, they do.**

Q. **Well, let's put up your deposition testimony, page 78,**

lines 11 to 15.

Question: But the claims of the asserted patents don't describe a particular technique for overcoming bias in PCR, correct?

Answer: Methods do not specifically in any independent step identify overcoming bias.

That was your testimony?

A. **It is, and if I could, Judge, just --**

Q. **You'll have the opportunity for your lawyer to ask a question.**

A. **Okay.**

Q. **The claims also --**

THE COURT: You know what, it's a judge hearing.

MR. JOHNSON: Okay.

THE COURT: Just let him explain here.

MR. JOHNSON: That's fine.

THE COURT: I'm conscious of time.

THE WITNESS: Could we put that back up?

So the fact is that they asserted several different methods, understanding that there were limitations when they were applying to the detection of the -- the donor DNA. They got over that kind of bias by saying we're going to sequence a thousand SNPs, so we're going to have a lot more data to look at, so if I only have two or three or four, I may have biases, but if I have a thousand, I'm going

to get a consensus of information that's going to be more reliable, more specific and more sensitive.

BY MR. JOHNSON:

Q. **But, again, the claims don't require specific solutions to overcoming the bias; right?**

A. **The claims require a series of steps to overcome that bias.**

Q. **But there's no reference to bias anywhere in the claims?**

A. **There's no word bias in the claims.**

Q. **Not only is there no word, there's no reference to an idea of overcoming the bias?**

A. **But there is in patent specification.**

Q. **That's the patent specification. I'm talking about the claims, sir. The claims do not have any requirement that there be a solution to overcoming bias? That's not in the claims; right?**

A. **That is not in the claims.**

Q. **And the claims also, they don't identify a single -- sorry. The claims -- let me start again. The claims talk about SNPs; right?**

A. **Yes.**

Q. **And there were by November 2009, there were methods that people were using to identify SNPs; right?**

A. **There were methods, again, in certain applications to**

identifying SNPs, correct.

Q. **And were methods available to identify homozygous SNPs back in 2009.**

A. **Yes.**

Q. **November; right? And the patent claims of the asserted patents don't identify or require the use of specific SNPs; right?**

A. **I'd like to elaborate on that. The answer is no, you can't specify specific SNPs because every transplant donor has different genetic differences, so you can't tell which SNPs you're going to use until you do the genotype.**

Q. **And that's my point; right? In fact, it would be obvious to somebody skilled in the art which SNP to use with which particular application; right?**

A. **I don't think it was necessarily obvious to one of skill in the art to use the sequence of patent claims in their entirety. One of the elements was the development of a SNP profile, but the idea of developing a SNP profile with thousands of SNPs to give you better sensitivity and specificity was part of the combination of patents that overcame those limitations.**

Q. **Let me show you your deposition transcript again to my point. Page 94, lines 1 to 13.**

Question: The patents themselves and the claims of the patent, they don't recite how you're supposed to

identify which SNPs work with the claims. Correct?

Answer: They don't cite a specific set of SNPs because it would be obvious to one skilled in the art that every condition is different. Organ donors and recipients have different genotypes, so you can't identify a single set of SNPs.

So you are correct, there is nothing in the description, I'm sorry, in the claim construction that specifies anything specific other than it needs to be a SNP that distinguishes the donor from the recipient.

MR. WALTER: Your Honor, I'm going to object. I don't feel like this is impeachment because that is fairly consistent with his testimony. The testimony hear about every condition being different is exactly what he said on direct. It's not impeachment, it's just not.

THE COURT: Well, all right. So I don't recall what he said on direct. But you think that this was appropriate use for impeachment as to the last answer, so move on.

BY MR. JOHNSON:

Q. A person of skill in the art could generate a SNP profile and a method from the fetal maternal DNA and use the same methods in organ transplants; right?

A. The methods in the -- I mean, you're asking again a yes/no question. The methods in the organ transplant also

require a quantification, which was also not used in fetal DNA. So the method for genotyping and quantifying the genotyping was a distinction in the asserted patent.

Q. **I'm going to be very specific again. A person of skill in the art could generate a SNP profile in methods from the fetal maternal DNA and use the same method in organ transplant; right?**

A. **Insofar as the sequencing methods, they could use the same platform to sequence one and the other. Knowing what they were sequencing was a different story.**

Q. **The claims of the '607 patent recite selective amplification of target DNA sequencing; right?**

A. **Yes.**

Q. **And selective application can be used as a genotyping technique; right?**

A. **Correct.**

Q. **And the claims don't tell you how to selectively amplify. They just say, do it; right?**

A. **The claims do not specify.**

Q. **And that's because one who had skill in the art knows how to do selective amplification; right?**

A. **Under certain circumstances, you're correct.**

Q. **And there's nothing in the claims that required selective amplification to be done in one tube; right?**

A. **That's not explicitly stated, but you're going back to**

one skilled in the art, it would be understood.

Q. **Not explicitly stated. It doesn't appear in the claims; right?**

A. **It's not stated in the claims, that it has to be done in one tube.**

Q. **We heard Mr. Reines in his opening refer to a thousand SNPs, and the written description of the asserted patents does not give details on how to selectively amplify at least a thousand SNPs; right?**

A. **You're now talking the description?**

Q. **That's right?**

A. **I think it does. I think it provides some references that refer to the use of multiplex genotyping to identify SNPs.**

Q. **Sir, again, your deposition transcript, page 101, line 25, to line 102, line 5.**

You were asked: Question: The written description of the asserted patent does not address how to selectively amplify at least 1,000 SNPs? I'm asking about the written description now; correct?

Answer: It does not give the details of how to do that, correct.

A. **In the written description of the patent, you are correct.**

Q. **Sir --**

A. **You're correct.**

Q. **That was your testimony and you stand by it?**

A. **Yes.**

Q. **Right?**

A. **Yes.**

Q. **A person of skill in the art could use the same laboratory technique to selectively amplify a thousand SNPs from a pregnant woman's cell-free DNA as they could to selectively amplify at least a thousand SNPs from a transplant recipient's cell-free DNA; right?**

A. **Repeat the question. I'm a little concerned about the motivation why you would do that in a fetal DNA, but go ahead.**

Q. **I will read it again. A person of skill in the art could use the same laboratory technique to selectively amplify a thousand SNPs from a pregnant woman's cell-free DNA as they could use to selectively amplify at least a thousand SNPs from a transplant recipient's cell-free DNA; right?**

A. **That method of technology platforms could be used, correct.**

Q. **And that's because the laboratory techniques are blind to the blood sample; right?**

A. **The laboratory techniques are individually blind to the blood sample, but the patent claims are not.**

Q. **Sir, I'm asking you about the laboratory techniques. The laboratory techniques are blind to the blood sample. It doesn't care whether it's coming from a pregnant woman, cell-free DNA, or from a transplant recipient's cell-free DNA. It is the same laboratory techniques; right?**

A. **Not so far as quantification, which is required in the asserted patents and not in the -- any of the fetal detection systems.**

Q. **I'm going to show you your deposition testimony again, please, page 252, line 12, to 253, line 5.**

Question: Thank you.

A person of skill in the art in November 2009 could use the same laboratory techniques to amplify -- to selectively amplify at least 1,000 SNPs from a pregnant woman's cell-free DNA as to selectively amplify at least 1,000 SNPs from a transplant recipient's cell-free DNA, correct? Just the laboratory techniques?

"Answer: You could use the same laboratory techniques. You know, the laboratory techniques, there are limitations -- they're routine or non-routine and all of that -- is blind to a blood sample.

You gave that testimony?

A. **I did give the testimony. I don't think that's inconsistent with what I was qualifying. That statement is correct. The qualifications of applications of the patent**

is also correct.

Q. **Well, let me ask it this way: You could hand me two tubes of blood, one from maternal and one from an organ transplant patient, and I wouldn't be able to tell the difference; right?**

A. **If you followed the claims of the patent, you certainly could, because in the organ transplant, you would have identified the genotype of the donor, which would have been reflected in your tube of donor recipient, which would not be reflected in the fetal DNA.**

So if you follow the patent claims, there is certainly a distinction of applying that technology to each of those tubes of blood.

Q. **I asked you -- let me again show you your deposition testimony because I was using your language.**

The same question and the later part of the answer on line 20, 21 down to 22, the top of page 253, line 5.

You could use the same laboratory techniques. You know, the laboratory techniques, there are limitations -- they're routine or non-routine, and all of that -- is blind to a blood sample. So I would hand you two tubes of blood, one for maternal and one from an organ transplant patient, and you wouldn't be able to tell the difference. You could run them through to obtain a

high-throughput sequence that will give you sequence variations relative to a reference genome.

That was your testimony; correct?

A. **If you did the experiment just as you outlined and did two types of blood and genotyped them and compared them to a referenced gene, you would both say they had variations. Which one came from the maternal, which came from an organ transplant you wouldn't know unless you performed the other steps of the patent claim.**

Q. **Let's look at sensitivity.**

A. **Again, I don't think this is inconsistent. It's true, you couldn't tell the difference, but the consistency of my argument is unless you're doing it with a combination with the other patents.**

Q. **You couldn't tell the difference and, in fact, as you said, it's the same laboratory techniques, whether it's, you know, DNA from a pregnant woman, you know, cell-free DNA from a pregnant woman or from an organ transplant. It's the same laboratory techniques; right?**

A. **Again, this is one of those things we discussed. It's the same laboratory technique, but the data analysis can be different. The results of the data analysis can be different.**

Q. **Okay. The results of the data analysis, that is not a limitation in any of the asserted claims, is it?**

A. **I think it is. I think the data analysis is a very important part of the asserted claims.**

Q. **Which part in the claim limitation do you think relates to or describes the data analysis?**

A. **I think determining the amount of a donor specific circulating free nucleic acid from a solid organ transplant is data analysis. It's determining it's data analysis.**

Q. **And there's no specific there at all about how to do that; right? It just says determine, analyze?**

A. **In the claims -- in the claim language, you are correct.**

Q. **And let me move on then. In the '652 patent, claim element 1D talks about sensitivity greater than 56 percent.**

Do you remember that?

A. **I do.**

Q. **And you did not provide an opinion on this 56 percent limitation in your declaration; right?**

A. **I'm sorry? I coughed just as you were asking that.**

Q. **Let me ask it again. You didn't provide an opinion on this 56 percent limitation in the '652 patent claims in your declaration; right?**

A. **I did not.**

Q. **And the inventors did not invent the concept of sensitivity; right?**

A. **Yeah, I will agree that they didn't invent**

sensitivity.

Q. **And claim 1D of the '607 patent talks about sequencing error rates of less than 1.5 percent; right?**

A. **Yes.**

Q. **Do you remember that? But the patent admits a typical sequencing error rate for base substitution varied between platforms for between .5 to 1.5 percent.**

Do you remember that?

A. **Yes.**

Q. **Can you agree, sir, that the inventors did not come up with the idea that resequencing or sequencing multiple times would decrease error rate; right?**

A. **They did not come up with that concept. They recognized that as a component of their patent.**

Q. **And, sir, the inventors were not the first to look at or quantify DNA in a cell-free sample; right?**

A. **Correct.**

Q. **And the patents admits that method for quantifying nucleic acids were well-known in the prior art; right?**

A. **Well, could you rephrase -- give me the question again.**

Q. **Yes. The patents admit that methods for quantifying nucleic acids were known in the art; right?**

A. **You're saying the claims acknowledge that?**

Q. **The patents. I'm referring to the specification.**

A. **It acknowledges -- it acknowledges that there are techniques that are known in the prior art.**

Q. **The patents, the written description tells a person of skill in the art that there are methods for quantifying nucleic acid and those methods are known in the prior art; correct?**

A. **Correct.**

Q. **And the patents further admit that the presence or absence of one or more nucleic acids from the transplant donor in the transplant recipient may determine by any suitable method known in the art; right?**

A. **Yes.**

Q. **And there were routine and conventional techniques for detection of DNA in November of 2009, weren't there?**

A. **As an isolated technique, correct.**

Q. **You say isolated technique. That wasn't part of your deposition response when you were asked the same question.**

Do you remember that?

A. **I don't remember the details if you want to bring it up. Again, it's not inconsistent with the fact that the deposition was -- was commenting on the techniques that were in total that any individual technique, the statement you're making is correct.**

Q. **You were asked the same -- I just asked you the same**

question that you were asked in your deposition and here's the question.

Yeah, my question was: There were actually routine and conventional techniques for detection of DNA in 2009; isn't that right?

Answer: That is -- that is correct. Although, again, that's a generality. To suggest that detecting specific DNA was always possible by some standard techniques, that's not correct.

There were ways of doing it in some circumstances. There were ways where it was more problematic in other circumstances, this being one of them, that are more problematic. That it is not a routine detection system.

That's your testimony?

A. **It's totally consistent with that statement.**

Q. **My point is the claims don't recite a specific technique for how to determine the amount of donor, cell-free and nucleic acid and how that needs to be done; correct?**

A. **It does actually -- no, I don't think that is correct. It does provide a combination of techniques that allows you to determine the amount of donor derived DNA.**

Q. **Again, sir, there's no specific technique for how that determination of the quantity needs to be done in the patent**

claims; right?

A. **There's no specific technique on how that should be done in the claims, correct.**

Q. **Okay. Now, you understand that by November of 2009, circulating DNA could be useful in cancer detection and treatment, particularly in identifying genetic changes that have occurred in a tumor?**

A. **Yes.**

Q. **And you would agree that by 2009, circulating DNA also was known to be useful for fetal diagnostics; is that correct?**

A. **Yes.**

Q. **And it's well-known in the prior art that the DNA and transplanted organ implements blood and can be detected using cell-free methodologies?**

A. **It can be, but -- it can be, but they weren't routine and conventional in that application.**

Q. **Well, we've seen some testimony about column 5, line 36 to 49. Let's put that up, please.**

Now, sir, this passage tells a person of ordinary skill in the art that practicing the invention includes conventional techniques; right?

A. **It includes, but is not limited to those conventional techniques.**

Q. **That was my question. It includes conventional**

techniques?

A. It includes conventional techniques.

Q. And you agree that the techniques that are described in the patents to carry out the claimed inventions were already known in November of 2009; right?

A. In their combination, they were not.

Q. I didn't ask you about the combination. All right.

Let's ask it a different way. Is there anything that's actually explicitly called out -- called out in the patent as unconventional?

A. I would argue that the sequence of patent claims from -- in all of the requirements of the patent steps, the claim steps, that was not conventional.

So you asked if the patent provides anything that was not conventional. My answer is, yes, the sequence of the steps that were provided were never described before and the sequence of steps provided to achieve solution to the problem of identifying organ DNA in a transplant had not been done before.

Q. Each of those steps individually was well-known and conventional and routine; right?

A. No.

Q. Sir, you were asked at your deposition, page 175:

By the way, is there anything that's actually explicitly called out in the patent as unconventional?

Answer: So you're asking -- so if you look at the technologies that are being -- that are being described in order to carry out the invention, I would argue that those technologies are known, many of them are known.

A. **That's exactly my comment. They were known. Known doesn't mean they were conventional.**

MR. WALTER: I would object again. This isn't impeachment. The question was routine, conventional routine, and he said no.

THE COURT: All right. Hold on a second. I mean, I don't know that it's directly contradictory. I'm informed by the testimony. It's part of the record. I'm going to consider it like I am for both sides. I'm going to consider the testimony. But let's go ahead. How much time do you have?

MR. JOHNSON: Just a couple minutes. Three questions.

THE COURT: All right.

BY MR. JOHNSON:

Q. **Exhibit C5. You were asked about the Vymetalova met group; right?**

A. **Yes.**

Q. **Vymetalova paper. That group was not reporting on experiments on cell-free DNA; correct?**

A. **Correct.**

Q. **And that group was not reporting on experiments that analyzed polymorphism or SNPs; right?**

A. **Correct.**

Q. **This 2000 paper, Exhibit C5, didn't report on any results of high-throughput sequencing.**

A. **Let me correct it. It's 2008.**

Q. **I'm sorry. The 2008 paper didn't report on any results of high-throughput sequencing, did it?**

A. **No. It was addressing the Y chromosome.**

MR. JOHNSON: No further questions.

THE COURT: All right. Redirect?

REDIRECT EXAMINATION

BY MR. WALTER:

Q. **All right. I want to start out where your cross-examination began. You were asked some questions about the distinction between high-throughput sequencing and next generation sequencing.**

Do you recall those questions?

A. **I do.**

Q. **And the implication was that there's a big difference between the two things and that there was a hotly disputed issue between the parties as to whether there's a distinction between next generation sequencing and high-throughput sequencing.**

All right. Do you know Dr. Quackenbush provided

testimony in this case?

A. **Yes.**

Q. **And you reviewed his testimony?**

A. **Yes.**

Q. **All right. He has provided a report in connection with summary judgment; is that correct?**

A. **Correct.**

Q. **Okay.**

MR. WALTER: Ms. Woo, can you bring up Appendix A?

BY MR. WALTER:

Q. **So this is the declaration of professor John Quackenbush. This is the report that you reviewed, you prepared, and I would like you to go to page A38.**

Ms. Woo, if you can do that.

All right. It's actually -- I think you have to go to A -- we have to get to 38. I think it's -- there we go. Thank you.

All right. So here you can see Dr. Quackenbush said in its 10-K, Helicos also acknowledges established genomic analysis technologies, including next generation sequencing, which, as explained in Section 7B3 below, is a term that for pertinent purposes is used interchangeably with multiplex sequencing or high-throughput sequencing.

Do you see that?

A. **I do.**

Q. **Okay. So is Dr. Quackenbush, is it your understanding, treating next generation sequencing and high-throughput sequencing interchangeably?**

A. **I think this is one area where we're in agreement.**

Q. **Okay. Let's take a look at A50.**

All right. Paragraph 95. You can blow that up.

Due to the rapid explosion in use of sequencing by synthesis instruments including the '454 sequencing in 2005, the Illumina Genome Analyzer and Applied Biosystem Solid Sequencer in 2006 and others shortly thereafter, my group and I quickly became involved in multiplex/high-throughput or next generation sequencing.

A. **Yes.**

Q. **How is Dr. Quackenbush treating next generation sequencing as high-throughput sequencing in terms of whether they're conceptually the same or different?**

A. **The same as I. They're the same.**

Q. **Okay. Let's go to 853.**

THE COURT: I actually thought that Dr. Quackenbush testified on direct to this. He equated them as well. So I never thought this was an issue. I asked the definition. I think it was raised to point out the claim difference between the two.

I mean, he's a scientist. He's not a lawyer.

So your point is well-taken and I didn't put a lot of emphasis on it for what it's worth.

MR. WALTER: Thank you. A conservative time was spent on it during cross.

THE COURT: Well, right. I hear you. But, in any event, you're free to do it. Your point is made.

MR. WALTER: Thank you.

THE COURT: You know, I get it. Put it this way. I'm not going to attribute any significance to the fact that the witness said that these two terms are at times used interchangeably and, in fact, both experts used them interchangeably.

MR. WALTER: Thank you.

BY MR. WALTER:

Q. **I want to ask one final question. You were asked a lot of questions about limitations in the sequencing technology, whether it was mapping short reads, biases, and you were asked a lot of questions about whether the claims include specific limitations to addressing those issues.**

How do the claims address the types of issues that were brought up on cross-examination?

A. **Well, the claims basically outline in a stepwise fashion all the steps that you would need to take in order to successfully get beyond the limitations of things that were not necessarily routine at that time in the application**

for detecting small amounts of DNA coming from the donor. It was a combination of all of the steps that overcame the limitations that were seen as a problem and were solved by the combination of all of those steps.

Q. **Was it the individual steps that overcame the problem? Was it the combination?**

A. **The combination. You had to apply all the steps to overcome the limitation. Each individual step may have some inherent nonconventional component to it that there were limitations, but when you applied all the steps, you were successful in identifying the donor derived DNA and quantifying it and associating with rejection, the proof being it was published as being a successful technique, overcame all of those limitations.**

MR. WALTER: Thank you.

THE COURT: Thank you. Can you help me out? You said that context is always important, and in your response on redirect you made the point that essentially the question in your mind is, is it routine in the application?

THE WITNESS: Correct.

THE COURT: All right. So if I step back, is it fair to say that you would agree that all of the techniques that are claimed were routine and conventional in some context? Would you agree with that?

THE WITNESS: Yeah, there are some very simple

applications.

THE COURT: So, in other words, if I'm trying to take two professors up here who both appear to be nice people and want to do a good job, right, but -- but that would be a way at least of harmonizing. I'm not saying I'm doing that. That would be one way to say you are not calling Dr. Quackenbush an outright liar. In part you're saying, you know, he's at Harvard, Stanford, has a lot of money. His idea of conventional might be a little different. But also it could be that there's agreement that these are routine and conventional. It's just the context.

And as I understand your testimony, you would agree that every disclosed technique is routine and conventional in some application. Your point is, it's just not the application of this patent?

THE WITNESS: I think that's an accurate statement.

THE COURT: All right. So, and it seems you're focusing on the ordering, the combination of the steps in the claimed method to draw the conclusion that they're not, these techniques are not routine and conventional as applied here.

THE WITNESS: And they were never previously disclosed in any publications or documents to say we have successfully overcome the limitations that this patent

overcame.

THE COURT: Okay. But now a number of times in your testimony you kind of made a point to qualify, you know, in anticipation of deposition testimony you were going to be shown. You said, as applied, as applied, right, or with the application. All right?

So, for instance, you said, next gen or high-throughput frequency, right. And you said, you admitted in 2009 it had a wide variety of applications. Right?

THE WITNESS: Correct.

THE COURT: But it hadn't been applied in this context?

THE WITNESS: Because of some of the recognized limitations.

THE COURT: Okay. Well, my first question is: Applied to what? In your mind, when you say "in this context," the context of this case talking about these patents, what is the application to?

THE WITNESS: The application in the combination of steps ultimately comes down to being able to identify the quantity of donor-derived DNA which represents a very small fraction, so there's a problem, small fraction in a recipient that has undergone a transplant.

THE COURT: Okay. So I want to make sure then.

As I understand it, you are saying it's applied to the quantification of cell-free DNA in the blood of a donor recipient?

THE WITNESS: Of the recipient.

THE COURT: Right.

THE WITNESS: To detect the donor DNA, I'm going to add one important component.

THE COURT: Hold up. I want to make sure when I leave here I've got a real clear definition.

THE WITNESS: Okay.

THE COURT: So the application to what? What am I applying the disclosed techniques to?

THE WITNESS: Applying it to the detection of donor-derived DNA in a recipient receiving an organ transplant and the patent claims provided with the sensitivity and specificity that nobody else had gotten prior to that.

THE COURT: All right. Hold up. Just give me a second.

All right. Now, the patent doesn't claim how to achieve sensitivity, does it?

THE WITNESS: It does if you use the combination of methods. Because you're using multiple SNPs, they claim the .03 percent sensitivity of detecting donor-derived DNA. They actually highlight what that sensitivity is and being

able to identify better than a .03 percent sensitivity, they actually comment on the sensitivity of detecting donor DNA in a recipient.

And if I may --

THE COURT: Just hold on. Okay. Go ahead.

THE WITNESS: The sensitivity is also dependent on the specificity. That is, I need to know that I've got the right sequences that distinguish the donor from the recipient. If I'm dependent on one, I could make some mistakes, but if I do a thousand, I now have a consensus opinion that gives me specificity and every one of those can be detected with specificity.

I know exactly what I'm looking for in the donor, so I know what I'm looking for in a --

THE COURT: Increasing the sample size?

THE WITNESS: Which is an important part to increase your sensitive --

THE COURT: But that's the bottom line. Right? The idea behind it is just to increase the sample size; is that correct?

THE WITNESS: To increase sensitivity and specificity, yes.

THE COURT: Right. You would increase specificity and sensitivity by increasing the sequencing?

THE WITNESS: Correct.

THE COURT: All right. And in 2008, maybe not in your opinion at least, you don't want to -- let's say out of this context. Wouldn't persons of ordinary skill in the art have realized that the more sequencing you do, you'll gain sensitivity and specificity?

THE WITNESS: I think you have to couch that in that these emerging technologies have these variables.

THE COURT: Put aside the emerging -- just the idea of sequencing. You said sequencing had been around a long time. Right?

THE WITNESS: Sure.

THE COURT: So that the more sequencing you do would lead to enhancement of sensitivity and specificity. Correct?

THE WITNESS: Correct.

THE COURT: That idea would have been known and accepted in the art. Correct?

THE WITNESS: Correct.

THE COURT: All right. Anything else?

MR. JOHNSON: No, Your Honor.

THE COURT: Incidentally, hold on. Anything else for this witness?

MR. JOHNSON: No, Your Honor.

MR. REINES: No, Your Honor.

THE COURT: Okay. Thank you very much.

(Witness excused.)

THE COURT: All right. So as I said, I'm not going to give any credence whatsoever or any significance to any equating NexGen with -- whatever the name is. I lose track of the name. But I don't think it's inappropriate to lead with it, right, I mean, because that's, after all, a cross-examination technique. You might get a witness to think, oh, I need to think twice here about how I'm careful with the words I use.

So I don't believe it's inappropriate. I don't want you to draw that conclusion, but at the end of the day, I think both experts used the term interchangeably, and I think the documents, I think it was well-known that the documents showed they're using it interchangeably. To me, right now I don't really see any significance to that.

Now, maybe it has got some significance substantively in which case I am going to want to hear that. I mean, does it have any significance substantively?

MR. JOHNSON: The only -- the distinction I was trying to make was that the patents, the patents which we've got to rely upon, the patents treat it pretty differently.

THE COURT: Well, of course, they do. They've got to defend the claims, I mean clearly. The treat NGS as a subset. Right?

MR. JOHNSON: And so we go to the intrinsic

evidence versus skill in the art, dependent claim, and that one part of the spec that says high-throughput systems that refers to vendor, that's not an NGS system.

THE COURT: Right.

MR. JOHNSON: It's a -- you know, so it is what it is.

THE COURT: Okay. If it has any significance in that regard, we'll see.

All right. For starters, I do think a helpful way to address where we are is effectively that I decided to sua sponte invoke 56(f) and say I want to reconsider summary judgment practice. So I mean is there any objection to me being able to do that? I know you don't want me to do it.

MR. REINES: That means all the objections we've set so forth, I don't want to at this late hour repeat them.

THE COURT: Wait. I mean, when you say -- no, no. But when you say the objections you set forth, I'm just talking about as a legal matter and my ability to do it. You know, that I have the authority under 56(f) to do it. I mean, are you challenging that?

MR. REINES: You have the ability to reconsider summary judgment.

THE COURT: Okay.

MR. REINES: But I mean the objections, which, look, I've been around too long. People will say I didn't

raise these now, so therefore I waived them, because you asked me about --

THE COURT: All right.

MR. REINES: That happens and it would happen here, I have total confidence.

THE COURT: Well, where I have you though as far as legal basis challenge what we do, you've got a Seventh Amendment argument. I'm only talking procedural. Is there any other legal argument?

MR. REINES: Prematurity.

THE COURT: Isn't that the same thing as the merits of the summary judgment motion?

MR. REINES: I would say that's procedural as to whether we should be doing summary judgment before fact discovery.

THE COURT: Okay. That one I'm comfortable with. Can you show me anything that says a judge can't do anything where, in managing a case, to conduct summary judgment? I'm looking for legal arguments.

MR. REINES: Yes, under 56, there's an established procedure where we put in a declaration and we state what else, why we think it's premature.

THE COURT: And you've done that?

MR. REINES: And we did that. I don't know if it's refreshed to now.

THE COURT: You can argue from anything that's in the record from now to oppose --

MR. REINES: Okay.

THE COURT: -- my deciding to decide short of a jury trial whether or not these patents are invalid under Section 101.

MR. REINES: Right. It has to do with fact discovery, but, yes, I understand.

THE COURT: Right. I think you need to set forth what other, what fact discovery you're missing if you can't make your argument, because you feel very strongly about the merits of your argument to date, so I'm curious what evidence do you think hasn't been adduced that will enable you to make an argument that you have not been able to make to date.

MR. REINES: Right. And at a minimum, it's the material contained within the declaration that I submitted when I knew there was a summary judgment motion pending. I had a summary judgment motion that I was facing.

THE COURT: Okay.

MR. REINES: Okay. So, and I think it's a well put-together document.

THE COURT: Okay. So you can --

MR. REINES: Correct.

THE COURT: We can do that.

MR. REINES: And then I think there's a new issue that has arisen.

THE COURT: Okay.

MR. REINES: Which is we have not done claim construction. Throughout these proceedings, the parties both agree that, for all intents and purposes, the claims were limited to high-throughput sequencing is equivalent to NGS. Quackenbush readily agreed with that.

I have testimony that I -- I'm sorry.

THE COURT: No, no, no.

MR. REINES: I have testimony that I didn't use with Quackenbush to impeach him on this point because it wasn't a disputed issue.

THE COURT: So let me find out if it really is disputed. Are you going to argue we have a different claim construction or I need to conduct claim construction to distinguish NGS from high-throughput?

MR. JOHNSON: Not for our purposes, no, Your Honor.

THE COURT: So you're willing to go with their definition, which is to treat them synonymously. Right?

MR. JOHNSON: Give me one second.

THE COURT: Yes.

(Pause.)

MR. REINES: And then, Your Honor --

THE COURT: Hold on.

MR. REINES: Understood.

THE COURT: I'm not conducting a Markman hearing, not right now.

MR. REINES: I understand. We didn't know the disputed issue. That's really...

MR. WALTER: We have no objection.

THE COURT: Okay. So we're going with the plaintiffs' construction, which I assume is plain and ordinary meaning?

MR. REINES: Yes.

THE COURT: Yes. Okay. Go ahead.

MR. REINES: The only thing I want to say, and I'm cognizant of time and Your Honor's hard stop, you know, I'm not going to go back through all of the legal stuff because we could do that forever.

The one thing I would say is that what I thought in terms of the Court's takeaway and as you are thinking about it fresh, I just want this opportunity and you have been generous about that, is repeatedly, Dr. Quackenbush said that coming with this method and applying it as a combination to cell-free DNA and using it for this purpose applied to natural phenomena was logical and straightforward. I think he said that repeatedly. And I don't deny that's their position. To me, that really does

sound in obviousness, and what the real argument is, is that people skilled in the art would have known.

And I just -- I guess all I can do is say that I just wouldn't -- I would ask you not to succumb to the temptation to use this as a shorthand obviousness ruling, because that's the danger, and we don't look at each one individually, that Diamond/Diehr has some excellent points about that, because every patent would fail.

THE COURT: Well, look, if I were you, I would do what you doing. You are trying to make it into an obviousness inquiry and let's see.

Now, do you want to brief this? What do you want to do? I want to say two things.

MR. REINES: Sure.

THE COURT: I would think if I were as an advocate, if I were in your shoes, that's what I would do tactically. And I say that, too, because keep in mind. You know, I learn personally through listening, questioning, probing. I may ask questions. I may say stupid things. I do all the time. But ultimately, it doesn't matter what I said. The only thing that's going to matter is what I put in writing.

MR. REINES: Understood.

THE COURT: Because my mind is not made up a hundred percent by any stretch. All right? So with that in

mind, go ahead.

MR. REINES: No. I really feel strongly that, you know, it's for Your Honor's decision-making process. I would suggest some post-trial briefing.

THE COURT: Okay.

MR. REINES: I don't want to do that if it's just more --

THE COURT: No. I want to give you every opportunity.

MR. REINES: Okay.

THE COURT: Because -- well, I want to give you every opportunity.

MR. REINES: Fair enough. That way we'd like an opportunity to brief it with the help of the transcript.

THE COURT: All right. We've got to get the transcript. They have to go first, I guess. What do you think?

MR. REINES: I mean, I guess, I would ask Your Honor one question.

THE COURT: Do you want to go first?

MR. REINES: Well, let me ask you my one question, because Your Honor seems to refocus that you're operating this point forward from Rule 56 and not Rule 52, and if that's true, but I think the parties would both benefit from knowing, you know what I'm saying? It's a

different thing of whether you are briefing and finding conclusions or whether you're briefing this intrinsic evidence, extrinsic evidence issue, you know. It just changes. You may say, I don't have to answer that.

THE COURT: No. Here's where I am ultimately. See, at the end of the day, I mean, unless there is a jury right, that you have a right, you know. I view this exactly like the indefiniteness situation and the Federal Circuit has endorsed it where -- and by the indefinite situation, I mean where the judge heard competing expert testimony and then the judge went on without the benefit of the jury fact-finding to make a determination as to validity with respect to 112. That's what indefinite does when get it up on the Federal Circuit and they have accepted that. All right.

So I mean, I will give you -- I don't know that it really matters whether it's raised as a Rule 52 or Rule 56 and I want to consider the legal argument. I mean, you know, the interlocutory appeal request made me wonder whether I really should as a matter of law even go beyond the written description and do I need to think about that question. So that should be part --

MR. REINES: Oh, I'm sure that's what you are thinking.

THE COURT: Yes. So I need to do that. And if

you win that hurdle, then you get over that hurdle. Then I'm going to go back to where I am here. Now I need to make some fact findings.

MR. REINES: Right. I'm pretty aware of the situation.

THE COURT: Right.

MR. REINES: So I just thought you maybe narrowed it down to 56.

THE COURT: Because I don't know as a practical matter if it matters. What I want to do is give you the full opportunity to lay whatever record you think is necessary such that if, and it is an if -- if I deem the patent at this stage invalid under 101, you would have a full record to take everything you want to the Federal Circuit. That's my goal. And I think that is better than I let this case play out and we have a jury trial and then I'm sure there's going to be an argument, this was a judge question to begin with and why did I let this all transpire.

MR. REINES: I think we're happy to go first because I do think the burden has kind of been on us.

THE COURT: No, it's not.

MR. REINES: I don't mean evidentiary. I mean burden of persuading.

THE COURT: I normally hate simultaneous briefing.

MR. REINES: I really don't feel comfortable telling you what is the best kind -- how you want to digest it. It would be happy going first, having them oppose it, having us reply on a normal cycle and explaining why. I mean, the Court came in. It's not common at least in my career to have a judge come in and say I'm very, very skeptical of your position, so with that said, I think we should be going first, because you're very, very skeptical and we're trying to overcome that. And so that's what I would propose.

THE COURT: Right. I'm very skeptical, and just keep in mind, not because I get a kick of coming in and volunteering my opinions to the parties. It's because I read the motion to dismiss briefing and I read Judge Burke's opinion and I had to because objections were filed that were brought to my attention and I had to deal with them. That's exactly what I did.

MR. REINES: Yes. No, I didn't mean -- I was trying to explain --

THE COURT: My concerns as to skepticism were in the context of objections were put before me and I had to rule on.

MR. REINES: Yes. I was just saying why -- you know, you can understand I'm sitting here, why we feel like we need to show you while we're right.

THE COURT: I mean, really quickly here.

MR. JOHNSON: So from my standpoint, Your Honor, we were the movant on 56. We're fine with him going first, but we would last to go last and have a surreply brief or we do two simultaneous briefs with two responses because, you know, whatever your reference is, Your Honor.

THE COURT: Okay. Here's what I'm going to do. First of all, how fast can you go?

MR. JOHNSON: You know, it is sort of dependent on when we get the transcript.

THE COURT: You'll probably get it very quickly.

MR. JOHNSON: Two weeks, Your Honor, from today?

THE COURT: Okay.

MR. JOHNSON: Is that do-able?

THE COURT: I'm going to let them go first. I'm going to let you go next and then you can go.

I will entertain -- I'm not at all guaranteeing. Let's see what comes in, you know, because I could also see having questions for the parties in their briefing.

MR. REINES: Your Honor, just because of the importance of the issue and all the balls moving, Mr. Johnson asked, like, if we see a need for a surreply, maybe we --

THE COURT: That's exactly what I meant, but let's wait and see what happens.

MR. JOHNSON: Well, so, one question, for example, on our end if we're going to go first. Do we address, want us to address the jury right trial? I mean, the right to --

THE COURT: Well, you know it's coming.

MR. JOHNSON: Right. But I sort of want to see what he says.

THE COURT: Well, you already read the letter. He says he has a right to a jury.

MR. REINES: We could put a letter on file.

THE COURT: Look, there's not a lot of case law out there. Right? I mean --

MR. JOHNSON: We're well aware of it.

THE COURT: The Federal Circuit says willfulness is a jury question. They've said it. I've got to follow it.

MR. JOHNSON: Page limits?

THE COURT: I will tell you what. I'm going to be late for an appointment. I'm going to let you all make a recommendation.

MR. JOHNSON: Okay.

THE COURT: About schedule and page limitations.

MR. JOHNSON: Okay.

THE COURT: Submit it to me. I mean, it seems to me, which all I would think about, if I'm the defendant

off the top of my head, I know that you are going to have to reiterate your argument, make it explicit that basically the Court erred on Rule 12 practice and should have ruled without any resort at all to extrinsic evidence. You're going to say that that there's no Seventh Amendment right.

MR. JOHNSON: Right.

THE COURT: And that it was okay for the Court to hold this hearing and determine if it thought that extrinsic evidence were necessary, you're going to rule that -- you know, you're going to explain why you think extrinsic evidence supports your position. Right?

And then the plaintiff is going to respond and say, Judge, it will be premature at this stage to rule on 101 and that you are absolutely allowed to go beyond the written description, and if you do, you're going to rule -- I would rule in their favor. And, by the way, you violated my client's constitutional rights by doing all of this without a jury trial.

I think those are all the arguments. Is there anything else?

MR. JOHNSON: I think that's true.

MR. REINES: I don't want to sit here in broad strokes, but also the procedural things that I raised earlier. There was the prematurity issue.

THE COURT: Yes. Well, prematurity is just --

MR. REINES: The question is whether a fully developed record --

THE COURT: Exactly. Sure. That's what I meant.

MR. REINES: Sorry.

MR. JOHNSON: We're on the same page.

THE COURT: Yes.

MR. JOHNSON: The only other thing I would say, we believe from defendant's standpoint discovery should be stayed while we deal with this.

THE COURT: Well, what's left, because that is --

MR. JOHNSON: I mean a lot is left. A lot is left. We think this should be --

THE COURT: I do think it should be stayed. Let me hear -- on the phone call I said the third party could go forward. Is that what I said, I believe?

MR. REINES: You said the case could go forward.

THE COURT: Right.

MR. REINES: Other than claim construction.

That's fine. There's a patent coming back at us that has been sort of not part of the conversation.

THE COURT: Yes.

MR. JOHNSON: We'd stay everything.

THE COURT: They can't do that. If they want to

stay, they cannot use it to their advantage.

MR. JOHNSON: We agree.

THE COURT: Other than to stop spending and focus on these issues. All right? Then we'll just stay it until resolution.

MR. JOHNSON: Okay.

THE COURT: Okay. And in the meantime you have another trial coming up very soon.

MR. REINES: I have. I have a trial with you.

THE COURT: That's what I mean.

MR. REINES: Yes.

THE COURT: Incidentally, I will tell you, there is a criminal case now in addition on that week of the calendar, but let's see what happens.

MR. REINES: Yes.

THE COURT: Okay. All right. Anything else?

MR. JOHNSON: I don't have a trial. I just have a fees application.

THE COURT: You have a what?

MR. JOHNSON: The Blatmann fees application. That's all I have.

THE COURT: Wait, you're involved -- wait.

MR. JOHNSON: I tried that, yes. I tried that.

THE COURT: You know, it's so funny. That's the problem. When you have 600 cases, they all run together.

Wait. I'm thinking to myself, you know, I recognized you. Where do I know this guy from? So it was Blatmann.

MR. JOHNSON: I defended Steve Freed and Tom Siebel.

THE COURT: Now, there were a lot of people.

MR. JOHNSON: It was me and Carlinsky and there were a few others.

THE COURT: So, wait. Is this --

MR. JOHNSON: Quinn Emanuel.

THE COURT: It is. Oh, I thought you guys were Goodwin.

MR. WOO: Yes, Your Honor. I'm with Goodwin.

MR. JOHNSON: Goodwin --

THE COURT: Anyway, I apologize. Again, I'm trying to stay focused. You have to understand. So, you know, I mean --

MR. JOHNSON: No, believe me.

THE COURT: I'm one of four. We all work hard. I spent my entire weekend here and not just reading your patents. I mean, I did read your patents, but we just have a lot of stuff to get through and it can go together and I apologize for that. I want to give this case its fair due and so work out a schedule and we'll get to it.

MR. JOHNSON: We will.

THE COURT: As soon as we can. Now, I will say this. Don't take too long, in part because my very talented law clerk who is working very closely with me on this case, and the clerks leave generally in September, so I really want to get this done. I've got two ANDA opinions I have to get out.

MR. REINES: We'll do it before that.

THE COURT: All right. Everybody have a great day.

(Counsel respond, "Thank you, Your Honor.")

(Hearing concluded at 3:47 p.m.)

- - -

$

$100 [1] - 161:25
$100,000 [1] - 161:25
$750,000 [2] - 145:8, 147:10

'

'07 [1] - 41:22
'08 [2] - 41:22, 65:21
'454 [6] - 95:9, 149:17, 161:6, 199:13, 201:16, 258:9
'497 [23] - 80:25, 82:2, 91:4, 96:19, 104:19, 105:19, 106:2, 117:12, 117:14, 117:23, 122:4, 176:22, 176:23, 176:25, 177:20, 213:19, 217:20, 218:5, 218:6, 219:25, 220:1, 228:14, 230:21
'607 [23] - 81:1, 85:17, 86:22, 87:6, 87:13, 87:18, 89:1, 91:4, 95:4, 96:20, 99:14, 118:3, 118:4, 118:16, 122:4, 174:8, 174:10, 177:1, 204:20, 237:4, 243:11, 250:2
'652 [22] - 80:4, 80:25, 82:1, 91:4, 92:22, 92:23, 111:5, 112:24, 113:5, 114:3, 114:5, 116:3, 117:4, 121:23, 126:22, 175:25, 176:3, 176:19, 233:9, 236:5, 249:12, 249:20
'98 [1] - 32:25

0

0.3 [1] - 104:5
0.5 [3] - 100:4, 101:10, 104:5
03 [7] - 96:23, 97:1, 97:16, 98:4, 111:10, 263:24, 264:1
09 [1] - 41:22

1

1 [50] - 11:23, 19:1, 55:21, 55:22, 57:11, 57:20, 58:12, 58:24, 61:22, 61:23, 73:1, 79:16, 80:3, 80:5, 106:11, 106:14, 106:18, 113:9, 113:12, 114:2, 114:5, 116:3, 117:4, 117:12, 117:14, 117:23, 118:3, 118:4, 118:16, 126:23, 126:25, 132:9, 174:10, 175:25, 176:2, 176:22, 176:23, 176:24, 177:20, 204:20, 213:19, 217:21, 228:8, 228:16, 228:17, 228:20, 228:22, 236:2, 237:4, 241:23
1,000 [9] - 50:20, 87:6, 87:11, 88:21, 89:3, 90:9, 244:19, 246:14, 246:16
1-2 [1] - 39:25
1.2 [3] - 85:1, 85:4, 122:22
1.5 [7] - 99:17, 100:4, 101:10, 102:5, 111:11, 250:3, 250:7
10 [1] - 191:2
10,000 [6] - 86:13, 87:16, 211:20, 212:1
10-K [11] - 141:9, 141:22, 156:19, 156:20, 156:22, 157:1, 157:5, 193:25, 194:2, 194:3, 257:20
10-Ks [1] - 146:3
101 [16] - 6:11, 11:18, 12:4, 15:5, 15:6, 17:24, 19:1, 20:11, 26:13, 26:18, 26:24, 75:5, 244:15, 269:6, 275:13, 279:14
102 [1] - 244:16
10K [1] - 144:13
11 [1] - 239:1
112 [2] - 152:3, 274:13
12 [5] - 23:6, 140:6, 169:6, 246:10, 279:3
12-one [1] - 207:23
13 [4] - 81:19, 186:5, 234:2, 241:23
1314 [1] - 23:15
14 [1] - 130:12
141 [1] - 231:22
145 [1] - 136:12
15 [4] - 92:22, 92:23, 191:2, 239:1
16 [2] - 187:17, 219:22
160 [1] - 90:1
160,000 [2] - 85:7, 85:9
17 [4] - 1:19, 136:12, 183:10, 187:18
175 [1] - 254:23
18 [2] - 151:16, 161:1
180 [1] - 130:12
19 [1] - 234:1
19-1804 [1] - 1:15
19-567 [1] - 1:9
198 [1] - 32:8
1985 [3] - 86:1, 88:16, 88:17
1990 [1] - 204:8
1992 [1] - 75:25
1994 [2] - 76:3, 86:12
1995 [1] - 84:4
1997 [2] - 76:5, 86:12
1998 [15] - 31:15, 32:1, 37:21, 39:24, 40:4, 40:11, 40:22, 40:25, 42:18, 51:13, 62:22, 125:14, 125:16, 126:14, 135:17
1999 [1] - 135:17
1:15 [1] - 168:4
1A [4] - 80:25, 81:1, 82:2, 114:3
1B [6] - 82:1, 82:2, 91:4, 111:5, 113:5
1C [4] - 85:18, 85:19, 89:1, 91:4
1D [8] - 96:20, 99:14, 104:19, 112:24, 116:5, 230:22, 249:13, 250:2
1S [1] - 96:21

2

2 [21] - 9:1, 11:14, 11:17, 19:2, 55:23, 57:18, 61:21, 62:7, 64:4, 73:1, 93:6, 102:10, 103:3, 103:9, 103:13, 103:17, 132:10, 140:7, 208:24, 228:8
20 [3] - 89:16, 231:22, 247:17
2000 [7] - 85:2, 92:18, 160:13, 161:25, 169:3, 222:16, 256:4
2001 [7] - 92:14, 149:11, 157:11, 160:14, 160:18, 220:5, 221:17
2002 [1] - 208:2
2003 [1] - 236:15
2005 [4] - 76:11, 149:19, 151:25, 258:10
2006 [7] - 106:6, 106:13, 186:3, 196:6, 196:23, 197:1, 258:11
2007 [8] - 61:12, 68:13, 72:7, 103:6, 106:13, 161:4, 161:9, 197:10
2008 [35] - 47:23, 61:12, 67:13, 67:23, 70:15, 76:17, 77:9, 95:1, 103:7, 135:15, 136:8, 136:18, 136:22, 137:22, 149:12, 151:2, 151:12, 165:17, 172:21, 172:24, 173:7, 173:14, 174:1, 174:2, 193:2, 196:7, 197:16, 197:17, 213:9, 214:13, 215:11, 216:1, 256:6, 256:7, 265:1
2008/2009 [2] - 145:4, 196:14
2009 [99] - 37:22, 45:10, 45:24, 47:17, 47:18, 61:11, 62:24, 69:11, 70:9, 70:12, 71:9, 76:20, 77:11, 79:8, 81:5, 83:10, 83:13, 83:14, 92:17, 92:19, 93:19, 96:1, 96:6, 102:3, 102:25, 105:19, 108:9, 108:22, 110:21, 119:2, 121:18, 135:7, 135:10, 135:15, 136:2, 136:8, 136:18, 136:23, 137:22, 139:11, 143:10, 149:1, 151:21, 158:18, 161:24, 162:5, 166:9, 169:3, 169:18, 172:15, 178:5, 189:11, 189:20, 190:2, 190:9, 191:10, 193:2, 193:11, 195:13, 196:7, 197:19, 199:1, 199:24, 200:19, 201:14, 206:6, 207:20, 211:4, 211:13, 212:22, 212:24, 213:1, 213:3, 222:7, 222:12, 222:16, 223:2, 225:24, 232:16, 233:12, 233:14, 233:20, 234:3, 234:18, 234:24, 235:17, 237:13, 237:21, 238:2, 238:6, 240:23, 241:3, 246:12, 251:14, 252:5, 253:4, 253:9, 254:5, 262:9
2010 [3] - 32:17, 72:24, 155:1
2011 [3] - 68:18, 144:24, 210:10
2012 [5] - 43:12, 43:18, 43:19, 44:3, 184:10
2013 [2] - 210:5, 210:9
2015 [1] - 32:17
2017 [3] - 159:7, 208:20, 209:12
2020 [1] - 183:18
2021 [1] - 1:19
21 [4] - 92:23, 183:22, 247:17
22 [2] - 184:14, 247:17
23 [2] - 180:22, 181:4
24 [1] - 161:1
25 [1] - 244:16
252 [1] - 246:10
253 [2] - 246:10, 247:17
26 [1] - 95:6
260 [1] - 178:18
28 [2] - 96:19, 140:10
29 [2] - 219:22, 220:2

3

3 [5] - 39:25, 86:4, 130:12, 136:12, 228:9
3,000 [1] - 98:6
30 [1] - 186:5
31 [1] - 68:13
33 [1] - 161:10
36 [4] - 121:23, 164:15, 179:13, 253:19
38 [1] - 257:17
3:30 [3] - 5:21, 123:24
3:47 [1] - 283:11

4

4 [7] - 191:2, 218:5, 218:6, 218:19, 227:25, 228:2, 228:15
43 [2] - 186:5, 233:6
44 [2] - 180:22, 181:5
45 [1] - 182:1
454 [1] - 92:6
46 [1] - 114:19
47 [2] - 180:7, 180:25
49 [4] - 121:23, 179:13, 182:20, 253:19

5

5 [11] - 119:7, 121:22, 179:4, 179:13, 182:12, 187:1, 244:16, 246:10, 247:18, 250:7, 253:18
50 [1] - 110:8
500,000 [3] - 84:9, 85:6, 89:25
502 [1] - 9:4
52 [5] - 13:4, 18:21, 20:4, 273:23, 274:17
536 [1] - 182:20
54 [1] - 182:1
56 [17] - 18:18, 18:20, 21:6, 21:21, 23:12, 111:7, 111:21, 112:16, 112:18, 249:13, 249:16, 249:20, 268:20, 273:23, 274:18, 275:8, 277:3
56(f [2] - 267:11, 267:19
56(f)(3 [1] - 21:8
58 [1] - 185:16

6

6 [1] - 119:1
60 [4] - 92:23, 92:24, 183:23, 234:1
600 [1] - 281:25
61 [2] - 126:22, 234:2
62 [1] - 183:23
65 [1] - 236:2
66 [1] - 180:7
67 [1] - 180:25

7

7 [4] - 24:4, 33:3, 126:22, 233:7
7-11 [1] - 55:16
78 [1] - 238:25
7B3 [1] - 257:22

8

8 [7] - 174:8, 180:22, 181:4, 181:25, 185:16, 191:2, 236:2
811 [1] - 23:15
853 [1] - 258:19

9

9 [4] - 144:13, 144:15, 231:22, 233:7
90 [1] - 209:20
94 [2] - 185:17, 241:23
95 [1] - 258:7
99.9 [1] - 110:6
9:00 [2] - 1:19, 4:4

A

a.m [2] - 1:19, 4:4
A1 [2] - 74:19, 75:2
A38 [1] - 257:14
A50 [1] - 258:6
ability [10] - 135:25, 175:9, 175:17, 198:19, 200:1, 205:7, 205:8, 235:23, 267:18, 267:21
able [21] - 5:22, 17:11, 34:9, 36:10, 73:4, 123:23, 135:16, 136:22, 137:22, 165:15, 174:24, 191:19, 202:19, 202:20, 247:4, 247:24, 262:21, 264:1, 267:13, 269:14, 277:14
abound [1] - 68:16
absence [1] - 251:9
absent [2] - 139:15, 139:25
absolute [1] - 68:21
absolutely [5] - 7:2, 144:20, 184:7, 238:4, 279:14
academic [2] - 75:14, 154:19
Academy [1] - 178:9
accept [1] - 178:13
acceptable [2] - 200:8, 200:10
accepted [2] - 265:17, 274:14
access [2] - 68:3, 185:12
accessing [2] - 165:19
accomplish [2] - 176:18, 224:6
accomplishing [1] - 225:3
accordance [2] - 22:18, 24:9
according [5] - 52:20, 87:12, 112:3, 157:14, 236:6
Accumetric [1] - 236:16
accuracy [11] - 68:21, 68:25, 69:2, 69:5, 93:18, 144:20, 175:18, 176:17, 180:19, 195:9, 199:2
accurate [7] - 11:20, 87:23, 104:1, 104:10, 170:19, 230:16, 261:16
accurately [1] - 195:7
achieve [12] - 73:4, 97:17, 97:18, 112:5, 112:7, 112:13, 175:17, 178:5, 199:2, 210:20, 254:17, 263:21
achieved [1] - 98:20
achieving [2] - 99:1, 155:4
acid [8] - 28:1, 67:10, 82:8, 108:18, 129:20, 249:6, 251:5, 252:19
acids [11] - 114:8, 116:8, 116:9, 116:10, 117:16, 117:18, 117:19, 156:12, 250:19, 250:23, 251:9
acknowledge [6] - 57:14, 65:9, 193:5, 215:14, 217:9, 250:24
acknowledged [2] - 55:9, 132:8
acknowledges [8] - 54:1, 54:6, 54:9, 54:12, 126:16, 251:1, 257:20
acknowledging [2] - 33:4, 187:10
acquire [2] - 11:19, 145:19
acquired [1] - 145:3
acquisition [1] - 196:16
ACTION [2] - 1:4, 1:10
actual [7] - 27:14, 27:20, 43:5, 102:7, 183:8, 184:24, 217:15
ad [1] - 14:5
adamant [1] - 49:2
add [7] - 95:17, 95:18, 95:19, 105:6, 105:7, 122:20, 263:7
added [2] - 71:14, 98:23
addition [9] - 93:13, 112:14, 151:8, 163:13, 163:18, 165:1, 165:9, 180:1, 281:13
additional [6] - 10:16, 19:6, 181:6, 197:23, 229:13
additionally [2] - 68:21, 194:17
address [11] - 6:6, 8:9, 8:20, 13:11, 23:18, 24:7, 244:18, 259:20, 267:10, 278:3
addressed [9] - 7:12, 7:14, 8:6, 67:22, 149:2, 150:18, 155:3, 155:14, 160:10
addressing [2] - 256:9, 259:19
adduce [2] - 12:2, 19:25
adduced [2] - 10:24, 269:13
adjudicate [4] - 7:2, 7:21, 7:22, 153:22
adjudicated [1] - 12:21
adjudication [3] - 6:19, 15:4, 20:2
adjust [7] - 110:25, 148:3, 148:9, 148:10, 148:11, 148:17, 148:18
adjusting [1] - 10:3
admission [2] - 24:17, 28:21
admissions [3] - 22:6, 23:4, 29:2
admit [4] - 64:23, 72:19, 250:22, 251:8
admits [6] - 22:11, 25:13, 26:1, 28:4, 250:5, 250:18
admitted [1] - 262:9
adopted [8] - 6:16, 6:24, 88:17, 92:20, 93:24, 94:5, 119:13, 152:1
advanced [5] - 17:8, 35:12, 45:15, 46:1, 46:5
advantage [1] - 281:1
advertising [1] - 101:19
advice [3] - 146:6, 146:7, 147:25
advisor [3] - 65:21, 65:22, 68:18
advisory [3] - 141:19, 146:4, 169:5
advocate [1] - 272:16
affected [1] - 166:8
affirm [1] - 137:12
affirmed [1] - 12:23
afford [1] - 12:2
afield [1] - 72:20
afraid [2] - 15:12, 31:9
afternoon [4] - 168:21, 168:24, 216:23, 216:24
afterwards [1] - 9:11
age [1] - 36:14
ago [2] - 93:23, 167:11
agree [43] - 17:13, 18:16, 19:5, 30:6, 30:11, 53:21, 53:22, 125:12, 129:8, 129:16, 130:1, 131:2, 131:13, 139:8, 140:12, 143:2, 143:17, 149:12, 151:21, 155:7, 155:13, 183:1, 198:15, 199:22, 206:7, 221:18, 224:21, 228:1, 230:3, 232:15, 233:12, 234:14, 235:17, 249:25, 250:10, 253:9, 254:3, 260:22, 260:24, 261:13, 270:6, 281:2
agreed [7] - 12:20, 12:21, 123:25, 124:24, 235:8, 270:8
agreeing [1] - 113:11
agreement [6] - 20:19, 153:4, 153:7, 153:22, 258:5, 261:10
agrees [1] - 31:1
agricultural [1] - 120:8

aha [3] - 43:2, 44:8, 44:12
ahead [6] - 40:2, 245:13, 255:14, 264:5, 271:12, 273:1
aid [1] - 63:14
air [1] - 164:7
akin [3] - 10:19, 12:8, 63:3
algorithms [1] - 69:25
Alice [10] - 32:19, 42:5, 59:8, 73:1, 131:16, 131:25, 132:1, 132:14, 132:15
align [1] - 191:16
aligning [1] - 191:15
alignment [1] - 69:24
alleging [1] - 132:22
allele [2] - 34:21, 34:24
alleles [3] - 34:19, 181:15
allograft [2] - 111:18, 111:24
allow [5] - 40:20, 148:3, 154:2, 154:6, 164:11
allowed [3] - 201:1, 237:1, 279:14
allows [4] - 4:11, 27:6, 67:5, 252:22
almost [3] - 48:3, 48:7, 162:20
alone [2] - 30:24, 112:18
alphabet [1] - 43:15
alternative [2] - 133:20, 133:22
altogether [1] - 118:23
amazing [1] - 167:7
Amazon [4] - 66:6, 66:19, 72:16, 121:4
amendment [2] - 158:23, 208:20
Amendment [3] - 158:23, 268:8, 279:5
amidst [1] - 34:9
amniocentesis [1] - 45:3
amount [18] - 45:6, 50:18, 68:12, 80:2, 97:9, 97:13, 115:17, 116:24, 117:3, 119:20, 125:10, 170:4, 176:9, 177:7, 188:10, 249:5, 252:18, 252:23
amounts [4] - 72:22, 200:3, 206:16, 260:1
amplicons [1] - 210:22
amplification [45] - 27:9, 28:1, 46:23, 47:2, 58:16, 64:16, 66:11, 71:15, 85:20, 85:21, 85:23, 86:3, 86:15, 86:17, 86:22, 87:4, 88:12, 88:15, 88:20, 90:9, 90:11, 90:15, 90:16, 90:22, 105:5, 202:5, 204:22, 204:25, 205:2, 205:4, 205:20, 205:21, 206:11, 206:19, 206:21, 207:14, 207:16, 208:5, 209:6, 211:3, 211:18, 237:5, 243:12, 243:21, 243:24
amplified [7] - 71:16, 87:7, 87:11, 105:11, 208:3, 210:23, 212:17
amplifies [1] - 85:21
amplify [20] - 46:12, 46:19, 86:9, 87:16, 204:13, 205:7, 205:8, 206:24, 207:10, 208:15, 243:18, 244:8, 244:19, 245:7, 245:9, 245:16, 245:17, 246:13, 246:14, 246:15
amplifying [3] - 104:22, 138:25, 209:22
analogy [4] - 48:11, 51:6, 58:20, 60:20
analysis [39] - 6:11, 16:22, 17:24, 26:24, 43:16, 45:14, 63:4, 63:9, 70:21, 72:3, 72:9, 76:7, 76:16, 76:22, 108:12, 108:25, 109:3, 120:6, 127:19, 132:9, 134:22, 134:24, 139:10, 144:21, 146:7, 152:7, 155:11, 169:9, 194:8, 197:24, 198:20, 248:21, 248:22, 248:24, 249:1, 249:4, 249:7, 257:21
analytic [4] - 23:1, 49:12, 49:15, 56:8
analytical [1] - 56:11
analytically [1] - 56:5
analyze [7] - 86:20, 86:24, 151:9, 163:14, 165:2, 165:12, 249:9
analyzed [2] - 109:5, 256:2
Analyzer [3] - 77:9, 103:5, 258:10
analyzer [2] - 97:21, 97:25
analyzing [8] - 79:15, 109:24, 120:25, 151:8, 163:13, 165:1, 165:10, 179:23
AND [1] - 1:2
ANDA [1] - 283:5
ANDREW [1] - 3:7
Andrews [1] - 47:16
Angeles [1] - 3:3
angiography [1] - 112:2
animal [1] - 64:14
ANNA [1] - 2:14
Anna [1] - 5:4
anneal [2] - 207:7, 207:9
announcement [1] - 4:22
answer [29] - 25:25, 56:13, 69:4, 70:17, 73:2, 125:18, 130:17, 135:2, 137:12, 137:25, 139:25, 140:18, 140:22, 141:2, 142:12, 167:14, 224:17, 226:16, 227:18, 231:20, 234:13, 236:1, 236:7, 241:8, 242:18, 244:21, 247:17, 254:15, 274:4
Answer [9] - 224:11, 225:8, 234:5, 234:21, 239:5, 242:2, 246:18, 252:6, 255:1
answered [2] - 137:3, 223:6
answering [2] - 41:8, 41:18
answers [2] - 71:25, 128:20
anticipate [1] - 140:23
anticipation [1] - 262:4
AnyDot [1] - 67:4
anyway [4] - 16:5, 88:5, 141:1, 282:15
apart [1] - 39:15
apologize [8] - 70:7, 74:3, 153:3, 159:20, 225:3, 282:15, 282:23
appeal [5] - 7:9, 12:13, 12:23, 14:11, 274:19
appear [10] - 68:20, 134:8, 144:19, 227:5, 227:6, 228:4, 228:12, 228:19, 244:2, 261:3
APPEARANCES [2] - 2:1, 3:1
Appendix [1] - 257:9
appends [1] - 42:6
applicability [1] - 144:21
applicable [4] - 43:24, 71:18, 139:17, 140:2
application [44] - 26:10, 26:11, 42:16, 49:8, 56:19, 63:6, 67:4, 67:19, 68:22, 72:2, 72:6, 96:8, 129:9, 129:23, 131:7, 131:18, 155:17, 184:10, 184:11, 185:14, 194:17, 194:25, 200:2, 209:10, 215:1, 216:3, 222:21, 222:22, 230:15, 235:22, 238:16, 241:14, 243:14, 253:17, 259:25, 260:19, 261:14, 261:15, 262:6, 262:19, 262:20, 263:11, 281:18, 281:20
applications [45] - 50:8, 50:11, 65:17, 66:1, 67:1, 67:2, 78:20, 93:1, 93:13, 96:8, 120:9, 130:22, 136:1, 137:3, 138:20, 148:15, 152:4, 155:4, 155:9, 165:23, 166:16, 166:17, 166:18, 167:3, 185:9, 194:24, 202:2, 206:16, 208:14, 214:18, 215:14, 215:25, 222:18, 222:20, 222:23, 223:3, 223:5, 233:22, 233:25, 237:15, 240:25, 246:25, 261:1, 262:9
Applied [3] - 84:2, 161:6, 258:10
applied [23] - 13:18, 13:20, 17:10, 37:1, 38:15, 38:16, 51:12, 56:2, 69:9, 76:8, 95:25, 123:10, 177:15, 224:24, 225:9, 260:10, 261:21, 262:5, 262:12, 262:17, 263:1, 271:23
applies [2] - 132:8, 132:10
apply [18] - 9:11, 10:1, 38:14, 44:1, 52:6, 53:6, 57:6, 65:1, 78:18, 107:1, 151:10, 163:15, 178:8, 232:3, 232:12, 232:20, 238:16, 260:7
applying [11] - 19:3, 51:21, 129:11, 230:12, 230:13, 230:14, 239:21, 247:12, 263:12, 263:13, 271:21
appointment [1] - 278:19
appointments [1] - 75:14
appreciate [2] - 8:25, 18:1
approach [25] - 21:15, 34:4, 35:14, 36:5, 41:7, 41:9, 46:18, 65:5, 67:11, 67:12, 72:11, 73:21, 74:6, 83:11, 108:20, 143:12, 168:18, 178:15, 178:24, 181:13, 181:18, 182:5, 182:8, 215:5, 216:9
approaches [14] - 35:17, 36:13, 71:1, 128:18, 171:25, 188:24, 189:1, 232:2, 232:11, 237:20, 237:25, 238:1, 238:5, 238:7
appropriate [3] - 21:19, 224:5, 242:18
appropriately [1] -

16:23
approval [1] - 155:4
approved [4] - 155:10, 158:25, 159:1, 210:25
area [5] - 34:6, 41:11, 45:5, 86:9, 258:5
areas [5] - 4:19, 46:20, 109:11, 174:17, 187:10
argue [9] - 22:22, 23:7, 137:18, 138:2, 213:15, 254:11, 255:3, 269:1, 270:15
argued [2] - 29:17, 113:8
argument [17] - 29:21, 29:22, 38:7, 40:12, 71:3, 87:22, 221:3, 248:13, 268:8, 268:9, 269:11, 269:12, 269:14, 272:1, 274:18, 275:17, 279:2
argument's [1] - 15:3
arguments [4] - 6:2, 26:6, 268:19, 279:19
Ariosa [6] - 26:14, 27:3, 27:19, 27:22, 57:25, 58:22
arisen [1] - 270:2
arises [1] - 114:25
Arka [1] - 5:10
arms [1] - 16:3
arrive [1] - 78:18
ARSHT [1] - 2:18
art [100] - 17:8, 19:4, 22:14, 25:16, 25:21, 28:5, 29:1, 31:12, 34:4, 37:6, 43:23, 46:3, 46:4, 50:6, 53:25, 54:3, 57:14, 64:24, 65:19, 67:7, 68:13, 68:15, 69:2, 69:8, 81:3, 81:7, 81:17, 83:8, 83:23, 85:11, 88:11, 88:14, 90:21, 96:18, 98:11, 99:11, 105:17, 108:9, 108:17, 108:18, 112:5, 118:24, 121:18, 122:3, 122:6, 126:17, 133:4, 135:13, 135:24, 136:6, 140:1, 141:10, 141:15, 143:3, 143:10, 143:17, 143:24, 144:6, 144:11, 157:15, 169:18, 172:14, 173:18, 176:12, 180:16, 185:11, 185:24, 189:6, 195:1, 209:21, 224:23, 229:10, 232:3, 232:12, 232:15, 236:20, 236:25, 237:1, 241:13, 241:16, 242:3, 242:21, 243:5, 243:20, 244:1, 245:6, 245:14, 246:12, 250:19, 250:23, 251:2, 251:4, 251:5, 251:11, 253:13, 253:21, 265:4, 265:17, 267:1, 272:2
article [37] - 42:18, 71:7, 106:6, 125:14, 126:1, 126:7, 135:16, 151:18, 151:19, 152:15, 153:15, 153:18, 153:24, 154:8, 155:1, 157:19, 157:21, 159:18, 162:11, 162:19, 163:8, 163:9, 166:19, 173:25, 179:1, 190:14, 193:10, 197:16, 208:4, 215:7, 217:2, 220:4, 220:7, 220:15, 221:12, 226:8
articles [7] - 211:6, 217:1, 217:2, 217:4, 217:5, 217:10, 225:16
articulately [1] - 64:5
artisan [1] - 138:21
artisans [3] - 125:14, 126:14, 207:19
aside [1] - 265:8
aspect [3] - 127:4, 205:22, 221:18
aspects [5] - 69:23, 120:25, 138:11, 139:2, 193:6
assay [7] - 84:10, 112:10, 148:21, 218:7, 218:21, 219:1
assays [1] - 181:17
asserted [23] - 163:2, 195:11, 213:2, 217:22, 221:23, 227:5, 227:16, 227:22, 228:5, 228:13, 228:19, 228:23, 231:5, 238:21, 239:2, 239:19, 241:6, 243:3, 244:7, 244:18, 246:7, 248:25, 249:2
assess [1] - 201:24
assessment [4] - 4:15, 6:10, 104:1, 183:1
assigns [1] - 103:24
associate [1] - 5:17
associated [10] - 72:23, 94:16, 170:5, 170:12, 174:25, 176:12, 177:10, 194:19, 206:20, 214:17
associating [1] - 260:12
assume [10] - 9:9, 15:1, 15:3, 35:24, 44:1, 67:6, 103:15, 125:25, 143:21, 271:9
assumed [1] - 152:12
assuming [2] - 14:12, 17:3
attacked [1] - 126:12
attacking [1] - 108:3
attacks [1] - 115:9
attempt [2] - 43:3, 171:12
attempted [1] - 127:4
attempts [2] - 171:9, 176:12
attend [1] - 113:1
attendant [1] - 16:16
attention [3] - 137:14, 235:9, 276:16
attorney [1] - 131:21
attractions [1] - 9:18
attribute [1] - 259:9
auction [1] - 42:3
Auer [1] - 197:16
authenticity [1] - 10:9
author [1] - 149:21
authored [2] - 126:19, 127:3
authority [2] - 21:8, 267:19
authors [4] - 160:1, 163:10, 173:6, 192:24
automated [2] - 220:24, 221:5
automation [1] - 220:25
availability [7] - 127:2, 158:11, 158:15, 189:8, 196:17, 196:21, 199:23
available [34] - 28:1, 28:7, 28:23, 65:16, 78:9, 84:5, 92:20, 93:14, 96:1, 97:23, 103:6, 108:5, 110:23, 112:3, 119:13, 122:17, 134:11, 135:20, 145:9, 149:1, 154:1, 189:15, 189:18, 196:22, 197:2, 198:4, 199:19, 222:7, 222:12, 222:13, 222:14, 222:15, 224:18, 241:2
avoid [2] - 63:12, 115:23
aware [12] - 68:1, 93:17, 143:10, 207:19, 207:21, 208:13, 217:17, 219:4, 219:19, 227:11, 275:4, 278:13
awhile [1] - 123:14

B

B-112 [1] - 179:13
B-113 [1] - 180:7
B-324 [1] - 204:19
B.J [1] - 13:10
B.S [1] - 50:6
B1 [6] - 126:21, 126:25, 180:22, 180:25, 181:4, 181:25
B1-12 [1] - 182:20
B1-15 [1] - 187:17
B1-17 [1] - 187:15
B15 [2] - 213:5
B18 [2] - 149:20, 151:16
B2 [4] - 176:22, 217:21, 219:23, 219:25
B3 [1] - 174:8
B40 [1] - 142:3
B46 [1] - 141:22
B5 [1] - 39:25
B52 [1] - 142:3
baby [1] - 35:4
bachelor's [3] - 46:4, 95:1, 119:14
background [7] - 33:13, 127:10, 127:25, 146:8, 169:13, 172:3, 202:23
bacteria [1] - 237:23
bad [2] - 63:23, 71:16
balls [1] - 277:21
bankrupt [2] - 146:21, 146:24
barrier [1] - 214:25
base [17] - 69:25, 82:22, 82:23, 89:9, 95:18, 95:19, 99:19, 99:21, 101:9, 103:24, 104:1, 122:13, 197:25, 205:13, 205:19, 250:6
based [21] - 15:18, 24:20, 28:16, 36:2, 71:1, 84:7, 101:20, 116:8, 116:25, 122:12, 137:7, 172:10, 172:11, 172:14, 173:19, 174:21, 192:24, 206:3, 212:19, 215:5, 221:3
bases [16] - 77:6, 82:9, 82:20, 82:23, 86:4, 93:18, 103:24, 114:16, 114:17, 114:20, 148:10, 164:15, 164:16, 191:3, 205:19
basic [11] - 42:8, 67:20, 91:11, 97:3, 130:14, 150:16, 160:8, 179:15, 179:22, 186:24
basis [5] - 95:3, 108:5, 166:25, 215:15, 268:7
bear [1] - 11:4
beautiful [1] - 41:6
became [10] - 92:20, 135:20, 175:2, 195:25, 202:2, 214:15, 220:25, 221:5, 258:12
become [3] - 41:20, 155:10, 213:11
BEFORE [1] - 1:22
began [3] - 31:18, 216:25, 256:15
begin [2] - 167:22, 275:18
beginning [4] - 4:4, 5:20, 103:6, 180:17
begins [1] - 163:17
behalf [4] - 5:2, 5:15,

18:13, 20:23
behind [1] - 264:19
below [1] - 257:22
bench [10] - 9:1, 9:11, 12:5, 13:5, 15:6, 15:10, 16:9, 16:18, 17:3, 64:7
benefit [5] - 138:4, 198:20, 226:10, 273:25, 274:11
Bernard [1] - 210:4
best [9] - 12:7, 15:14, 17:5, 17:6, 52:6, 115:24, 130:18, 199:2, 276:2
beta [1] - 46:1
better [8] - 17:12, 73:4, 98:16, 99:4, 195:17, 241:19, 264:1, 275:15
between [33] - 22:5, 32:17, 38:2, 46:22, 50:19, 82:21, 82:23, 85:5, 86:8, 86:12, 91:6, 100:4, 101:9, 104:5, 109:6, 109:22, 110:14, 125:5, 153:21, 169:25, 172:8, 174:17, 181:16, 205:25, 206:23, 250:6, 250:7, 256:16, 256:21, 256:22, 256:23, 258:24
beyond [7] - 15:1, 34:16, 85:10, 148:18, 259:24, 274:20, 279:14
bias [18] - 152:16, 164:3, 164:4, 226:22, 226:25, 227:4, 227:6, 238:18, 238:22, 239:4, 239:6, 239:22, 240:5, 240:7, 240:8, 240:10, 240:12, 240:16
biases [10] - 68:20, 144:19, 164:4, 164:10, 190:17, 226:5, 226:12, 226:13, 239:25, 259:17
big [3] - 100:14, 230:9, 256:20
billion [3] - 86:4, 114:17, 114:20
binder [18] - 74:19, 74:20, 74:22, 74:25, 75:2, 126:23, 126:25, 130:13, 140:7, 140:8, 142:6, 144:14, 152:16, 152:21, 152:24, 216:10, 216:16, 228:8
binders [5] - 73:19, 124:14, 124:16, 140:9, 216:12
binding [1] - 14:21
bing [5] - 68:23
binoculars [3] - 52:11, 52:13, 52:16
biochemistry [1] - 122:1
biologic [2] - 192:2, 192:4
biological [8] - 41:12, 71:20, 116:16, 151:11, 163:16, 187:2, 192:8, 192:9
Biology [1] - 75:16
biology [9] - 97:3, 122:1, 122:2, 139:14, 179:23, 185:10, 186:18, 192:13, 192:21
biomarkers [1] - 72:23
biomedical [1] - 75:19
biomolecules [1] - 183:19
biopsies [2] - 170:9
Biostatistics [1] - 75:13
Biosystem [1] - 258:10
Biosystems [3] - 84:2, 134:14, 161:7
bit [7] - 19:23, 110:25, 126:21, 189:4, 199:25, 208:9, 229:21
Blatmann [2] - 281:20, 282:3
blind [5] - 245:22, 245:24, 246:2, 246:21, 247:22
blood [14] - 40:5, 58:5, 128:23, 245:23, 245:25, 246:2, 246:21, 247:3, 247:13, 247:22, 247:23, 248:5, 253:14, 263:2
bloodstream [9] - 35:6, 35:7, 97:9, 97:14, 107:16, 114:24, 115:2, 125:6, 171:7
blow [8] - 141:23, 173:5, 183:23, 187:19, 190:11, 198:7, 209:14, 258:7
blown [1] - 186:8
blueprint [1] - 114:13
BOARD [2] - 1:4, 1:10
board [2] - 141:19, 146:4
bodily [1] - 33:23
body [15] - 97:4, 97:14, 100:17, 107:13, 114:14, 115:2, 115:4, 115:6, 115:12, 115:20, 115:25, 120:12, 125:1, 127:10
body's [1] - 115:8
boil [1] - 38:6
boilerplate [1] - 64:14
book [1] - 100:14
booklets [1] - 100:14
borrowing [1] - 6:17
Boston [1] - 3:17
bottom [5] - 47:12, 66:3, 197:17, 218:2, 264:18
bought [4] - 92:10, 103:7, 196:8, 196:12
bound [3] - 23:6, 105:7, 112:16
box [3] - 94:24, 165:6, 195:5
boy [1] - 39:13
bracketed [1] - 86:7
brain [1] - 77:16
BRCA1 [1] - 148:24
break [7] - 71:3, 114:22, 123:22, 124:1, 167:23, 167:24
breaking [2] - 50:9, 72:5
breaks [1] - 114:21
breast [3] - 72:23, 77:17, 109:11
Brian [2] - 5:2, 169:1
BRIAN [2] - 2:3, 168:12
brief [7] - 14:14, 20:24, 137:7, 137:9, 272:12, 273:14, 277:4
briefing [12] - 9:25, 12:11, 12:12, 14:16, 20:16, 29:11, 273:4, 274:1, 274:2, 275:25, 276:14, 277:19
briefly [5] - 21:23, 171:3, 176:3, 205:11, 212:11
briefs [2] - 137:14, 277:5
Brigham [1] - 75:18
bring [44] - 47:10, 52:1, 140:22, 172:19, 173:4, 174:7, 175:25, 176:22, 179:13, 180:6, 180:7, 180:22, 182:20, 183:5, 183:10, 184:9, 184:14, 185:3, 185:16, 186:1, 186:4, 186:6, 187:15, 189:23, 192:22, 193:23, 197:3, 197:12, 197:18, 204:19, 207:23, 208:18, 208:22, 208:23, 209:7, 210:14, 213:5, 213:18, 214:11, 215:7, 215:8, 251:20, 257:9
bringing [1] - 7:20
brings [1] - 28:13
broad [2] - 130:4, 279:22
Broad [1] - 183:18
broader [2] - 34:24, 144:21
broadly [1] - 45:4
broken [1] - 120:24
brought [3] - 38:13, 259:21, 276:16
buffers [1] - 179:23
building [1] - 4:19
built [1] - 201:10
bunch [1] - 33:20
burden [2] - 275:20, 275:23
burdened [2] - 194:18, 195:3
Burke [3] - 11:23, 55:14, 62:3
Burke's [1] - 276:14
business [4] - 63:21, 102:19, 197:6
buy [7] - 45:18, 46:1, 55:16, 84:8, 100:9, 119:10
buying [3] - 17:14, 61:18, 145:13
BY [61] - 2:3, 2:6, 2:10, 2:14, 2:19, 2:22, 3:3, 3:7, 3:12, 3:16, 3:20, 74:12, 74:24, 80:17, 88:10, 101:6, 114:4, 124:20, 130:10, 131:15, 132:18, 138:10, 141:5, 142:18, 151:20, 152:25, 154:17, 156:3, 168:23, 174:4, 174:9, 180:8, 181:3, 182:21, 183:24, 184:15, 185:5, 186:10, 187:21, 189:25, 190:12, 197:14, 197:20, 198:8, 204:18, 207:25, 208:25, 209:8, 209:16, 213:20, 214:9, 216:20, 234:16, 235:16, 235:25, 240:3, 242:20, 255:19, 256:13, 257:11, 259:14

C

C-31 [1] - 208:18
C-31-8 [1] - 208:22
C.V [1] - 146:17
C1 [1] - 140:6
C13 [2] - 214:11, 214:12
C13-8 [1] - 214:21
C14 [3] - 189:23, 190:1, 226:8
C14-8 [1] - 190:10
C14-9 [1] - 192:22
C17 [2] - 197:12, 197:15
C17-8 [1] - 199:3
C17-9 [1] - 198:6
C18 [1] - 157:19
C20 [1] - 178:25
C21 [2] - 186:1
C21-47 [1] - 186:4
C22 [2] - 185:13
C22-18 [1] - 185:16
C23 [3] - 183:16, 183:22
C23-21 [1] - 183:22
C23-28 [1] - 183:22
C24 [2] - 184:9
C24-12 [1] - 184:14
C25 [3] - 183:21, 184:21
C25-18 [1] - 185:4
C26 [2] - 183:5
C26-5 [1] - 183:10
C29 [2] - 144:12, 144:15

C29-9 [1] - 193:23
C30-1 [1] - 197:3
C32 [2] - 209:7, 209:9
C32-8 [1] - 209:13
C42 [3] - 210:3, 210:14
C5 [4] - 172:19, 255:20, 256:4
C5-3 [1] - 173:4
calendar [1] - 281:14
California [6] - 2:7, 2:11, 2:23, 3:3, 3:8, 3:21
callout [1] - 119:7
callouts [1] - 92:5
Cancer [5] - 75:15, 75:16, 76:12, 76:15, 169:7
cancer [16] - 72:24, 77:17, 97:7, 109:3, 109:10, 109:12, 110:18, 161:16, 166:1, 166:2, 166:3, 166:9, 167:11, 169:8, 253:5
cancers [1] - 169:10
candid [1] - 64:11
cannot [4] - 5:21, 22:22, 23:3, 281:1
Cantor [8] - 72:1, 72:2, 72:13, 133:19, 133:25, 135:25, 136:23, 136:25
capabilities [1] - 198:3
capable [1] - 111:21
carcinoma [1] - 72:23
card [1] - 162:9
cardiac [3] - 111:8, 111:18, 111:23
Cardionet [1] - 25:5
care [1] - 246:3
CAREDX [2] - 1:4, 1:10
CareDx [10] - 2:16, 22:7, 22:21, 24:25, 27:25, 28:4, 39:25, 113:10, 124:24, 126:6
CareDx's [3] - 29:2, 112:20, 159:6
career [1] - 276:6
careful [3] - 41:8, 235:14, 266:8
Carlinsky [1] - 282:7
carries [1] - 110:7
carry [3] - 28:7, 254:4, 255:3
case [73] - 6:7, 6:11, 6:13, 6:16, 6:17, 6:19, 6:20, 12:15, 12:17, 12:24, 13:10, 13:14, 13:17, 13:25, 23:14, 23:24, 24:6, 25:5, 27:3, 27:12, 27:19, 27:20, 28:14, 30:7, 33:23, 35:11, 38:24, 49:1, 49:3, 51:15, 52:6, 53:6, 57:25, 60:15, 66:9, 66:10, 75:5, 77:21, 97:21, 99:18, 100:2, 101:3, 104:5, 111:17, 112:21, 113:2, 127:12, 129:5, 133:2, 133:9, 134:17, 141:17, 142:25, 153:13, 163:2, 171:17, 187:14, 210:12, 212:5, 212:10, 257:1, 262:18, 266:17, 268:18, 275:16, 278:11, 280:18, 281:13, 282:23, 283:3
cases [10] - 26:14, 27:15, 28:8, 63:21, 63:22, 170:20, 207:1, 207:2, 281:25
catalogued [1] - 85:1
categories [1] - 59:19
cattle [2] - 72:19, 120:7
caused [1] - 200:9
CAV [1] - 111:8
caveat [2] - 235:9, 235:11
CDC [2] - 4:9, 105:23
CDC's [1] - 4:22
cell [184] - 26:12, 27:10, 30:9, 30:20, 33:5, 34:6, 39:15, 40:4, 40:6, 41:19, 41:24, 43:9, 43:15, 43:20, 44:1, 44:24, 45:14, 46:6, 46:12, 56:2, 56:9, 56:19, 58:5, 60:1, 61:16, 63:16, 64:15, 65:7, 68:12, 72:24, 76:22, 77:15, 77:16, 78:20, 78:21, 79:18, 79:23, 80:2, 80:21, 80:24, 81:4, 81:9, 81:14, 81:16, 81:22, 82:7, 91:3, 96:14, 96:22, 96:23, 96:25, 97:1, 97:5, 102:16, 104:20, 107:7, 107:9, 107:12, 107:18, 107:22, 108:1, 108:3, 108:7, 108:10, 108:22, 109:14, 109:23, 110:2, 114:7, 114:10, 114:11, 114:14, 114:21, 114:22, 114:23, 114:25, 115:1, 115:3, 115:4, 115:5, 116:8, 116:9, 116:11, 116:13, 116:24, 117:3, 117:6, 117:15, 117:17, 117:19, 117:25, 118:6, 118:8, 118:9, 118:12, 118:18, 120:22, 120:24, 121:10, 121:13, 121:14, 121:19, 122:2, 123:4, 124:25, 125:3, 125:10, 125:13, 126:12, 128:23, 129:20, 130:21, 130:23, 133:15, 135:6, 135:10, 136:1, 138:11, 138:23, 139:1, 139:3, 139:9, 139:17, 140:3, 140:12, 141:6, 156:6, 156:12, 156:15, 158:11, 159:6, 169:2, 170:4, 171:2, 171:4, 171:7, 171:10, 171:13, 171:18, 171:19, 173:10, 173:15, 173:21, 174:20, 175:1, 175:7, 175:10, 176:9, 176:13, 177:6, 177:11, 178:5, 185:14, 185:15, 192:18, 192:19, 200:3, 208:15, 214:24, 224:4, 224:10, 224:16, 230:15, 232:17, 232:18, 245:8, 245:10, 245:16, 245:18, 246:4, 246:15, 246:16, 248:17, 250:16, 252:19, 253:15, 255:24, 263:2, 271:22
cell-free [166] - 26:12, 27:10, 30:9, 30:20, 33:5, 34:6, 40:4, 41:19, 41:24, 43:9, 43:15, 43:20, 44:1, 44:24, 45:14, 46:6, 46:12, 56:2, 56:9, 56:19, 58:5, 60:1, 61:16, 63:16, 65:7, 68:12, 72:24, 76:22, 77:15, 77:16, 78:20, 78:21, 79:18, 79:23, 80:2, 80:21, 80:24, 81:4, 81:9, 81:14, 81:16, 81:22, 91:3, 96:14, 96:22, 96:23, 96:25, 97:1, 97:5, 102:16, 104:20, 107:7, 107:9, 107:12, 107:18, 107:22, 108:1, 108:3, 108:7, 108:10, 108:22, 109:14, 109:23, 110:2, 114:7, 114:10, 114:11, 114:25, 115:3, 115:4, 115:5, 116:8, 116:9, 116:11, 116:13, 116:24, 117:3, 117:6, 117:15, 117:17, 117:19, 117:25, 118:6, 118:8, 118:9, 118:12, 118:18, 120:22, 120:24, 121:10, 121:13, 121:14, 121:19, 123:4, 124:25, 125:3, 125:10, 125:13, 126:12, 128:23, 129:20, 130:21, 130:23, 133:15, 135:6, 135:10, 136:1, 138:11, 138:23, 139:1, 139:3, 139:9, 139:17, 140:3, 140:12, 141:6, 156:6, 156:12, 156:15, 158:11, 159:6, 170:4, 171:2, 171:4, 171:7, 171:10, 171:13, 171:18, 173:10, 173:15, 173:21, 174:20, 175:1, 175:7, 175:10, 176:9, 176:13, 177:6, 177:11, 178:5, 200:3, 208:15, 214:24, 224:4, 224:10, 224:16, 230:15, 232:17, 232:18, 245:8, 245:10, 245:16, 245:18, 246:4, 246:15, 246:16, 248:17, 250:16, 252:19, 253:15, 255:24, 263:2, 271:22
cells [12] - 97:4, 97:8, 107:25, 108:4, 109:17, 109:18, 109:21, 115:5, 115:13, 117:2, 171:5
cellular [10] - 43:13, 43:24, 138:22, 139:2, 139:8, 139:17, 140:2, 156:6, 156:13, 156:15
Center [1] - 75:15
center [3] - 75:19, 169:6, 200:6
centers [1] - 77:3
ceratin [1] - 104:4
certain [17] - 26:17, 27:7, 52:13, 52:14, 84:23, 93:17, 132:9, 139:20, 140:4, 140:5, 142:24, 179:5, 199:19, 233:22, 233:24, 240:25, 243:22
certainly [17] - 21:10, 46:3, 59:21, 75:10, 75:25, 77:2, 79:15, 80:5, 82:5, 84:1, 134:9, 138:8, 172:13, 206:15, 211:7, 247:7, 247:12
certified [2] - 158:19, 158:22
Cf [1] - 43:15
CFC)(CJB [2] - 1:9, 1:15
cfDNA [2] - 43:13, 43:24
chain [6] - 50:23, 85:25, 213:22, 214:1, 214:11, 214:23
chair [3] - 154:19, 169:4, 169:7
Chair [1] - 75:12
challenge [5] - 70:25, 71:7, 165:20, 215:4, 268:7
challenged [1] - 12:9
challenges [10] - 152:7, 152:11,

152:12, 170:12, 170:15, 172:14, 174:25, 176:11, 177:10, 206:20
challenging [4] - 138:12, 159:4, 166:4, 267:20
Chan [1] - 75:17
chance [2] - 4:21, 101:1
change [4] - 67:24, 104:12, 122:21, 158:16
changed [5] - 4:18, 67:19, 150:15, 159:4, 160:7
changes [4] - 68:12, 130:24, 253:6, 274:4
channels [3] - 98:21, 98:22, 98:24
chapter [1] - 33:21
characteristics [3] - 97:21, 139:7, 146:6
characterize [1] - 18:11
characterized [1] - 230:25
characterizing [1] - 20:4
charity [1] - 76:19
chart [3] - 68:5, 141:15, 141:18
Chatterjee [1] - 5:11
chemical [3] - 41:12, 184:12, 186:23
chemistries [1] - 146:10
chemistry [5] - 122:1, 146:8, 146:9, 179:22, 185:10
chemotherapy [1] - 167:13
child [2] - 27:11, 110:7
chimeric [1] - 173:9
chimers [1] - 86:7
chip [2] - 84:7, 84:9
chip-based [1] - 84:7
chips [1] - 84:8
choice [1] - 7:6
chose [1] - 201:13
chromosome [17] - 34:8, 34:13, 127:8, 127:9, 127:24, 171:16, 171:18, 172:2, 172:4, 172:23, 173:12, 180:13, 180:15, 181:8, 181:22, 209:11, 256:9
chromosomes [5] - 114:15, 114:19, 127:7, 174:18
Circuit [18] - 6:7, 6:13, 6:18, 8:5, 8:8, 12:13, 12:14, 12:24, 13:17, 14:20, 14:21, 19:22, 132:1, 132:8, 274:8, 274:14, 275:15, 278:14
circulating [26] - 76:16, 77:17, 96:23, 108:25, 109:3, 109:12, 109:13, 109:14, 109:16, 117:15, 117:17, 117:19, 118:5, 118:8, 118:9, 124:25, 125:12, 128:23, 129:11, 130:21, 174:14, 177:2, 249:6, 253:5, 253:9
circulation [1] - 109:22
circumspect [1] - 201:11
circumstance [1] - 181:21
circumstances [6] - 15:12, 15:15, 17:19, 243:22, 252:11, 252:12
circumvents [1] - 182:9
citable [1] - 28:6
citations [2] - 152:4, 178:18
cite [7] - 134:8, 134:11, 134:14, 136:22, 147:16, 147:20, 242:2
cited [11] - 7:4, 19:12, 89:14, 105:21, 127:15, 135:23, 141:12, 143:25, 144:1, 178:20, 183:15
cites [3] - 33:3, 68:15, 149:11
citing [2] - 28:6, 144:5
CIVIL [2] - 1:4, 1:10
claim [108] - 28:18, 30:13, 51:17, 54:17, 54:21, 54:23, 57:11, 57:12, 57:15, 58:25, 60:6, 61:24, 62:5, 68:24, 69:4, 79:12, 80:3, 80:5, 80:7, 80:25, 81:1, 82:1, 84:11, 85:17, 85:19, 87:6, 89:1, 89:15, 89:16, 91:3, 94:15, 96:20, 111:5, 112:4, 112:24, 113:5, 113:9, 113:12, 114:2, 114:5, 116:3, 117:4, 117:12, 117:14, 117:23, 118:3, 118:4, 118:16, 128:22, 129:7, 169:22, 174:7, 174:10, 174:12, 174:13, 175:4, 175:25, 176:2, 176:4, 176:22, 176:23, 176:24, 177:20, 182:7, 188:12, 204:20, 204:24, 213:19, 217:21, 218:5, 218:6, 218:19, 227:25, 228:2, 228:15, 228:16, 228:17, 228:20, 228:22, 229:12, 230:22, 231:5, 231:12, 232:22, 233:2, 233:8, 237:4, 238:12, 242:8, 248:9, 249:3, 249:10, 249:12, 250:2, 254:13, 258:23, 263:20, 263:23, 267:1, 270:4, 270:15, 270:16, 280:20
claimed [28] - 22:17, 23:20, 26:23, 26:24, 27:7, 28:24, 29:4, 29:24, 30:16, 56:25, 66:21, 71:19, 77:22, 101:22, 118:24, 120:14, 121:18, 122:11, 129:3, 133:3, 133:10, 156:22, 156:23, 179:17, 205:22, 254:4, 260:23, 261:20
claiming [16] - 32:20, 33:17, 42:7, 54:1, 54:7, 54:8, 55:10, 55:19, 57:1, 58:8, 59:4, 60:22, 61:24, 64:19, 71:24, 128:25
claims [164] - 29:8, 29:10, 29:12, 29:13, 29:14, 29:24, 44:5, 46:10, 49:16, 54:18, 55:25, 58:4, 72:25, 78:5, 78:25, 79:10, 79:14, 79:16, 81:4, 81:8, 81:11, 82:1, 83:9, 83:15, 83:18, 84:15, 84:22, 85:13, 86:22, 87:9, 87:13, 87:18, 87:23, 88:1, 88:8, 88:22, 90:4, 91:25, 97:17, 100:8, 100:24, 101:4, 105:19, 106:2, 109:15, 111:25, 112:4, 113:8, 113:10, 113:14, 113:15, 117:23, 118:22, 120:21, 121:12, 122:15, 129:1, 129:8, 129:22, 130:15, 130:18, 131:17, 132:21, 134:6, 139:21, 149:7, 149:9, 156:4, 156:10, 157:7, 157:16, 157:22, 158:8, 158:16, 169:13, 169:20, 176:6, 179:21, 217:22, 218:10, 218:11, 224:22, 225:6, 225:8, 226:12, 226:18, 226:21, 226:23, 226:24, 227:2, 227:4, 227:5, 227:6, 227:8, 227:10, 227:12, 227:13, 227:14, 227:16, 227:20, 227:22, 228:5, 228:13, 228:19, 229:8, 229:10, 229:14, 229:15, 229:17, 229:24, 230:1, 231:10, 232:23, 236:5, 236:6, 238:13, 238:21, 239:2, 239:12, 240:4, 240:6, 240:9, 240:10, 240:15, 240:17, 240:18, 240:19, 240:20, 241:5, 241:16, 241:24, 242:1, 243:11, 243:17, 243:19, 243:23, 244:3, 244:4, 245:25, 247:6, 247:11, 248:25, 249:2, 249:10, 249:20, 250:24, 252:17, 253:1, 253:3, 254:11, 259:18, 259:20, 259:22, 263:15, 266:23, 270:6
clairvoyance [1] - 22:2
clarification [1] - 57:19
clarify [4] - 32:23, 79:3, 101:23, 196:3
class [2] - 58:3, 166:13
classic [1] - 9:17
clean [1] - 234:14
cleanup [1] - 9:21
clear [18] - 6:8, 8:24, 13:22, 15:25, 19:21, 30:24, 33:4, 54:7, 54:8, 55:18, 59:5, 69:16, 70:10, 107:22, 139:24, 187:7, 228:18, 263:9
clearly [7] - 6:3, 13:7, 31:15, 55:12, 172:17, 181:20, 266:23
clerk [1] - 283:3
clerks [1] - 283:4
Cleveland [1] - 26:14
CLIA [1] - 158:22
click [2] - 66:5, 66:19
clicking [1] - 72:16
client [2] - 21:10, 47:15
client's [1] - 279:17
Clinic [1] - 26:14
clinic [2] - 155:15, 158:21
clinical [16] - 67:20, 111:14, 150:16, 155:4, 155:9, 155:17, 158:11, 158:15, 158:19, 158:22, 159:4, 160:8, 165:23, 172:20, 215:14, 215:17
clinically [2] - 155:10, 167:9
clonal [1] - 92:9
cloning [2] - 64:15, 186:17
close [3] - 9:22, 207:3, 213:13
closed [1] - 10:17
closely [2] - 13:7, 283:3
co [3] - 154:22, 160:1, 163:10

co-authors [2] - 160:1, 163:10
co-published [1] - 154:22
coded [1] - 30:2
cognizant [2] - 80:10, 271:14
collaborated [1] - 45:17
colleague [3] - 31:5, 152:18, 153:1
colleague's [1] - 6:10
colleagues [1] - 178:6
collected [1] - 103:22
collection [4] - 77:5, 82:7, 89:20, 152:10
colloquial [2] - 42:9, 219:11
COLM [1] - 1:22
colon [2] - 166:9, 167:11
color [1] - 30:2
column [26] - 33:3, 92:22, 92:23, 121:22, 126:22, 141:25, 142:19, 143:12, 150:24, 154:25, 179:4, 179:13, 180:7, 180:22, 180:25, 181:4, 181:25, 182:12, 183:22, 185:16, 186:4, 187:1, 187:17, 187:18, 219:22, 253:18
combination [50] - 48:8, 49:16, 51:23, 51:25, 52:24, 56:1, 56:2, 56:3, 56:15, 56:18, 61:1, 61:6, 63:13, 63:18, 70:3, 78:1, 78:16, 78:17, 118:24, 119:1, 120:10, 122:24, 135:1, 175:2, 175:12, 175:20, 175:22, 176:20, 177:9, 177:19, 177:25, 224:24, 225:2, 225:10, 226:17, 232:4, 241:20, 248:13, 252:22, 254:6, 254:7, 260:2, 260:4, 260:6, 260:7, 261:19, 262:20, 263:22, 271:22
combinations [3] - 89:21, 120:14, 123:3
combine [1] - 65:1
combined [1] - 62:1
comfortable [4] - 6:9, 48:2, 268:16, 276:1
coming [13] - 9:18, 80:21, 100:16, 101:1, 173:12, 189:15, 246:3, 260:1, 271:21, 276:12, 278:5, 280:21, 281:8
comma [1] - 137:24
commenced [1] - 4:3
comment [6] - 6:17, 13:15, 131:25, 210:17, 255:5, 264:2
commenting [1] - 251:22
commercial [24] - 22:16, 22:20, 25:9, 25:20, 77:8, 83:12, 88:25, 92:7, 92:8, 93:11, 95:23, 95:24, 122:17, 122:23, 135:20, 135:23, 149:18, 151:25, 156:8, 156:16, 197:7, 201:6, 223:13
commercially [15] - 28:1, 28:7, 28:23, 78:9, 84:4, 92:20, 93:14, 97:22, 103:6, 134:10, 199:18, 222:7, 222:12, 222:14, 222:15
committee [1] - 169:5
common [16] - 30:1, 34:5, 48:6, 82:13, 82:21, 85:5, 170:8, 185:8, 185:10, 185:22, 185:24, 191:4, 192:15, 205:14, 205:17, 276:5
commonality [1] - 216:3
communicated [1] - 100:11
communicates [1] - 51:6
communication [1] - 73:4
companies [7] - 11:7, 45:6, 159:2, 197:1, 201:4, 223:11, 223:13
company [12] - 45:4, 84:2, 92:6, 92:14, 109:9, 134:13, 146:20, 146:24, 147:5, 194:2, 196:1, 212:6
compare [4] - 102:14, 160:23, 184:5, 201:7
compared [3] - 111:7, 207:17, 248:5
compares [1] - 28:12
compelling [1] - 17:10
competing [5] - 7:5, 8:7, 12:19, 13:1, 274:10
complementary [1] - 207:8
complete [1] - 168:5
completely [3] - 8:13, 108:12, 116:1
completion [1] - 16:17
complex [3] - 68:9, 143:12, 148:5
complexities [1] - 194:10
complexity [1] - 194:7
complicate [2] - 172:5, 181:9
complicated [4] - 41:11, 46:13, 71:21, 154:13
complication [2] - 35:3, 36:3
component [4] - 233:4, 250:14, 260:9, 263:7
components [2] - 79:16, 190:18
composed [1] - 91:14
compositions [1] - 186:24
comprise [1] - 89:4
comprised [2] - 91:21, 219:2
comprises [3] - 218:1, 218:7, 218:25
comprising [4] - 85:22, 95:7, 114:7
compromise [1] - 187:11
Computational [1] - 75:16
computer [1] - 42:4
computing [2] - 160:24
concentration [3] - 31:21, 125:23, 140:24
concentrations [6] - 43:16, 43:20, 139:10, 140:13, 141:7, 141:8
concept [8] - 47:10, 56:12, 63:8, 171:2, 204:15, 206:18, 249:23, 250:13
conceptually [1] - 258:17
concerned [2] - 7:19, 245:11
concerns [1] - 276:20
concise [1] - 208:10
conclude [6] - 15:4, 173:7, 189:2, 192:24, 210:21, 211:7
concluded [3] - 42:11, 199:10, 283:11
conclusion [9] - 20:5, 32:3, 32:12, 173:5, 173:14, 215:6, 261:20, 266:11
conclusions [4] - 9:5, 10:1, 192:23, 274:2
concurrent [1] - 173:2
condition [2] - 242:4, 242:14
conduct [3] - 54:18, 268:18, 270:16
conducting [1] - 271:3
conference [2] - 7:11
confession [3] - 64:20, 64:21
confidence [1] - 268:5
confident [1] - 61:23
configurable [1] - 147:24
configured [1] - 147:12
confined [1] - 14:6
conflicting [2] - 6:8, 12:20
conflicts [2] - 47:1, 48:24
confusing [1] - 20:5
confusion [1] - 196:5
connection [6] - 10:15, 15:20, 84:16, 85:13, 214:23, 257:5
connectivity [1] - 21:13
Connolly [2] - 57:5, 57:7
CONNOLLY [1] - 1:22
conscious [2] - 214:7, 239:17
consensus [8] - 70:11, 198:13, 198:16, 199:1, 199:7, 206:3, 240:1, 264:10
conservative [1] - 259:3
consider [10] - 7:10, 132:20, 135:18, 173:20, 193:14, 200:6, 217:14, 255:13, 255:14, 274:18
consideration [2] - 35:16, 206:13
considerations [1] - 63:10
considered [5] - 78:2, 135:3, 175:24, 199:10, 216:4
consist [1] - 166:24
consistency [1] - 248:12
consistent [7] - 97:20, 104:9, 173:17, 235:6, 235:12, 242:13, 252:16
constitute [1] - 89:13
constitutional [1] - 279:17
construction [6] - 242:8, 270:5, 270:16, 271:9, 280:20
contain [1] - 94:19
contained [1] - 269:17
containing [2] - 80:24, 212:19
contains [4] - 49:7, 86:5, 87:1, 104:24
contemporaneous [1] - 48:8
contemporaneously [1] - 197:22
contention [1] - 21:6
context [27] - 9:11, 9:22, 10:11, 19:20, 56:19, 91:22, 105:18, 135:11, 139:19, 140:15, 200:23, 208:15, 224:18, 224:19, 225:20, 226:7, 235:23, 238:13, 238:15, 260:17, 260:24, 261:11, 262:13, 262:18, 265:3, 276:21
contexts [2] - 138:12, 139:12
Continued [1] - 3:1
continues [1] - 187:18
contradictory [1] - 255:11
contrary [3] - 44:9, 139:15, 140:1
contribute [1] - 193:6
contributed [2] - 20:5,

69:25
contributing [1] - 195:8
control [1] - 159:17
controversy [1] - 160:15
convenience [1] - 21:1
conventional [161] - 17:11, 17:14, 19:3, 22:13, 24:17, 24:23, 25:8, 25:15, 26:12, 26:15, 27:16, 28:5, 28:21, 33:11, 35:11, 42:2, 42:24, 43:25, 44:9, 44:10, 44:13, 45:10, 49:19, 49:20, 52:22, 63:1, 63:6, 69:17, 69:20, 77:25, 78:2, 78:5, 78:7, 78:19, 81:5, 81:6, 83:10, 83:11, 87:17, 88:24, 90:23, 92:21, 93:25, 94:13, 96:6, 102:3, 104:8, 105:19, 105:20, 106:1, 107:3, 108:11, 108:12, 108:14, 117:5, 118:20, 119:10, 119:16, 120:4, 120:11, 121:17, 121:25, 122:10, 122:12, 123:8, 128:19, 130:19, 134:25, 135:1, 149:7, 157:25, 158:17, 169:18, 173:22, 175:13, 175:21, 175:24, 176:20, 177:21, 177:23, 177:25, 178:14, 179:5, 179:18, 180:2, 181:11, 182:17, 182:25, 183:14, 184:2, 184:19, 187:6, 188:4, 188:8, 188:22, 189:2, 189:11, 189:20, 193:11, 193:15, 194:12, 194:15, 194:23, 195:13, 195:19, 196:19, 196:22, 198:15, 199:24, 200:2, 200:4, 200:19, 201:22, 202:1, 202:2, 206:6, 206:15, 209:24, 211:4, 211:8, 211:13, 212:22, 213:4, 213:11, 213:16, 215:24, 216:5, 222:9, 222:22, 230:4, 230:7, 230:16, 230:18, 234:4, 234:19, 234:22, 237:20, 237:25, 238:1, 238:5, 238:7, 251:13, 252:4, 253:17, 253:22, 253:23, 253:25, 254:2, 254:13, 254:15, 254:21, 255:6, 255:8, 260:23, 261:9, 261:11, 261:14, 261:21
conventionality [18] - 11:5, 17:20, 22:5, 23:2, 23:11, 23:19, 23:22, 24:1, 24:7, 24:9, 24:12, 28:15, 28:20, 43:4, 80:24, 81:24, 91:2, 107:6
conversation [2] - 201:24, 280:22
copies [8] - 86:7, 86:10, 86:19, 86:23, 87:1, 104:23, 114:17, 192:19
copy [5] - 184:22, 184:23, 184:24, 185:1, 216:15
copying [2] - 86:17, 104:21
copyright [1] - 209:11
core [1] - 145:10
coronary [1] - 112:1
correct [110] - 32:5, 38:18, 52:2, 52:25, 59:6, 123:15, 125:7, 125:25, 126:8, 126:17, 127:5, 128:8, 129:12, 129:24, 133:3, 135:10, 138:15, 138:19, 138:24, 139:4, 139:11, 139:18, 141:7, 141:11, 141:17, 141:20, 142:20, 143:14, 144:6, 145:4, 145:15, 146:22, 147:14, 148:2, 149:25, 150:20, 151:6, 152:19, 154:18, 155:7, 155:17, 186:19, 203:17, 218:4, 222:1, 222:13, 222:15, 223:3, 223:9, 224:10, 224:16, 225:7, 225:12, 225:21, 225:25, 226:3, 226:6, 228:24, 229:1, 229:7, 232:9, 233:11, 233:16, 233:22, 235:21, 236:4, 236:16, 236:17, 239:4, 241:1, 242:1, 242:7, 243:16, 243:22, 244:20, 244:22, 244:24, 245:1, 245:21, 246:17, 246:25, 247:1, 248:3, 249:11, 250:17, 251:6, 251:7, 251:15, 251:24, 252:6, 252:9, 252:20, 252:21, 253:3, 253:11, 255:24, 255:25, 256:3, 256:6, 257:6, 257:7, 260:20, 262:11, 264:20, 264:25, 265:14, 265:15, 265:17, 265:18, 269:24
correctly [2] - 126:2, 201:13
CORREDOR [1] - 3:7
Corredor [1] - 5:10
correlate [3] - 17:19, 117:7, 161:16
correlated [1] - 100:24
correlation [31] - 32:12, 32:20, 38:2, 39:23, 39:24, 40:3, 40:22, 40:23, 40:25, 42:17, 44:14, 57:13, 64:23, 64:24, 124:25, 125:5, 125:7, 126:5, 126:9, 126:16, 127:20, 129:4, 129:7, 130:16, 133:2, 133:9, 133:12, 133:14, 135:14, 136:6, 136:15
correlations [1] - 53:20
cost [19] - 67:15, 70:13, 94:5, 143:13, 145:12, 150:14, 160:6, 160:18, 160:21, 160:24, 161:2, 161:9, 161:24, 162:11, 194:7, 194:8, 195:3, 198:20, 199:8
costs [4] - 68:3, 145:8, 161:21, 194:18
couch [1] - 265:6
coughed [1] - 249:18
Counsel [3] - 2:16, 3:9, 3:22
counsel [8] - 4:23, 137:6, 149:6, 153:4, 153:19, 168:1, 229:12, 283:10
counting [3] - 105:13, 105:14, 107:19
couple [7] - 5:20, 11:12, 46:1, 71:23, 188:19, 205:11, 255:16
course [7] - 7:10, 8:14, 10:14, 23:11, 54:14, 54:16, 266:22
COURT [334] - 1:1, 4:6, 5:1, 5:5, 5:12, 5:19, 8:21, 10:23, 11:10, 11:12, 11:16, 12:1, 14:8, 14:10, 14:14, 14:19, 14:23, 14:25, 15:3, 15:7, 15:9, 15:22, 16:8, 17:13, 17:17, 18:10, 19:8, 19:11, 20:14, 20:21, 20:25, 21:4, 21:11, 21:22, 23:22, 24:2, 29:16, 29:19, 31:7, 31:9, 32:2, 32:6, 32:9, 32:11, 32:14, 32:21, 32:23, 33:1, 33:25, 35:19, 36:11, 36:17, 36:23, 37:4, 37:10, 37:12, 37:14, 37:23, 38:1, 38:10, 38:23, 39:6, 39:11, 39:21, 40:1, 40:9, 40:14, 40:19, 41:1, 41:4, 41:16, 44:7, 44:20, 45:20, 47:6, 47:12, 48:10, 48:15, 48:17, 49:22, 49:25, 50:3, 51:2, 51:5, 51:9, 51:16, 51:20, 51:24, 53:3, 53:10, 53:13, 53:24, 54:3, 54:9, 54:13, 54:15, 54:17, 54:21, 54:23, 55:2, 55:24, 56:3, 56:15, 57:19, 57:22, 58:6, 58:10, 58:17, 58:21, 58:24, 59:2, 59:22, 60:13, 60:15, 60:22, 63:25, 66:8, 66:13, 66:16, 68:24, 69:3, 73:6, 73:8, 73:12, 73:15, 73:17, 73:20, 73:22, 74:5, 74:7, 80:8, 80:13, 88:4, 88:7, 100:9, 100:16, 113:17, 113:20, 113:22, 114:1, 123:12, 123:16, 123:19, 123:21, 124:1, 124:5, 124:9, 124:15, 124:18, 129:15, 130:1, 131:2, 131:24, 132:3, 132:6, 137:5, 137:23, 138:2, 140:18, 140:21, 141:1, 142:8, 142:14, 151:14, 151:18, 153:13, 154:11, 154:16, 155:22, 155:24, 159:13, 159:15, 159:22, 159:25, 160:3, 163:1, 163:7, 166:20, 166:23, 167:5, 167:18, 167:20, 167:22, 168:4, 168:11, 168:17, 168:19, 173:24, 174:2, 180:23, 181:1, 191:11, 191:18, 191:21, 191:25, 192:8, 192:10, 192:13, 202:6, 202:11, 202:15, 202:21, 203:7, 203:12, 203:16, 203:18, 203:23, 204:3, 204:7, 204:11, 204:14, 204:17, 214:3, 214:6, 216:8, 216:11, 216:17, 234:8, 234:14, 235:6, 235:11, 235:14, 239:13, 239:15, 239:17, 242:16, 255:10, 255:18, 256:11, 258:20, 259:5, 259:8, 260:16, 260:21, 261:2, 261:18, 262:2,

262:12, 262:16, 262:25, 263:5, 263:8, 263:11, 263:18, 264:5, 264:15, 264:18, 264:23, 265:1, 265:8, 265:12, 265:16, 265:19, 265:21, 265:25, 266:2, 266:22, 267:4, 267:7, 267:16, 267:23, 268:3, 268:6, 268:11, 268:16, 268:23, 269:1, 269:4, 269:9, 269:20, 269:23, 269:25, 270:3, 270:10, 270:14, 270:20, 270:23, 271:1, 271:3, 271:8, 271:12, 272:9, 272:15, 272:24, 273:5, 273:8, 273:11, 273:15, 273:20, 274:5, 274:25, 275:6, 275:9, 275:21, 275:24, 276:11, 276:20, 277:1, 277:7, 277:11, 277:13, 277:15, 277:24, 278:5, 278:8, 278:11, 278:14, 278:18, 278:22, 278:24, 279:7, 279:25, 280:3, 280:7, 280:11, 280:15, 280:19, 280:23, 280:25, 281:3, 281:7, 281:10, 281:12, 281:16, 281:19, 281:22, 281:24, 282:6, 282:9, 282:11, 282:15, 282:19, 283:1, 283:8

court [4] - 6:9, 101:23, 123:21, 226:10

Court [39] - 1:25, 6:25, 8:24, 9:1, 9:2, 9:24, 12:9, 12:11, 12:24, 14:2, 17:1, 25:18, 32:16, 42:22, 48:7, 49:4, 63:2, 64:7, 64:8, 64:20, 75:8, 75:23, 78:25, 79:3, 82:3, 82:18, 107:23, 114:11, 118:23, 124:16, 138:9, 147:9, 168:20, 168:25, 216:12, 217:12, 276:5, 279:3, 279:7

Court's [2] - 132:25, 271:18

courthouse [2] - 5:14, 21:12

courtroom [2] - 4:3, 4:9

courts [2] - 23:5, 24:7

Courts [1] - 130:2

cover [6] - 36:18, 57:2, 149:8, 165:6, 169:14, 169:17

coverage [1] - 190:22

covered [1] - 172:12

covering [1] - 169:15

covers [1] - 36:15

Craig [2] - 92:15, 160:16

crazy [1] - 44:21

create [3] - 82:6, 146:17, 215:20

created [5] - 34:6, 203:11, 203:12, 203:16, 203:25

creating [1] - 53:15

creatinine [2] - 170:10, 170:18

credence [1] - 266:3

credibility [4] - 4:15, 9:2, 17:4, 137:9

credit [1] - 162:9

criminal [1] - 281:13

critical [1] - 67:23

critiques [1] - 229:4

CROSS [2] - 124:19, 216:19

cross [20] - 9:19, 9:20, 11:22, 123:14, 124:14, 153:6, 153:15, 153:16, 153:25, 155:21, 160:4, 167:25, 216:7, 216:10, 216:16, 228:7, 256:15, 259:4, 259:21, 266:7

cross-examination [6] - 153:16, 216:7, 216:16, 256:15, 259:21, 266:7

CROSS-EXAMINATION [2] - 124:19, 216:19

cross-examine [3] - 123:14, 153:15, 153:25

cross-examined [1] - 160:4

crucial [1] - 39:20

culture [1] - 64:15

curious [2] - 7:24, 269:12

current [6] - 32:10, 32:19, 48:7, 111:7, 111:23, 186:18

cutting [2] - 40:24, 45:8

cycle [1] - 276:4

D

D-1 [1] - 176:1

D18 [1] - 159:14

damage [2] - 39:16, 40:6

Dana [10] - 75:16, 76:11, 76:15, 77:7, 77:14, 108:25, 154:21, 200:14, 200:17, 201:10

Dana-Farber [10] - 75:16, 76:11, 76:15, 77:7, 77:14, 108:25, 154:21, 200:14, 200:17, 201:10

danger [1] - 272:6

DARRYL [1] - 3:20

Darryl [1] - 5:17

data [59] - 68:22, 76:13, 76:22, 76:23, 92:12, 94:18, 95:1, 95:2, 101:17, 103:21, 104:3, 104:4, 104:10, 104:11, 109:4, 109:5, 111:1, 146:7, 151:5, 151:9, 151:10, 152:7, 152:17, 155:11, 160:22, 161:11, 162:13, 163:12, 163:14, 163:15, 164:2, 164:8, 164:9, 164:12, 164:17, 164:18, 164:22, 165:1, 165:2, 165:13, 165:15, 165:19, 165:21, 166:18, 166:21, 166:23, 167:15, 194:17, 198:19, 206:3, 239:24, 248:21, 248:22, 248:24, 249:1, 249:4, 249:7

date [17] - 38:3, 44:3, 67:23, 70:15, 79:7, 159:9, 172:25, 173:24, 178:22, 210:7, 210:9, 210:10, 210:12, 210:13, 213:12, 269:12, 269:15

dated [1] - 213:8

dates [2] - 136:23, 196:8

daughter's [1] - 110:10

daylight [1] - 60:21

de [1] - 6:11

deal [6] - 35:14, 64:2, 191:10, 205:8, 276:16, 280:10

dealing [1] - 33:15

dealt [1] - 35:9

death [4] - 39:15, 40:6, 185:14, 185:15

debate [4] - 61:20, 63:2, 64:9, 69:14

December [1] - 68:13

decide [3] - 14:12, 52:8, 269:4

decided [1] - 267:10

deciding [2] - 64:7, 269:4

decision [9] - 6:14, 13:11, 17:1, 20:12, 27:21, 47:4, 200:7, 201:20, 273:3

decision-making [1] - 273:3

decisions [1] - 32:17

deck [1] - 28:9

declaration [14] - 7:4, 11:1, 16:2, 46:25, 75:4, 112:21, 134:20, 135:23, 229:20, 249:17, 249:21, 257:12, 268:21, 269:17

declarations [1] - 8:8

declared [1] - 12:11

decrease [2] - 162:11, 250:12

deem [1] - 275:12

deemed [1] - 201:22

deems [1] - 21:19

deep [1] - 17:24

defect [1] - 27:10

defend [2] - 65:4, 266:23

defendant [3] - 5:15, 20:15, 278:25

Defendant [4] - 1:9, 1:15, 3:9, 3:22

defendant's [1] - 280:9

defendants [8] - 7:13, 8:17, 8:18, 18:11, 19:20, 20:24, 21:19, 153:23

defended [1] - 282:4

defense [1] - 23:18

deficiencies [1] - 171:25

define [3] - 100:22, 149:14, 217:9

defined [1] - 219:5

definitely [3] - 18:6, 69:10, 121:4

definition [15] - 12:25, 92:18, 132:23, 202:7, 202:8, 202:15, 203:2, 203:21, 204:1, 218:20, 218:22, 237:3, 258:23, 263:9, 270:21

definitions [1] - 151:23

definitive [1] - 8:14

definitively [1] - 46:9

degree [2] - 95:2, 235:3

degrees [1] - 119:14

DeJong [2] - 3:16, 5:18

DELAWARE [1] - 1:2

Delaware [1] - 1:18

demonstrate [2] - 12:3, 189:10

demonstrated [3] - 170:19, 178:9, 187:9

demonstrates [2] - 33:22, 199:23

demonstrating [1] - 178:24

demyelination [1] - 186:2

denied [1] - 7:17

deny [2] - 7:6, 271:25

deoxynucleotide [1] - 46:13

deoxyribonucleic [1] - 82:8

Department [1] - 75:12

department [5] - 154:15, 154:18, 154:19, 154:20, 169:3

dependent [12] - 29:12, 29:13, 113:8, 113:10, 113:15, 177:16, 177:18, 218:10, 264:6, 264:9, 267:1, 277:9

deposition [35] - 25:23, 113:1, 128:9, 128:12, 130:12, 136:11, 136:19, 137:8, 140:15, 140:21, 140:23, 223:1, 224:7, 225:4, 231:18, 232:8, 233:6, 233:23, 233:24, 234:17, 236:1, 238:9, 238:11, 238:14, 238:15, 238:25, 241:22, 244:15, 246:9, 247:14, 251:17, 251:22, 252:1, 254:23, 262:4
depositions [1] - 10:20
depth [1] - 100:22
Derek [3] - 5:3, 5:8, 63:14
DEREK [2] - 2:10, 2:19
derived [19] - 118:5, 118:8, 118:18, 171:2, 171:4, 171:10, 171:13, 174:14, 174:25, 176:12, 177:10, 200:3, 221:25, 237:18, 252:23, 260:11, 262:22, 263:14, 263:24
describe [36] - 24:14, 45:20, 50:11, 72:14, 75:22, 76:24, 93:14, 102:23, 104:8, 106:18, 111:25, 112:8, 120:13, 120:17, 142:21, 142:22, 142:25, 144:5, 158:3, 171:3, 174:12, 176:24, 181:18, 188:14, 217:4, 224:25, 225:2, 225:10, 225:13, 225:15, 225:18, 226:21, 231:14, 231:23, 238:21, 239:3
described [39] - 12:16, 24:10, 26:25, 65:8, 67:18, 88:16, 95:10, 100:13, 103:9, 106:10, 106:12, 106:17, 108:13, 126:6, 128:18, 129:4, 134:13, 137:1, 157:1, 181:5, 182:2, 182:24, 195:13, 219:8, 220:14, 223:18, 223:23, 224:19, 225:19, 232:4, 232:5, 232:13, 233:4, 235:5, 236:19, 236:24, 254:3, 254:16, 255:2
describes [5] - 65:16, 100:1, 106:11, 188:6, 249:4
describing [14] - 17:18, 85:24, 97:12, 100:15, 101:3, 110:22, 122:8, 129:17, 134:1, 175:4, 179:1, 180:9, 180:10, 238:15
description [75] - 22:11, 26:5, 52:21, 54:10, 78:8, 79:4, 81:13, 81:15, 83:20, 83:21, 83:25, 84:15, 84:21, 84:24, 88:22, 89:22, 90:2, 90:8, 90:11, 90:14, 92:4, 93:2, 93:3, 93:4, 93:7, 93:14, 97:15, 97:18, 97:19, 98:2, 98:10, 98:13, 98:18, 99:23, 100:1, 100:6, 102:9, 102:10, 108:13, 112:1, 112:12, 112:14, 117:11, 120:15, 122:4, 122:11, 122:15, 134:12, 139:22, 156:4, 156:8, 156:10, 157:1, 158:2, 180:16, 181:6, 186:12, 208:8, 224:2, 224:8, 224:14, 227:2, 231:13, 231:21, 231:22, 232:5, 242:8, 244:7, 244:10, 244:18, 244:20, 244:23, 251:3, 274:21, 279:15
description's [1] - 28:21
descriptions [1] - 182:17
desert [1] - 34:6
deserving [1] - 49:10
design [2] - 86:6, 188:14
designed [5] - 43:23, 138:22, 139:16, 140:2, 148:12
desired [1] - 78:19
despite [1] - 178:2
detail [8] - 24:11, 24:16, 27:21, 45:18, 67:6, 75:7, 188:7, 211:24
detailed [1] - 78:23
details [7] - 28:25, 96:12, 212:2, 225:17, 244:8, 244:21, 251:20
detect [23] - 58:5, 72:22, 84:9, 91:3, 95:18, 95:19, 105:12, 109:17, 117:5, 121:19, 129:18, 133:16, 133:23, 136:1, 157:25, 171:10, 175:10, 192:14, 203:25, 221:25, 263:6
detected [4] - 184:25, 203:16, 253:14, 264:12
detecting [29] - 95:21, 99:5, 109:24, 110:12, 111:16, 111:21, 114:6, 117:15, 117:24, 119:6, 120:22, 120:24, 121:13, 127:9, 127:21, 129:18, 129:19, 129:23, 131:8, 172:2, 173:16, 177:2, 180:20, 203:14, 206:16, 252:7, 260:1, 263:24, 264:2
detection [26] - 26:11, 35:15, 42:1, 43:16, 79:20, 97:12, 98:4, 102:17, 116:8, 127:5, 131:5, 139:10, 146:10, 171:13, 178:3, 180:13, 182:8, 184:11, 203:13, 239:21, 246:8, 251:14, 252:4, 252:14, 253:5, 263:13
detects [1] - 98:6
determination [4] - 11:18, 127:23, 252:25, 274:12
determinations [2] - 9:2, 52:15
determine [16] - 24:1, 33:6, 91:18, 95:20, 116:20, 119:19, 119:23, 134:3, 134:5, 170:3, 175:4, 249:9, 251:10, 252:18, 252:23, 279:8
determined [2] - 127:8, 177:3
determining [10] - 80:1, 116:7, 116:23, 169:24, 174:16, 176:6, 177:6, 181:9, 249:5, 249:7
develop [3] - 30:11, 164:11, 201:19
developed [11] - 76:8, 84:4, 105:24, 158:25, 173:3, 190:15, 200:24, 203:4, 234:24, 234:25, 280:2
developing [4] - 109:20, 176:8, 201:6, 241:18
development [6] - 34:7, 109:21, 169:2, 169:5, 201:17, 241:17
device [2] - 60:17, 212:5
diabetes [1] - 161:16
diagnosing [1] - 116:5
diagnosis [3] - 25:7, 72:11, 215:1
diagnostic [9] - 26:17, 27:15, 27:17, 41:20, 43:10, 46:7, 194:23, 215:10, 215:25
diagnostically [1] - 215:21
diagnostics [9] - 44:25, 68:23, 72:4, 120:5, 194:18, 211:1, 215:7, 215:17, 253:10
Diamond [3] - 49:11, 49:13, 56:6
Diamond/Diehr [1] - 272:7
DiBenedetto [2] - 3:13, 5:16
dictated [1] - 203:24
die [8] - 97:4, 97:8, 107:25, 109:17, 109:18, 109:21, 109:22, 117:3
died [1] - 126:11
Diehr [3] - 49:11, 49:14, 56:6
dies [2] - 114:21, 115:1
differ [3] - 89:9, 120:1, 167:10
difference [12] - 34:23, 46:21, 82:22, 82:23, 91:6, 174:17, 247:5, 247:25, 248:12, 248:15, 256:20, 258:24
differences [12] - 34:20, 82:12, 82:14, 82:21, 91:9, 110:14, 169:25, 170:2, 181:16, 205:25, 241:10
different [86] - 19:23, 38:17, 50:22, 57:25, 65:6, 66:15, 66:22, 67:22, 69:14, 70:19, 76:9, 82:15, 82:16, 87:12, 88:2, 89:11, 89:12, 95:14, 102:14, 110:10, 111:12, 122:20, 127:3, 133:3, 135:21, 139:3, 139:6, 139:7, 142:23, 147:11, 148:19, 148:21, 148:23, 150:18, 151:3, 151:4, 154:4, 160:10, 163:11, 163:12, 163:25, 164:2, 164:5, 164:14, 164:23, 165:11, 165:24, 167:12, 171:20, 171:22, 173:9, 176:15, 187:2, 190:21, 197:11, 198:17, 205:14, 212:7, 217:16, 218:15, 218:16, 218:17, 229:3, 230:2, 235:18, 235:21, 236:8, 237:15, 238:16, 239:20, 241:10, 242:4, 242:5, 242:14, 243:10, 248:22, 248:23, 254:8, 258:17, 261:10, 270:15, 274:1
differentiate [3] - 41:24, 109:6, 173:11

differently [3] - 19:15, 167:13, 266:21
difficult [6] - 41:23, 43:17, 43:19, 139:10, 173:11, 215:20
difficulties [4] - 120:23, 172:22, 190:21, 229:6
difficulty [1] - 190:20
dig [1] - 75:7
digest [1] - 276:2
digital [44] - 50:22, 50:23, 66:11, 70:18, 70:20, 72:12, 79:25, 104:20, 104:24, 105:16, 105:18, 105:20, 105:22, 105:25, 106:3, 106:4, 106:8, 106:11, 106:14, 106:19, 106:22, 107:1, 107:3, 128:5, 131:12, 213:21, 214:1, 214:10, 214:22, 215:1, 215:10, 215:24, 230:24, 231:5, 231:7, 231:9, 231:14, 231:24, 232:1, 232:2, 232:10, 232:11, 232:17
dilute [2] - 105:1, 105:2
diluting [1] - 105:13
dilution [1] - 212:14
dimensional [1] - 70:22
dimer [2] - 207:11, 207:22
dimers [2] - 71:17, 210:18
diminish [1] - 94:12
direct [20] - 25:25, 73:14, 113:23, 130:11, 136:11, 140:6, 147:8, 149:2, 154:25, 162:7, 167:25, 168:16, 187:24, 212:9, 226:2, 226:5, 230:24, 242:15, 242:17, 258:21
DIRECT [2] - 74:11, 168:22
directed [25] - 19:1, 53:19, 58:25, 61:24, 62:5, 80:19, 129:9, 129:12, 129:13, 129:19, 129:23, 129:25, 130:1, 130:7, 130:9, 130:19, 131:17, 131:18, 169:9, 169:16, 185:21, 188:24, 208:14, 230:1, 230:2
directing [1] - 24:6
direction [1] - 56:23
directional [1] - 181:23
directions [1] - 219:15
directly [5] - 6:5, 23:18, 139:25, 200:5, 255:11
director [3] - 75:15, 75:19, 200:5
disabuse [1] - 52:18
disadvantages [3] - 142:24, 143:2, 143:11
disagree [3] - 53:10, 58:23, 234:23
disagreement [2] - 10:5, 153:21
disagreements [1] - 36:2
disclose [10] - 22:16, 78:11, 78:14, 121:9, 163:3, 194:4, 198:9, 198:18, 208:4, 221:12
disclosed [16] - 23:20, 25:10, 32:1, 40:22, 126:7, 126:9, 128:14, 186:12, 190:13, 209:17, 219:18, 220:3, 220:15, 261:13, 261:24, 263:12
discloses [2] - 78:8, 183:12
disclosing [10] - 104:16, 184:1, 184:18, 186:13, 197:7, 199:4, 209:1, 210:16, 214:22, 215:10
disclosure [10] - 22:19, 28:24, 72:16, 103:19, 153:14, 179:16, 179:19, 179:20, 193:9, 215:23
disclosures [1] - 93:3
disconnect [1] - 38:5
discovering [1] - 162:17
discovery [20] - 10:16, 10:17, 10:25, 11:4, 16:1, 16:17, 19:6, 19:7, 38:4, 38:10, 40:23, 109:8, 165:23, 166:17, 167:7, 268:15, 269:8, 269:10, 280:9
discrimination [1] - 72:9
discuss [7] - 84:6, 84:7, 90:8, 90:11, 99:23, 112:12, 113:8
discussed [15] - 145:2, 157:21, 161:24, 175:1, 179:15, 182:18, 185:7, 187:24, 188:3, 192:25, 197:23, 208:9, 227:24, 236:3, 248:20
discusses [3] - 54:13, 92:15, 130:3
discussing [11] - 75:24, 77:1, 79:1, 89:16, 111:13, 139:20, 172:22, 205:6, 208:2, 215:19, 227:23
discussion [6] - 114:9, 187:22, 190:11, 190:16, 196:4, 230:24
disease [6] - 26:17, 27:18, 161:17, 167:10, 167:12
diseases [1] - 161:16
dismiss [6] - 6:20, 6:21, 7:15, 19:14, 20:2, 276:14
disorders [1] - 186:2
dispute [11] - 7:6, 12:18, 22:5, 41:2, 57:10, 234:3, 234:5, 234:9, 234:18, 234:21, 235:23
disputed [5] - 68:9, 256:21, 270:13, 270:15, 271:6
disputes [1] - 64:6
dissect [2] - 49:12, 56:5
dissection [4] - 49:12, 49:15, 56:8, 56:11
distinction [8] - 189:13, 218:25, 219:19, 243:3, 247:12, 256:16, 256:23, 266:19
distinctions [1] - 195:15
distinguish [8] - 170:3, 171:22, 172:9, 174:18, 175:5, 181:15, 264:8, 270:17
distinguishable [2] - 39:4, 50:19
distinguishes [4] - 127:25, 171:20, 176:7, 242:10
distinguishing [2] - 34:19, 221:1
distract [2] - 32:13, 32:22
distributed [1] - 197:10
district [2] - 6:9, 24:6
District [2] - 6:25, 12:24
DISTRICT [2] - 1:1, 1:2
dive [1] - 17:24
divided [1] - 87:11
dividing [1] - 212:13
Division [1] - 75:17
DNA [316] - 26:12, 27:10, 30:9, 30:20, 31:16, 31:22, 33:5, 33:13, 33:22, 34:6, 34:8, 35:5, 35:6, 36:21, 39:1, 39:18, 40:4, 41:19, 41:24, 41:25, 43:5, 43:9, 43:13, 43:20, 43:24, 44:2, 44:24, 45:1, 45:14, 46:6, 46:12, 46:19, 52:7, 53:16, 53:22, 56:2, 56:9, 56:20, 58:5, 60:2, 61:16, 63:16, 65:7, 68:12, 71:19, 72:21, 76:2, 76:7, 76:16, 76:23, 77:5, 77:15, 77:16, 77:17, 77:18, 78:20, 78:21, 79:18, 79:23, 80:2, 80:21, 80:25, 81:4, 81:10, 81:14, 81:16, 81:22, 82:7, 82:8, 82:21, 83:5, 83:6, 85:4, 85:20, 86:8, 91:3, 91:13, 91:19, 95:15, 95:16, 95:20, 96:14, 96:22, 96:23, 96:25, 97:2, 97:5, 97:8, 97:9, 97:10, 97:13, 102:15, 102:16, 104:20, 104:22, 104:25, 105:6, 105:9, 105:11, 107:7, 107:10, 107:12, 107:15, 107:18, 107:22, 108:1, 108:4, 108:7, 108:10, 108:22, 109:1, 109:3, 109:7, 109:8, 109:12, 109:13, 109:14, 109:16, 109:18, 109:19, 109:23, 109:25, 110:1, 110:4, 110:7, 110:8, 110:9, 110:12, 110:14, 111:15, 112:10, 114:10, 114:12, 114:13, 114:25, 115:3, 115:4, 115:5, 115:14, 115:16, 115:18, 116:11, 116:13, 116:17, 116:20, 116:24, 117:3, 117:6, 117:25, 118:6, 118:8, 118:9, 118:12, 118:18, 119:20, 120:12, 120:22, 120:24, 121:10, 121:13, 121:14, 121:19, 122:2, 123:4, 123:5, 124:25, 125:3, 125:5, 125:10, 125:13, 125:23, 126:12, 127:5, 128:23, 129:11, 129:18, 130:22, 130:23, 131:8, 133:15, 135:6, 135:10, 136:1, 137:2, 138:11, 138:22, 138:23, 139:1, 139:2, 139:3, 139:5, 139:6, 139:8, 139:9, 139:17, 140:2, 140:3, 140:12, 141:6, 156:6, 156:12, 156:13, 156:15, 158:11, 159:7, 170:5, 171:3, 171:4, 171:6, 171:7, 171:8, 171:10, 171:18, 171:20, 172:2, 172:4, 173:9, 173:12, 173:15, 173:21, 174:14, 174:20, 174:21, 175:1, 175:7, 175:10, 176:9, 176:13, 177:2,

177:6, 177:7, 177:11, 178:5, 179:24, 181:8, 190:3, 190:19, 190:21, 190:25, 192:2, 192:4, 192:7, 192:16, 192:17, 192:18, 192:19, 192:20, 200:3, 203:1, 204:5, 205:13, 206:16, 207:8, 208:15, 208:16, 212:14, 212:16, 212:19, 214:24, 215:2, 224:4, 224:10, 224:16, 230:15, 232:17, 232:18, 237:5, 237:6, 237:19, 239:22, 242:22, 243:2, 243:6, 243:12, 245:8, 245:10, 245:12, 245:17, 245:18, 246:4, 246:5, 246:15, 246:16, 247:10, 248:17, 250:16, 251:14, 252:4, 252:8, 252:23, 253:5, 253:9, 253:13, 254:18, 255:24, 260:1, 260:11, 262:22, 263:2, 263:6, 263:14, 263:24, 264:2, 271:22
do-able [1] - 277:14
doable [1] - 71:22
Doctor [1] - 159:25
doctor [1] - 140:18
document [17] - 42:24, 43:3, 43:8, 142:4, 142:11, 142:14, 143:6, 143:15, 144:1, 153:11, 194:2, 194:3, 197:4, 208:1, 208:19, 269:22
documentation [5] - 145:24, 147:7, 147:13, 147:22, 188:16
documentations [1] - 148:2
documented [2] - 34:17, 37:8
documents [5] - 188:18, 231:17, 261:24, 266:13, 266:14
dollar [2] - 94:6, 147:10
dollars [3] - 101:15, 160:19, 162:9
dominant [2] - 96:3, 102:25
Dominici [1] - 164:5
done [23] - 8:1, 8:2, 8:6, 10:24, 19:15, 47:25, 55:17, 61:7, 76:21, 106:21, 188:9, 200:22, 219:12, 220:23, 243:24, 244:4, 252:19, 252:25, 253:3, 254:19, 268:23, 270:4, 283:5
donor [105] - 26:12, 31:16, 31:18, 31:22, 33:5, 33:22, 34:11, 34:14, 37:2, 37:3, 37:5, 37:8, 37:15, 37:16, 38:16, 38:25, 80:2, 96:21, 96:22, 96:25, 97:13, 97:16, 102:14, 107:7, 107:9, 107:12, 107:15, 107:20, 108:10, 108:19, 109:6, 110:3, 111:10, 114:9, 115:16, 115:18, 116:8, 116:9, 116:11, 116:13, 116:20, 116:24, 117:6, 117:15, 117:17, 117:25, 118:10, 119:20, 120:1, 120:12, 124:25, 125:5, 125:13, 125:23, 126:12, 129:18, 129:20, 131:8, 169:25, 170:3, 170:4, 171:2, 171:4, 171:5, 171:6, 171:8, 171:9, 171:13, 171:23, 172:6, 172:9, 174:17, 174:25, 175:5, 176:7, 176:12, 177:5, 177:10, 200:3, 205:25, 221:25, 236:18, 236:23, 237:2, 237:18, 237:19, 239:21, 241:9, 242:10, 247:8, 247:9, 249:5, 251:10, 252:18, 252:23, 260:1, 260:11, 262:22, 263:2, 263:6, 263:14, 263:24, 264:2, 264:8, 264:14
donor's [1] - 177:3
donor-derived [4] - 237:18, 262:22, 263:14, 263:24
donor-specific [3] - 31:16, 236:18, 236:23
donor/recipient [1] - 176:16
donors [2] - 181:16, 242:4
doubles [1] - 160:25
Down [2] - 44:25, 45:1
down [15] - 38:6, 60:8, 66:3, 67:7, 71:3, 98:4, 105:3, 114:22, 124:11, 150:11, 165:7, 197:17, 247:17, 262:21, 275:8
Dr [83] - 24:19, 25:17, 26:20, 27:1, 30:6, 31:1, 31:6, 43:11, 46:4, 46:24, 47:19, 49:1, 63:15, 65:20, 68:6, 68:17, 69:2, 70:15, 71:12, 71:22, 73:10, 74:13, 77:20, 92:25, 106:6, 106:13, 112:20, 113:1, 118:7, 122:5, 124:21, 125:14, 125:15, 125:20, 133:19, 133:25, 135:24, 135:25, 156:4, 168:24, 174:11, 179:3, 181:5, 182:2, 183:5, 183:11, 183:16, 183:25, 184:16, 185:18, 186:11, 187:23, 189:4, 190:13, 193:24, 195:21, 196:15, 197:4, 197:15, 198:1, 198:9, 199:12, 199:22, 200:12, 200:16, 200:20, 201:3, 206:5, 208:19, 209:9, 210:3, 210:16, 211:9, 211:19, 215:9, 216:21, 256:25, 257:19, 258:2, 258:15, 258:20, 261:7, 271:20
dramatically [2] - 70:13, 161:12
draw [4] - 32:3, 32:11, 261:20, 266:11
drawing [1] - 235:9
Drew [1] - 5:9
droplet [7] - 47:18, 47:20, 47:21, 71:9, 88:1, 212:11, 212:21
droplets [9] - 47:10, 47:11, 47:14, 47:15, 71:9, 87:19, 87:24, 88:8, 212:7
dropped [3] - 70:13, 161:25, 162:8
dropping [1] - 161:12
drops [1] - 160:24
drug [1] - 169:8
drugs [3] - 115:10, 115:23, 166:14
due [4] - 40:5, 132:6, 258:8, 282:23
dueling [3] - 22:9, 23:13, 23:15
duly [2] - 74:8, 168:12
during [6] - 141:16, 179:9, 182:22, 198:25, 210:23, 259:4
dwelling [1] - 66:23
Dwyer [1] - 5:4
DWYER [1] - 2:14
dye [1] - 184:12
dying [4] - 107:14, 108:4, 115:6, 115:13
dysfunction [1] - 114:6

E

earliest [1] - 210:7
early [10] - 70:17, 76:5, 77:3, 108:24, 114:13, 171:9, 171:12, 171:14, 201:1
easier [7] - 63:5, 63:8, 86:19, 86:23, 104:23, 110:5, 110:13
easiest [1] - 160:12
easily [3] - 69:18, 87:2, 87:15
easy [5] - 24:23, 30:3, 69:18, 80:5, 127:2
eat [1] - 168:3
economic [1] - 199:6
edge [1] - 45:8
editorial [1] - 13:15
EDWARD [1] - 2:6
Edward [1] - 5:3
effect [2] - 29:14, 207:12
effectively [2] - 71:9, 267:10
efficiency [1] - 206:25
efficient [4] - 8:10, 18:15, 50:15, 125:22
efficiently [1] - 206:24
EGFR [1] - 166:14
egregious [1] - 230:10
eight [1] - 159:11
Einstein's [1] - 59:17
either [12] - 12:10, 26:13, 36:23, 101:2, 122:15, 129:15, 142:6, 156:15, 226:25, 227:9, 227:16, 229:16
elaborate [2] - 199:25, 241:8
element [25] - 24:10, 49:13, 79:16, 79:22, 80:1, 80:6, 82:1, 85:17, 85:19, 86:10, 89:1, 89:17, 91:3, 96:20, 96:21, 99:14, 104:19, 111:5, 112:24, 122:21, 131:9, 217:25, 221:24, 249:13
elemental [1] - 10:6
elements [11] - 48:9, 82:2, 82:9, 91:14, 119:4, 119:8, 119:9, 189:13, 190:24, 191:4, 241:17
eligibility [1] - 19:21
eligible [2] - 62:5, 73:1
elk [1] - 72:19
elucidate [2] - 26:15, 29:14
EMANUEL [3] - 2:22, 3:2, 3:6
Emanuel [2] - 5:9, 282:10
embodiments [2] - 112:17, 182:7
embody [1] - 95:22
emerged [1] - 51:11
emerging [19] - 41:21, 45:23, 46:6, 46:7, 50:16, 63:17, 66:7, 66:24, 71:11, 189:17, 189:19, 193:3, 200:25, 231:1, 231:3, 265:7,

265:8
EMILY [1] - 3:13
Emily [1] - 5:16
emphasis [2] - 109:11, 259:2
emphasized [1] - 49:8
employed [2] - 75:9, 210:5
employee [2] - 214:15
employs [4] - 22:13, 25:14, 121:24, 183:13
enable [1] - 269:14
enablement [3] - 24:13, 28:16, 28:17
enables [1] - 191:22
encapsulated [1] - 212:14
encompass [1] - 162:24
encompassed [1] - 187:8
end [7] - 18:2, 137:23, 138:3, 202:21, 266:11, 274:6, 278:2
ended [1] - 65:23
endorsed [1] - 274:9
endowments [2] - 200:25, 201:9
energy [2] - 59:15, 59:16
engaged [1] - 16:24
enhancement [1] - 265:13
enjoy [1] - 16:7
enlightening [1] - 154:13
enterprise [1] - 150:5
entertain [3] - 12:14, 14:25, 277:17
entertained [1] - 12:15
entire [6] - 36:10, 66:21, 137:25, 146:17, 150:18, 282:20
entirely [2] - 67:21, 160:9
entirety [1] - 241:17
envelope [2] - 61:8, 61:13
enzyme [3] - 184:11, 192:17, 192:19
enzymes [1] - 114:21
enzymology [1] - 186:20
equal [1] - 207:18
equals [2] - 53:9, 59:17
equate [1] - 222:20
equated [1] - 258:21
equating [1] - 266:4
equipment [3] - 145:3, 145:7, 147:11
equivalent [6] - 52:1, 161:3, 217:14, 218:18, 219:2, 270:7
equivalently [1] - 222:21
equivalents [2] - 220:22, 227:24
erred [1] - 279:3
error [35] - 99:16, 99:17, 99:18, 99:23, 99:25, 100:2, 100:3, 100:7, 100:8, 100:10, 100:13, 100:20, 100:23, 100:24, 101:5, 101:8, 101:13, 101:19, 102:2, 102:4, 103:17, 103:20, 104:5, 111:11, 151:4, 163:11, 163:12, 190:22, 192:5, 198:2, 200:9, 250:3, 250:6, 250:12
errors [8] - 69:11, 100:25, 111:15, 152:16, 191:6, 191:9, 229:20, 229:25
especially [6] - 5:25, 6:10, 23:17, 37:3, 50:6, 55:7
ESQ [13] - 2:3, 2:6, 2:10, 2:14, 2:19, 2:22, 3:3, 3:7, 3:7, 3:12, 3:13, 3:16, 3:20
essence [1] - 128:2
essentially [9] - 9:1, 10:7, 19:18, 82:5, 89:13, 91:10, 93:7, 183:4, 260:18
establish [1] - 83:8
established [12] - 28:20, 63:7, 71:11, 72:25, 88:7, 90:21, 90:23, 151:24, 157:24, 195:18, 257:20, 268:21
establishing [1] - 81:25
establishment [1] - 70:24
EUROFINS [1] - 1:14
Eurofins [2] - 3:23, 5:16
evaluated [1] - 190:5
evaluating [2] - 190:3, 201:22
evaluation [1] - 201:14
event [4] - 112:18, 207:17, 209:6, 259:6
eventually [2] - 146:20
everywhere [3] - 39:2, 39:5, 93:24
evidence [35] - 7:10, 10:7, 11:19, 12:2, 12:20, 15:25, 18:23, 19:9, 19:25, 22:11, 22:21, 23:3, 23:9, 45:11, 46:9, 64:10, 70:6, 88:5, 123:19, 178:1, 178:2, 189:5, 189:22, 217:3, 217:5, 217:15, 267:1, 269:13, 274:3, 279:4, 279:9, 279:11
evidentiary [2] - 15:25, 275:22
exact [2] - 110:25, 183:12
exactly [12] - 11:7, 144:4, 191:17, 196:8, 197:9, 242:14, 255:5, 264:13, 274:7, 276:17, 277:24, 280:3
examination [11] - 73:14, 147:8, 147:16, 149:2, 153:16, 168:16, 216:7, 216:16, 256:15, 259:21, 266:7
EXAMINATION [6] - 74:11, 124:19, 156:2, 168:22, 216:19, 256:12
examine [3] - 123:14, 153:15, 153:25
examined [3] - 74:9, 160:4, 168:13
Examining [1] - 24:8
example [17] - 11:6, 12:7, 13:21, 27:2, 34:8, 34:25, 35:4, 47:24, 98:17, 133:4, 138:25, 164:5, 170:11, 173:13, 195:10, 238:10, 278:2
Example [9] - 93:6, 102:10, 103:3, 103:9, 103:13, 103:17, 106:11, 106:14, 106:18
examples [10] - 83:24, 102:7, 104:15, 106:8, 106:22, 192:3, 223:15, 223:17, 238:4, 238:8
excellent [1] - 272:7
except [3] - 60:22, 64:19, 153:6
exception [1] - 4:13
exceptional [2] - 200:21, 200:22
excerpted [1] - 143:23
exchange [1] - 15:20
exchanges [1] - 16:16
excuse [5] - 97:6, 142:1, 149:21, 179:9, 193:2
excused [1] - 266:1
Exhibit [12] - 39:25, 74:19, 75:2, 144:12, 151:16, 157:19, 217:21, 219:22, 226:8, 228:8, 255:20, 256:4
exhibit [5] - 73:18, 74:22, 151:15, 152:20, 152:22
exhibits [2] - 153:4, 153:10
exist [3] - 37:15, 121:2, 139:23
existed [4] - 43:18, 56:4, 60:23, 93:19
existence [1] - 222:8
existing [19] - 22:16, 29:1, 36:18, 38:14, 44:13, 51:13, 51:21, 78:12, 90:17, 93:11, 109:4, 120:19, 120:20, 144:11, 156:8, 162:21, 162:22, 166:18, 191:15
exists [3] - 48:18, 82:17, 122:22
expansion [1] - 76:12
expect [6] - 43:23, 108:4, 108:7, 139:16, 140:2, 209:21
expected [1] - 39:17
expense [2] - 198:21, 199:10
expensive [1] - 201:12
experience [5] - 75:22, 76:24, 108:21, 201:7, 209:4
experiences [3] - 200:11, 200:14, 200:17
experiment [6] - 102:10, 102:15, 102:16, 103:11, 106:10, 248:4
experiments [5] - 102:7, 104:16, 106:8, 255:24, 256:1
expert [28] - 7:4, 8:8, 9:18, 9:19, 12:19, 13:1, 15:20, 19:13, 22:7, 22:9, 23:13, 23:18, 25:22, 27:1, 29:2, 29:11, 30:6, 62:17, 63:15, 67:14, 68:6, 68:14, 75:4, 112:20, 123:17, 153:25, 274:10
expertise [1] - 17:7
experts [7] - 7:5, 17:4, 23:16, 73:3, 106:22, 259:11, 266:12
explain [13] - 21:14, 25:18, 33:20, 34:2, 82:3, 82:18, 114:11, 141:10, 213:25, 239:15, 276:19, 279:10
explained [4] - 27:1, 61:21, 130:17, 257:22
explaining [2] - 36:21, 276:4
explains [1] - 67:9
explicit [1] - 279:2
explicitly [9] - 12:14, 14:20, 24:6, 25:23, 25:24, 243:25, 244:2, 254:9, 254:25
exploit [2] - 40:21, 171:13
explores [1] - 115:12
explosion [3] - 162:15, 162:25, 258:8
expression [1] - 171:21
expressly [1] - 153:8
extension [1] - 18:19
extent [3] - 21:9, 147:9, 163:21
extract [1] - 46:11
extraordinary [2] - 17:8, 69:8
extreme [1] - 55:3
extremely [2] - 44:24, 45:2
extrinsic [11] - 7:10, 22:6, 22:22, 23:3,

217:3, 217:6, 217:10, 274:3, 279:4, 279:9, 279:11
eye [1] - 58:19

F

f)(3) [1] - 21:21
F3d [1] - 23:15
face [4] - 13:18, 13:19, 130:6, 180:21
faced [1] - 68:2
facilities [1] - 145:10
facing [2] - 152:7, 269:19
fact [54] - 10:18, 11:25, 13:20, 13:23, 16:1, 17:6, 18:22, 22:3, 22:4, 22:10, 23:16, 25:1, 25:12, 38:1, 47:22, 50:17, 54:5, 54:6, 64:6, 65:17, 94:12, 96:3, 106:5, 127:23, 138:3, 144:11, 162:17, 164:21, 171:4, 176:6, 184:18, 188:5, 192:1, 200:4, 201:14, 210:24, 212:25, 219:5, 222:6, 223:10, 223:15, 227:4, 238:12, 239:19, 241:12, 248:15, 251:21, 259:10, 259:11, 268:14, 269:7, 269:10, 274:12, 275:3
fact-finder [1] - 138:3
fact-finding [1] - 274:12
fact-intensive [1] - 11:25
factor [2] - 160:25
facts [8] - 7:1, 7:2, 7:4, 15:5, 17:3, 18:24, 19:12, 138:4
factual [1] - 7:5
faculty [1] - 154:14
Fahnestock [1] - 5:8
FAHNESTOCK [2] - 2:19, 5:7
fail [3] - 32:20, 55:21, 272:8
failed [1] - 161:7
failure [4] - 111:19, 114:7, 209:21, 209:25
failures [1] - 111:22
fair [11] - 4:14, 45:6, 131:3, 132:12, 142:9, 203:25, 214:7, 234:13, 260:22, 273:13, 282:23
fairly [5] - 10:12, 97:4, 111:2, 195:2, 242:12
fairness [2] - 7:13, 15:18
fall [2] - 58:4, 161:21
falling [5] - 63:12, 160:21, 161:3, 161:9, 161:11
false [1] - 35:7
familiar [5] - 142:14, 142:15, 159:19, 159:22, 212:25
fancy [1] - 34:2
far [10] - 14:19, 72:19, 88:14, 125:15, 125:19, 184:7, 215:4, 236:15, 246:6, 268:6
Farber [10] - 75:16, 76:11, 76:15, 77:7, 77:14, 108:25, 154:21, 200:14, 200:17, 201:10
Farnan [1] - 5:2
FARNAN [5] - 2:2, 2:3, 4:25, 5:2, 5:6
fashion [2] - 211:11, 259:23
fast [1] - 277:8
fatal [2] - 45:2, 215:2
father [1] - 114:18
fault [1] - 20:3
favor [2] - 159:13, 279:16
feasibility [2] - 72:8, 72:10
feasible [1] - 135:21
features [1] - 34:8
federal [1] - 76:20
Federal [18] - 6:7, 6:12, 6:18, 8:5, 8:8, 12:13, 12:14, 12:24, 13:17, 14:20, 14:21, 19:22, 131:25, 132:7, 274:8, 274:14, 275:14, 278:14
fees [2] - 281:18, 281:20
FELIPE [1] - 3:7
Felipe [1] - 5:10
female [13] - 34:12, 37:9, 37:15, 37:16, 38:22, 38:25, 39:3, 127:10, 128:1, 167:10, 171:17, 173:10, 181:24
females [1] - 167:11
fetal [15] - 27:10, 35:6, 44:25, 45:1, 72:4, 72:9, 121:14, 123:5, 242:22, 243:1, 243:6, 245:12, 246:7, 247:10, 253:10
fetus [2] - 109:20, 110:7
few [9] - 35:5, 95:24, 113:24, 156:1, 162:8, 167:11, 187:20, 214:10, 282:8
fewer [1] - 99:20
field [7] - 55:8, 60:5, 60:24, 61:9, 62:11, 108:6, 178:13
fields [2] - 99:3, 187:2
figure [9] - 4:21, 27:9, 27:16, 33:10, 42:14, 45:1, 47:23, 52:11, 53:8
Figure [1] - 119:7
figured [1] - 40:11
figuring [1] - 152:10
file [1] - 278:10
filed [10] - 72:6, 78:1, 143:19, 186:3, 208:13, 208:20, 209:12, 210:5, 276:15
filing [5] - 143:20, 144:25, 197:22, 213:12, 213:14
filled [1] - 174:21
final [3] - 6:16, 80:18, 259:15
finally [1] - 159:8
finder [1] - 138:3
findings [4] - 9:4, 10:1, 18:22, 275:3
fine [8] - 11:15, 20:25, 124:4, 126:4, 228:10, 239:16, 277:3, 280:21
fingerprint [2] - 82:6, 83:5
fingers [1] - 109:21
finish [4] - 63:24, 113:23, 123:23, 123:24
finite [1] - 10:13
firm [1] - 5:17
first [48] - 11:13, 12:23, 13:8, 13:11, 21:2, 30:19, 30:21, 43:9, 47:15, 51:2, 57:8, 59:8, 62:1, 73:10, 76:1, 78:24, 79:3, 82:3, 131:16, 145:3, 149:16, 151:24, 152:8, 160:13, 161:13, 163:19, 164:1, 164:21, 165:3, 165:16, 172:1, 175:4, 182:17, 187:20, 190:1, 204:10, 206:10, 250:15, 262:16, 273:16, 273:20, 275:19, 276:3, 276:8, 277:3, 277:8, 277:15, 278:2
fit [1] - 237:2
five [5] - 45:3, 124:2, 200:6, 214:5, 214:21
fix [1] - 148:7
fixed [4] - 148:11, 148:15, 148:16
flags [3] - 68:16, 69:12, 69:21
flip [2] - 24:13, 28:17
floating [3] - 52:7, 53:16, 53:21
Fluidigm [1] - 214:16
fluids [1] - 33:23
fly [1] - 191:5
focus [6] - 22:3, 52:12, 64:10, 187:15, 201:19, 281:4
focused [4] - 44:23, 72:4, 164:25, 282:16
focusing [1] - 261:19
folks [2] - 52:3, 124:2
follow [11] - 30:3, 33:8, 94:24, 103:16, 126:24, 144:13, 180:4, 187:13, 206:9, 247:11, 278:15
follow-on [2] - 33:8, 144:13
followed [3] - 7:8, 111:4, 247:6
following [3] - 8:4, 47:25, 231:20
follows.. [2] - 74:10, 168:14
FOR [1] - 1:2
force [1] - 15:12
forced [1] - 16:9
forego [1] - 16:9
foreign [1] - 121:19
forensics [1] - 83:5
forest [2] - 52:14, 52:17
forever [1] - 271:16
forget [2] - 6:15, 173:24
forgive [2] - 206:1, 230:9
form [1] - 197:10
formal [1] - 7:24
formally [1] - 8:17
formation [1] - 210:22
former [1] - 75:15
forming [1] - 127:19
forms [2] - 82:15
formula [1] - 49:9
formulated [1] - 127:11
forth [7] - 16:2, 27:9, 61:22, 147:8, 267:15, 267:17, 269:10
forties [1] - 40:13
fortune [1] - 201:4
forward [9] - 4:10, 6:19, 15:18, 68:14, 138:5, 153:23, 273:23, 280:17, 280:18
foundation [1] - 154:10
founder [1] - 45:7
four [23] - 30:1, 32:16, 44:6, 53:9, 79:16, 80:11, 80:16, 80:18, 80:19, 82:10, 98:25, 102:13, 103:10, 103:11, 119:4, 119:7, 127:20, 128:2, 128:15, 200:6, 239:25, 282:19
fourth [1] - 80:1
fraction [11] - 97:1, 97:16, 111:10, 170:4, 171:8, 171:18, 173:15, 177:6, 215:2, 262:23
fractions [1] - 173:10
fragmented [2] - 138:14, 138:17
fragments [5] - 76:8, 114:22, 120:25, 203:1, 208:15
frame [9] - 108:23, 173:2, 196:14, 196:17, 196:18, 199:19, 200:1, 200:19, 238:8
framework [2] - 21:24,

165:8
Francesca [1] - 164:5
Francisco [2] - 3:8, 3:21
frankly [1] - 6:12
free [172] - 26:12, 27:10, 30:9, 30:20, 33:5, 34:6, 40:4, 41:19, 41:24, 41:25, 43:9, 43:15, 43:20, 44:1, 44:24, 45:14, 46:6, 46:12, 52:7, 53:16, 53:21, 56:2, 56:9, 56:19, 58:5, 60:1, 61:16, 63:16, 65:7, 68:12, 72:24, 76:22, 77:15, 77:16, 78:20, 78:21, 79:18, 79:23, 80:2, 80:21, 80:24, 81:4, 81:9, 81:14, 81:16, 81:22, 91:3, 96:14, 96:22, 96:23, 96:25, 97:1, 97:5, 102:16, 104:20, 107:7, 107:9, 107:12, 107:18, 107:22, 108:1, 108:7, 108:10, 108:22, 109:14, 109:23, 110:2, 114:7, 114:10, 114:11, 114:25, 115:3, 115:4, 115:5, 116:8, 116:9, 116:11, 116:13, 116:24, 117:3, 117:6, 117:15, 117:17, 117:19, 117:25, 118:6, 118:8, 118:9, 118:12, 118:18, 120:22, 120:24, 121:10, 121:13, 121:14, 121:19, 123:4, 124:25, 125:3, 125:10, 125:13, 126:12, 128:23, 129:20, 130:21, 130:23, 133:15, 135:6, 135:10, 136:1, 138:11, 138:23, 139:1, 139:3, 139:9, 139:17, 140:3, 140:12, 141:6, 156:6, 156:12, 156:15, 158:11, 159:6, 170:4, 171:2, 171:4, 171:7, 171:10, 171:13, 171:18, 173:10, 173:15, 173:21, 174:20, 175:1, 175:7, 175:10, 176:9, 176:13, 177:6, 177:11, 178:5, 200:3, 208:15, 214:24, 224:4, 224:10, 224:16, 230:15, 232:17, 232:18, 245:8, 245:10, 245:16, 245:18, 246:4, 246:15, 246:16, 248:17, 249:6, 250:16, 252:19, 253:15, 255:24, 259:6, 263:2, 271:22
free-floating [3] - 52:7, 53:16, 53:21
Freed [1] - 282:4
frequency [3] - 95:12, 157:11, 262:8
frequently [1] - 181:8
fresh [1] - 271:19
friends [1] - 94:1
frivolous [1] - 55:15
front [7] - 8:17, 47:16, 69:14, 142:10, 228:6, 228:7, 228:8
fuel [1] - 62:11
fulfill [1] - 235:4
full [3] - 234:12, 275:11, 275:14
fully [2] - 132:23, 280:1
functioning [1] - 192:2
fundamental [1] - 39:9
fundamentally [2] - 139:3, 139:5
funded [1] - 76:18
funding [3] - 145:14, 145:16, 145:18
funny [1] - 281:24
future [1] - 153:14

G

gain [1] - 265:5
gatekeeping [1] - 6:24
gears [1] - 202:4
gen [3] - 202:8, 203:19, 262:7
gender [14] - 35:14, 35:16, 35:21, 35:24, 36:8, 41:15, 133:5, 171:15, 172:11, 177:16, 177:18, 180:12, 181:22, 181:23
genders [1] - 41:9
gene [7] - 76:7, 97:24, 148:24, 166:11, 184:22, 185:1, 248:6
general [11] - 130:7, 131:11, 131:13, 169:19, 179:20, 179:25, 182:17, 186:13, 186:14, 237:22, 238:3
General [1] - 109:2
generality [4] - 27:5, 78:6, 218:17, 252:7
generally [8] - 46:2, 70:25, 89:8, 91:8, 115:10, 130:3, 169:13, 283:4
generate [22] - 77:5, 79:21, 92:11, 94:14, 94:17, 95:1, 161:11, 162:12, 163:11, 164:2, 182:14, 190:17, 198:14, 235:2, 235:3, 237:21, 237:22, 238:1, 238:6, 238:7, 242:21, 243:5
generated [6] - 71:16, 94:25, 109:4, 111:1, 151:3, 203:14
generates [1] - 98:5
generating [8] - 83:16, 91:25, 95:2, 183:7, 183:9, 204:25, 205:2, 237:24
generation [53] - 45:9, 45:25, 68:8, 68:19, 72:21, 76:18, 77:14, 142:25, 143:11, 143:18, 145:6, 150:3, 150:8, 150:9, 151:22, 152:17, 157:21, 158:4, 158:7, 187:15, 187:23, 188:9, 188:21, 191:10, 193:10, 193:18, 194:5, 194:22, 197:24, 198:12, 199:24, 200:18, 201:21, 202:13, 203:3, 204:12, 218:7, 219:1, 219:10, 219:13, 220:13, 221:2, 221:7, 221:16, 226:5, 228:15, 228:21, 256:17, 256:23, 257:21, 258:3, 258:13, 258:15
generations [1] - 177:17
generic [2] - 174:22, 205:1
generous [1] - 271:20
genes [5] - 76:7, 76:9, 146:16, 146:18, 148:22
genetic [9] - 82:6, 86:6, 127:25, 144:21, 161:15, 169:9, 169:25, 241:10, 253:6
Genome [3] - 77:9, 160:22, 258:10
genome [48] - 46:15, 46:17, 46:20, 67:11, 76:1, 76:13, 77:4, 77:10, 82:7, 82:10, 82:11, 82:17, 85:2, 86:4, 97:21, 100:20, 103:5, 114:16, 139:1, 152:8, 152:9, 157:13, 160:13, 161:13, 161:21, 161:22, 161:25, 162:1, 162:3, 162:6, 165:3, 165:8, 165:11, 165:16, 166:3, 166:5, 166:10, 167:15, 169:6, 191:4, 200:5, 204:10, 207:4, 248:2
Genomes [1] - 165:17
genomes [14] - 82:6, 85:3, 89:8, 89:9, 104:14, 160:16, 160:17, 160:18, 160:19, 165:9, 165:16, 166:2, 166:6, 166:24
genomic [2] - 85:21, 257:21
Genomic [2] - 76:6, 77:2
genomics [1] - 122:2
genotype [30] - 83:20, 84:13, 84:14, 87:5, 127:24, 137:2, 156:7, 174:15, 177:3, 205:23, 234:4, 234:20, 235:2, 235:3, 235:17, 235:19, 235:20, 236:8, 236:18, 236:21, 236:23, 237:1, 237:22, 237:24, 238:2, 238:6, 238:8, 241:11, 247:8
genotyped [1] - 248:5
genotypes [3] - 134:2, 237:21, 242:5
genotyping [37] - 30:2, 30:14, 72:14, 79:19, 81:25, 82:4, 82:5, 83:8, 83:11, 83:12, 83:13, 83:16, 84:12, 86:25, 87:4, 119:5, 119:25, 129:10, 130:20, 156:5, 232:21, 232:22, 233:2, 233:9, 233:13, 233:14, 233:17, 233:20, 235:22, 236:4, 236:13, 236:16, 237:9, 243:2, 243:3, 243:14, 244:13
genuine [8] - 18:24, 22:4, 22:10, 23:13, 23:16, 23:21, 24:25, 31:2
German [1] - 92:14
Germany [1] - 67:4
given [8] - 115:22, 147:25, 199:7, 199:8, 199:10, 216:3, 223:17
glad [4] - 5:14, 18:5, 65:11, 163:24
glorified [1] - 16:19
go-forward [1] - 68:14
goal [8] - 18:9, 86:18, 86:21, 100:20, 176:18, 178:5, 224:6, 275:15
goals [1] - 70:3
God [2] - 131:25, 162:12
GOODWIN [2] - 3:16, 3:20
Goodwin [5] - 5:18, 282:12, 282:13, 282:14
Gordon [1] - 72:18
GOTSHAL [3] - 2:6, 2:10, 2:14
Gotshal [1] - 5:4
grab [1] - 65:14
Grader [1] - 23:14
graft [3] - 39:16, 114:6, 182:9
grant [2] - 76:20, 77:11
graphic [2] - 162:21, 162:24

great [5] - 20:21, 38:4, 62:4, 73:22, 283:8
greater [3] - 111:7, 112:17, 249:13
Greek [1] - 82:15
ground [2] - 154:5, 164:7
Group [1] - 172:20
group [11] - 34:16, 34:17, 77:15, 82:15, 109:1, 146:13, 157:12, 255:21, 255:23, 256:1, 258:12
grouped [1] - 79:15
growing [2] - 109:17, 109:18
grows [1] - 207:14
guaranteeing [1] - 277:17
Guardant [1] - 49:1
guess [11] - 11:10, 11:12, 22:2, 39:6, 129:1, 208:23, 219:7, 220:20, 272:3, 273:16, 273:18
guidance [20] - 4:9, 70:2, 81:11, 81:13, 84:18, 85:9, 85:14, 87:10, 87:14, 87:20, 88:23, 90:2, 90:7, 92:1, 93:8, 106:20, 117:10, 121:1, 133:1, 147:9
guilty [2] - 17:14, 210:18
guise [1] - 8:7
gun [1] - 40:11
Gunning [1] - 1:24
gut [1] - 61:5
guy [3] - 42:10, 52:15, 282:2
guys [1] - 282:11

H

Haberny [3] - 5:9, 31:6, 73:13
HABERNY [29] - 3:3, 73:16, 73:18, 73:21, 74:2, 74:12, 74:24, 80:15, 80:17, 88:6, 88:10, 101:6, 113:7, 113:21, 113:24, 114:2, 114:4, 123:11, 142:5, 152:20, 152:22, 153:3, 155:25, 156:3, 159:12, 159:20, 167:19, 168:15, 168:18
half [4] - 94:6, 99:20, 110:7, 167:24
half-a-million [1] - 94:6
half-hour [1] - 167:24
hallways [1] - 4:18
hampered [2] - 68:20, 144:19
hand [6] - 73:19, 74:4, 166:8, 168:15, 247:2, 247:22
handed [4] - 74:22, 124:16, 168:20, 216:12
handle [1] - 73:14
Hannah [7] - 42:13, 42:19, 44:22, 45:14, 57:6, 59:25, 123:5
happy [3] - 73:2, 275:19, 276:3
hard [7] - 49:2, 56:20, 101:24, 161:18, 202:7, 271:14, 282:19
hardly [2] - 17:10, 72:25
Harismendy [1] - 190:2
harmonizing [1] - 261:5
harness [2] - 135:13, 136:6
harnessing [1] - 136:14
Harris [1] - 70:5
Harvard [7] - 75:13, 75:20, 145:9, 154:15, 164:6, 201:9, 261:8
harvest [1] - 175:7
hat [1] - 72:14
hate [1] - 275:24
Hawaii [1] - 6:25
haystack [5] - 33:14, 34:10, 43:6, 43:21, 63:16
head [3] - 169:3, 226:11, 279:1
header [3] - 142:22, 186:6, 186:7
Health [1] - 75:13
healthy [1] - 118:14
hear [10] - 26:25, 30:6, 45:6, 59:12, 101:24, 113:16, 242:13, 259:5, 266:17, 280:16
heard [22] - 16:14, 93:23, 171:14, 172:1, 195:21, 196:15, 198:1, 199:12, 200:12, 206:5, 216:25, 217:11, 220:4, 221:19, 226:4, 227:7, 227:15, 227:20, 229:21, 244:6, 274:10
hearing [11] - 7:23, 8:12, 9:25, 12:10, 13:5, 20:3, 153:14, 239:13, 271:4, 279:8, 283:11
heart [7] - 41:25, 43:1, 111:17, 111:19, 111:21, 161:17, 173:13
heavily [2] - 194:18, 195:3
Helicos [35] - 45:6, 45:7, 65:16, 65:17, 68:17, 92:7, 95:10, 100:3, 101:10, 101:12, 101:25, 102:1, 141:9, 141:20, 141:22, 143:4, 143:5, 144:13, 144:24, 145:15, 145:19, 145:21, 146:2, 156:18, 157:1, 157:5, 157:7, 157:16, 161:6, 193:17, 193:18, 193:20, 201:16, 257:20
help [7] - 9:15, 43:14, 76:14, 162:7, 201:19, 260:16, 273:14
helpful [3] - 80:9, 131:25, 267:9
helping [1] - 120:7
heterozygous [11] - 85:7, 89:2, 89:4, 89:5, 89:6, 89:11, 89:12, 89:19, 89:23, 89:25, 90:3
high [146] - 27:5, 30:17, 49:20, 49:21, 50:4, 50:16, 50:23, 52:2, 52:4, 54:19, 54:20, 58:3, 60:3, 64:16, 65:13, 65:15, 66:14, 66:24, 67:3, 68:9, 68:19, 72:21, 76:17, 76:25, 78:6, 79:24, 91:2, 91:6, 91:22, 91:24, 92:3, 92:5, 92:15, 92:16, 93:2, 93:5, 93:6, 93:15, 93:19, 94:16, 94:20, 95:7, 95:9, 95:12, 96:5, 96:14, 98:3, 98:12, 102:4, 102:8, 102:9, 102:20, 102:24, 103:8, 103:14, 104:16, 110:15, 110:18, 115:13, 127:23, 129:10, 130:20, 143:13, 149:9, 149:10, 149:13, 149:14, 149:15, 149:17, 150:3, 150:25, 155:2, 157:7, 157:9, 157:11, 158:4, 158:6, 169:14, 173:9, 178:12, 183:19, 185:22, 190:6, 190:7, 190:15, 195:24, 196:2, 199:13, 200:9, 202:10, 202:14, 202:16, 202:25, 203:3, 203:7, 203:20, 204:5, 212:14, 217:13, 218:2, 218:6, 218:21, 218:22, 218:25, 219:5, 219:8, 219:17, 220:3, 220:12, 220:16, 221:1, 221:19, 221:24, 222:2, 222:4, 222:6, 222:11, 222:16, 223:2, 223:11, 223:14, 223:19, 223:24, 224:3, 224:9, 224:15, 225:23, 227:23, 228:2, 229:5, 229:20, 229:25, 248:1, 256:5, 256:8, 256:16, 256:24, 257:24, 258:4, 258:16, 262:8, 267:2, 270:7, 270:17
high-throughput [129] - 30:17, 49:20, 49:21, 50:4, 50:16, 50:23, 52:2, 52:4, 54:19, 54:20, 60:3, 64:16, 65:13, 65:15, 66:14, 66:24, 67:3, 68:9, 68:19, 76:17, 76:25, 79:24, 91:2, 91:6, 91:22, 91:24, 92:3, 92:5, 92:15, 92:16, 93:5, 93:6, 93:15, 93:19, 94:16, 94:20, 95:7, 95:9, 96:5, 96:14, 98:3, 98:12, 102:4, 102:8, 102:9, 102:20, 102:24, 103:8, 103:14, 104:16, 110:15, 129:10, 130:20, 149:9, 149:10, 149:13, 149:14, 149:15, 149:17, 150:3, 150:25, 155:2, 157:7, 157:9, 158:4, 158:6, 183:19, 185:22, 190:6, 190:7, 190:15, 195:24, 196:2, 202:10, 202:14, 202:16, 202:25, 203:3, 203:7, 203:20, 204:5, 217:13, 218:2, 218:6, 218:21, 218:22, 218:25, 219:5, 219:8, 219:17, 220:3, 220:12, 220:16, 221:1, 221:19, 221:24, 222:2, 222:4, 222:6, 222:11, 222:16, 223:2, 223:11, 223:14, 223:19, 223:24, 224:3, 224:9, 224:15, 225:23, 227:23, 228:2, 229:5, 229:20, 229:25, 248:1, 256:5, 256:8, 256:16, 256:24, 257:24, 258:4, 258:16, 262:8, 267:2, 270:7, 270:17
higher [8] - 63:4, 98:20, 99:2, 99:5, 220:25, 221:1, 221:6, 221:7
highlight [3] - 208:7, 209:14, 263:25
highlighted [3] - 101:8, 209:15, 210:15
highlighting [3] - 190:14, 209:2, 209:5
himself [1] - 55:16

history [1] - 167:12
hit [1] - 205:11
HLA [8] - 171:19, 171:22, 172:7, 172:9, 172:10, 180:16, 181:13, 181:15
hoc [1] - 14:5
hold [9] - 21:11, 75:14, 255:10, 263:8, 263:18, 264:5, 265:21, 271:1, 279:8
holding [1] - 64:21
Holmes [1] - 5:10
HOLMES [1] - 3:7
homozygous [12] - 85:7, 89:2, 89:4, 89:5, 89:6, 89:10, 89:12, 89:18, 89:22, 90:1, 90:3, 241:2
honest [4] - 192:1, 218:23, 219:11, 227:17
honestly [1] - 144:8
Honor [85] - 4:25, 5:7, 5:13, 8:20, 9:6, 9:15, 9:23, 11:5, 11:22, 13:7, 15:14, 16:14, 16:21, 18:12, 18:16, 18:21, 20:18, 21:3, 21:6, 21:15, 21:18, 21:19, 21:24, 22:2, 23:25, 27:13, 28:9, 28:15, 29:2, 29:23, 31:5, 31:8, 31:12, 36:1, 39:19, 39:22, 50:10, 50:25, 60:7, 61:4, 61:14, 65:11, 73:9, 73:16, 73:18, 74:2, 74:3, 87:25, 113:7, 113:12, 113:15, 132:16, 137:19, 141:4, 142:5, 153:3, 155:20, 155:25, 159:20, 167:19, 168:15, 168:21, 216:9, 216:14, 216:18, 234:7, 235:8, 242:11, 265:20, 265:23, 265:24, 270:19, 270:25, 273:19, 273:22, 277:2, 277:6, 277:12, 277:20, 282:13, 283:10
Honor's [4] - 21:20, 37:18, 271:14, 273:3
HONORABLE [1] - 1:22
hope [4] - 10:22, 73:3, 155:3, 155:18
hopefully [3] - 63:20, 105:3, 152:15
Hospital [2] - 75:18, 109:2
hotly [1] - 256:21
hour [2] - 167:24, 267:15
hours [1] - 167:25
house [1] - 162:6
housekeeping [1] - 5:20
huge [2] - 38:5, 161:14
hugely [1] - 235:24
human [14] - 43:4, 75:25, 85:2, 100:20, 114:16, 118:6, 118:18, 157:12, 160:13, 165:16, 175:13, 191:4, 204:10, 205:17
Human [1] - 160:22
hundred [5] - 13:13, 99:21, 112:19, 191:3, 272:25
hundreds [3] - 99:11, 160:19, 167:3
hurdle [2] - 275:1
hurdles [2] - 155:14, 215:20

I

i.e [1] - 53:20
IC [1] - 81:1
idea [20] - 30:19, 42:20, 43:8, 71:13, 99:8, 171:17, 172:3, 195:18, 198:11, 209:18, 219:10, 232:1, 240:12, 241:18, 250:11, 261:9, 264:19, 265:9, 265:16
identical [3] - 110:1, 110:6, 110:8
identified [8] - 54:11, 133:9, 141:14, 177:5, 199:5, 223:13, 229:5, 247:8
identifies [2] - 126:19, 227:3
identify [21] - 72:15, 84:16, 87:2, 133:12, 135:9, 170:23, 205:24, 223:10, 229:17, 232:3, 232:12, 239:6, 240:19, 240:24, 241:2, 241:6, 242:1, 242:5, 244:13, 262:21, 264:1
identifying [11] - 83:6, 84:6, 84:8, 134:1, 170:1, 185:1, 185:20, 241:1, 253:6, 254:18, 260:11
Il [2] - 77:9, 103:5
Illumina [20] - 77:9, 92:10, 92:11, 95:25, 98:1, 98:22, 102:13, 102:19, 102:21, 103:5, 145:16, 161:6, 164:14, 195:25, 196:4, 196:8, 196:12, 201:17, 258:10
Illumina's [1] - 102:23
image [1] - 165:6
imagine [1] - 204:4
immune [3] - 108:3, 115:8, 126:12
immunology [1] - 121:25
immunosuppressive [2] - 115:10, 115:23
impeach [1] - 270:12
impeachment [5] - 234:13, 242:12, 242:15, 242:18, 255:8
imperfection [1] - 144:14
implementing [2] - 178:21, 201:12
implements [1] - 253:14
implication [1] - 256:20
importance [1] - 277:21
important [18] - 10:6, 27:13, 38:21, 42:14, 61:8, 73:23, 139:20, 178:11, 178:19, 205:22, 206:13, 209:3, 230:10, 235:24, 249:2, 260:17, 263:7, 264:16
importantly [3] - 177:13, 196:11, 202:1
impossible [1] - 42:12
impractical [2] - 42:1, 173:16
imprecisely [1] - 130:3
improve [4] - 101:19, 104:12, 146:9, 178:3
improved [3] - 172:16, 172:17, 210:21
improvement [2] - 27:6, 158:23
improvements [4] - 69:22, 193:5, 196:13, 230:19
impugn [1] - 200:21
IN [2] - 1:1, 1:2
inability [1] - 192:14
inappropriate [2] - 266:5, 266:10
Inc [3] - 2:16, 3:10, 3:23
INC [4] - 1:4, 1:8, 1:10, 1:14
incidentally [3] - 35:19, 265:21, 281:12
include [6] - 87:4, 91:19, 91:20, 220:3, 221:23, 259:19
included [4] - 68:7, 76:15, 143:23, 150:22
includes [10] - 35:23, 59:10, 59:19, 93:7, 103:17, 125:5, 253:22, 253:23, 253:25, 254:2
including [6] - 16:4, 42:13, 76:22, 147:8, 257:21, 258:9
inconsistent [5] - 45:24, 47:22, 246:24, 248:11, 251:21
incorporated [1] - 66:4
incorrect [2] - 38:15, 207:13
increase [14] - 98:11, 98:13, 107:14, 115:18, 116:13, 117:3, 125:5, 125:10, 126:13, 210:19, 264:17, 264:19, 264:21, 264:23
increased [1] - 69:5
increases [3] - 40:5, 68:25, 210:19
increasing [2] - 264:15, 264:24
increasingly [1] - 162:13
indeed [3] - 22:10, 25:22, 26:20
indefinite [4] - 12:9, 12:12, 274:9, 274:13
indefiniteness [8] - 8:6, 8:9, 13:8, 13:14, 13:16, 13:19, 19:22, 274:8
independent [12] - 29:7, 29:10, 29:13, 79:10, 79:12, 79:14, 118:22, 218:11, 228:5, 228:13, 228:19, 239:6
independently [1] - 232:5
indicate [4] - 144:9, 185:9, 187:8, 214:25
indicated [29] - 7:10, 7:18, 8:4, 22:12, 22:15, 25:14, 25:19, 26:3, 26:22, 28:22, 50:13, 64:17, 65:4, 81:20, 121:25, 180:3, 180:4, 182:15, 183:14, 184:4, 184:20, 185:25, 187:9, 187:14, 188:11, 191:8, 197:10
indicates [1] - 116:22
indicating [4] - 122:7, 181:10, 188:11, 213:7
indication [3] - 99:7, 106:25, 210:4
individual [13] - 71:20, 93:8, 98:24, 166:6, 184:23, 225:13, 225:18, 236:9, 237:2, 251:23, 260:5, 260:8
individually [4] - 175:15, 245:24, 254:20, 272:7
individuals [3] - 82:16, 166:25, 167:4
industry [2] - 92:7, 141:11
ineligible [1] - 169:16
infancy [3] - 151:22, 152:13, 155:2
infections [1] - 120:7
information [8] - 127:25, 139:15, 139:25, 151:11, 163:16, 198:22, 198:25, 240:1
informed [4] - 20:11,

21:12, 123:2, 255:12
infrastructure [1] - 68:3
inherent [13] - 100:2, 175:16, 191:9, 191:23, 192:20, 193:2, 194:10, 200:8, 230:4, 230:6, 235:1, 238:18, 260:9
inherited [4] - 34:8, 48:1, 114:18
inhibitors [1] - 166:14
initial [2] - 6:6, 18:3
injection [1] - 135:14
innovation [2] - 54:8, 162:15
innovative [3] - 58:14, 107:1, 107:5
inquiry [2] - 55:4, 272:11
insight [1] - 56:21
insofar [1] - 243:8
installations [1] - 197:1
instance [3] - 12:17, 36:18, 262:7
instances [1] - 138:16
instead [3] - 29:1, 206:1, 206:3
instincts [3] - 17:7, 18:3, 18:4
institute [1] - 200:15
Institute [7] - 75:16, 76:1, 76:6, 76:12, 77:2, 160:23, 183:18
Institute's [1] - 169:8
institutions [2] - 200:25, 201:5
instruct [2] - 224:22, 225:8
instruction [2] - 66:6, 66:20
instructions [8] - 22:18, 91:20, 94:25, 95:3, 103:16, 104:13, 111:4, 149:1
instrument [23] - 92:8, 94:7, 96:3, 96:17, 98:5, 100:2, 100:7, 100:15, 102:25, 104:3, 121:5, 122:17, 134:7, 145:8, 145:12, 146:14, 147:2, 147:4, 149:18, 151:25, 199:14, 199:23, 200:4
instrument's [1] - 103:25
instruments [45] - 91:18, 93:6, 93:8, 93:11, 94:17, 94:22, 95:10, 95:13, 95:23, 95:24, 96:11, 100:23, 101:13, 101:20, 103:21, 103:23, 105:24, 106:5, 110:24, 134:8, 134:10, 145:9, 145:11, 146:5, 146:11, 147:23, 148:3, 148:5, 148:16, 150:10, 152:1, 156:9, 161:19, 163:5, 164:23, 187:23, 189:4, 189:9, 196:24, 196:25, 198:4, 222:17, 223:2, 223:11, 258:9
insulting [1] - 62:11
insurance [1] - 159:2
integral [1] - 85:5
integrate [6] - 151:10, 163:15, 164:4, 164:12, 165:12, 166:21
intending [1] - 55:13
intensive [4] - 10:18, 11:25, 13:21, 13:23
intents [1] - 270:6
interaction [1] - 209:19
interchangeably [6] - 257:23, 258:4, 259:11, 259:12, 266:12, 266:14
interested [3] - 29:21, 46:21, 132:14
interesting [2] - 91:19, 152:11
interestingly [1] - 196:11
interests [1] - 28:10
interlocutory [2] - 7:8, 274:19
internal [2] - 34:7, 103:25
Internet [2] - 21:13, 21:16
internet [4] - 31:9, 31:10, 62:10, 62:12
interpret [2] - 132:1, 218:24
interpretation [2] - 130:18, 228:1
interprimer [1] - 209:19
intravascular [1] - 112:2
intrinsic [16] - 22:6, 22:10, 22:22, 22:23, 22:25, 23:4, 24:20, 24:21, 24:24, 25:10, 30:23, 64:10, 217:5, 217:15, 266:25, 274:2
introduce [1] - 168:25
introduced [7] - 94:4, 119:12, 131:9, 149:18, 161:7, 161:20
invalid [6] - 12:4, 12:12, 18:25, 61:13, 269:5, 275:13
invalidate [1] - 130:8
invalidity [1] - 20:2
invasive [6] - 35:15, 42:15, 45:2, 72:11, 170:9, 170:16
invent [9] - 30:8, 47:19, 71:22, 222:2, 222:4, 231:7, 237:11, 249:23, 249:25
invented [18] - 24:18, 30:13, 30:16, 52:11, 84:12, 86:1, 99:8, 99:13, 105:23, 107:1, 129:4, 129:7, 158:20, 160:17, 231:5, 232:22, 233:2, 233:8
invention [52] - 22:13, 23:8, 25:14, 34:5, 35:13, 37:21, 48:6, 48:8, 53:7, 54:2, 54:7, 54:25, 55:10, 56:12, 56:13, 56:14, 57:2, 57:6, 57:7, 57:9, 57:12, 57:13, 58:9, 61:17, 63:19, 64:22, 65:4, 65:10, 66:21, 71:24, 77:23, 84:17, 84:20, 101:22, 105:22, 121:24, 122:12, 128:22, 129:1, 175:13, 176:19, 177:19, 179:6, 179:17, 182:8, 183:13, 205:22, 232:24, 233:5, 253:21, 255:3
inventions [5] - 48:3, 62:11, 128:14, 133:3, 254:4
inventive [10] - 49:6, 52:22, 52:23, 62:13, 62:14, 62:21, 63:7, 122:8, 123:9
inventor [1] - 149:11
inventors [23] - 30:7, 30:13, 30:16, 42:13, 61:9, 81:21, 84:11, 84:25, 92:2, 99:7, 103:2, 106:25, 129:3, 174:24, 222:2, 231:4, 232:21, 233:2, 233:8, 237:11, 249:23, 250:10, 250:15
invents [1] - 47:9
invest [1] - 101:15
investigational [1] - 159:3
invite [2] - 8:1, 60:8
invited [1] - 6:20
invoke [1] - 267:11
involve [2] - 169:24, 170:15
involved [9] - 58:1, 76:21, 77:3, 77:13, 109:1, 179:22, 214:18, 258:12, 281:22
involves [3] - 65:15, 79:19, 108:16
Irizarry [2] - 152:18, 153:1
isolate [1] - 212:16
isolated [5] - 223:20, 232:23, 232:25, 251:15, 251:16
isolation [2] - 77:24, 224:1
issue [51] - 6:6, 7:12, 9:4, 10:6, 13:9, 14:10, 14:16, 16:20, 18:24, 19:11, 22:4, 22:10, 23:14, 23:16, 23:21, 24:25, 27:14, 27:22, 28:12, 29:4, 29:25, 30:7, 31:2, 50:11, 55:6, 55:9, 59:4, 68:11, 135:22, 156:5, 156:11, 156:23, 157:2, 157:4, 157:22, 158:3, 158:17, 159:10, 194:8, 198:24, 215:12, 227:3, 229:19, 256:22, 258:22, 270:2, 270:13, 271:6, 274:3, 277:21, 279:24
issued [2] - 66:2, 92:10
issues [22] - 8:10, 18:8, 68:2, 69:23, 138:14, 150:25, 171:1, 175:16, 192:25, 193:4, 193:13, 199:4, 207:20, 225:23, 226:4, 226:13, 226:22, 226:24, 229:16, 259:19, 259:20, 281:4
italics [1] - 49:8
iterations [1] - 219:13
itself [5] - 27:21, 34:17, 132:8, 149:10, 188:24

J

jackpot [2] - 207:12, 207:15
Japan [2] - 146:13, 146:15
jigsaw [1] - 165:5
job [1] - 261:4
Joe [3] - 51:6, 55:15, 58:3
John [2] - 67:14, 257:12
JOHN [1] - 74:8
Johnson [7] - 5:9, 16:6, 18:13, 20:3, 63:23, 216:21, 277:22
jOHNSON [1] - 242:20
JOHNSON [65] - 2:22, 18:12, 19:10, 20:13, 20:18, 20:23, 73:9, 73:13, 123:25, 153:7, 153:9, 168:3, 168:6, 216:9, 216:14, 216:18, 216:20, 234:10, 234:15, 234:16, 235:8, 235:13, 235:15, 235:16, 235:25, 239:14, 239:16, 240:3, 255:16, 255:19, 256:10, 265:20, 265:23, 266:19, 266:25, 267:5, 270:18, 270:22, 277:2, 277:9, 277:12, 277:14, 278:1, 278:6, 278:13, 278:17, 278:21, 278:23, 279:6, 279:21,

280:6, 280:8, 280:13, 280:24, 281:2, 281:6, 281:17, 281:20, 281:23, 282:4, 282:7, 282:10, 282:14, 282:18, 282:25
join [2] - 21:10, 21:20
joined [1] - 6:22
journal [1] - 178:12
journals [2] - 178:13, 185:11
Judge [10] - 11:23, 47:16, 55:14, 57:5, 57:7, 62:3, 206:1, 239:8, 276:14, 279:13
judge [10] - 6:9, 16:23, 56:7, 206:2, 239:13, 268:17, 274:10, 274:11, 275:17, 276:6
judges [2] - 4:21, 6:13
judgment [35] - 6:22, 6:23, 6:24, 7:3, 7:7, 7:16, 7:17, 8:7, 8:15, 10:7, 10:16, 12:11, 12:18, 12:22, 13:2, 15:19, 16:20, 18:20, 19:19, 19:20, 20:1, 22:8, 60:8, 113:9, 147:25, 153:5, 257:6, 267:12, 267:22, 268:12, 268:14, 268:19, 269:18, 269:19
judicial [2] - 7:20, 7:25
JUNIOR [2] - 1:5, 1:11
jury [23] - 7:20, 13:13, 13:23, 14:7, 14:16, 15:4, 15:14, 16:9, 16:23, 17:2, 23:10, 64:8, 142:10, 206:2, 269:5, 274:6, 274:11, 275:16, 278:3, 278:9, 278:15, 279:18

K

Kahvejian [2] - 149:21, 157:19
KAREN [1] - 3:12
Karen [1] - 5:13
Kary [3] - 86:1, 88:16
keep [4] - 14:6, 168:2, 272:17, 276:12
Keller [3] - 5:12, 5:14
KELLER [4] - 3:12, 3:12, 5:13, 21:15
kernel [1] - 42:20
Kevin [4] - 5:9, 5:18, 18:12, 216:21
KEVIN [2] - 2:22, 3:16
key [3] - 31:13, 189:12, 198:10
kick [1] - 276:12
kidding [1] - 129:15
kidney [13] - 31:17, 110:9, 116:16, 116:17, 118:5, 118:6, 118:7, 118:10, 118:17, 118:18, 170:10, 174:13
kill [4] - 42:4, 45:3, 115:13, 186:9
killing [1] - 116:16
kind [48] - 10:9, 13:22, 20:6, 25:25, 27:21, 28:17, 41:22, 44:9, 49:2, 62:12, 67:10, 77:13, 95:16, 98:15, 103:2, 109:24, 111:12, 120:6, 124:12, 128:5, 130:5, 132:17, 143:15, 148:14, 148:25, 156:14, 162:2, 165:19, 167:16, 173:19, 184:19, 186:22, 187:4, 188:13, 190:5, 191:6, 193:9, 193:10, 194:25, 198:11, 198:21, 201:11, 215:23, 219:11, 239:22, 262:3, 275:20, 276:2
kindly [1] - 210:14
kinds [1] - 41:10
kit [7] - 28:2, 119:10, 122:17, 122:19, 148:19, 148:23
kits [13] - 22:17, 78:9, 84:2, 119:11, 120:20, 147:5, 147:23, 148:12, 148:16, 148:19, 148:25
knowing [6] - 6:11, 6:12, 100:22, 243:9, 273:25
knowledge [4] - 46:5, 84:25, 145:20, 206:10
known [78] - 19:3, 24:10, 24:15, 24:22, 25:8, 25:21, 26:1, 26:4, 28:5, 28:18, 37:21, 40:3, 40:25, 42:17, 42:18, 47:12, 48:4, 48:5, 48:9, 49:9, 50:3, 50:12, 53:8, 55:8, 56:8, 56:9, 56:10, 62:24, 62:25, 64:23, 64:25, 65:1, 81:7, 81:17, 83:11, 83:22, 96:18, 98:15, 99:10, 99:11, 99:12, 108:16, 108:18, 122:16, 125:13, 125:15, 138:21, 143:3, 233:12, 233:18, 233:20, 234:4, 234:10, 234:19, 234:21, 237:13, 237:15, 250:19, 250:23, 251:2, 251:5, 251:11, 253:10, 253:13, 254:5, 254:20, 255:4, 255:5, 265:16, 266:13, 272:2
knows [7] - 14:3, 46:24, 50:10, 60:4, 64:2, 64:3, 243:20
KRAS [2] - 166:10, 166:12

L

lab [8] - 41:12, 42:17, 45:16, 58:2, 58:3, 65:20, 91:17, 95:2
laboratories [4] - 212:24, 237:14, 237:16, 237:17
laboratory [29] - 40:16, 44:16, 55:12, 61:15, 63:20, 69:24, 109:25, 158:23, 158:24, 179:25, 186:17, 215:16, 232:16, 245:7, 245:15, 245:22, 245:24, 246:1, 246:2, 246:5, 246:13, 246:17, 246:18, 246:19, 247:19, 247:20, 248:16, 248:19, 248:21
lack [6] - 28:22, 28:24, 68:21, 144:19, 199:7, 220:22
laid [3] - 9:14, 20:20, 33:9
Lancet [7] - 31:15, 32:1, 33:3, 42:18, 125:14, 125:21, 126:7
landscape [3] - 67:19, 150:16, 160:7
lane [1] - 103:12
lanes [2] - 102:13, 103:10
language [14] - 17:14, 27:24, 64:23, 89:15, 112:4, 159:18, 184:5, 184:6, 186:25, 187:4, 225:4, 247:15, 249:10
laptop [3] - 65:14, 165:16, 165:18
large [9] - 76:6, 76:21, 77:4, 90:18, 97:4, 162:13, 164:20, 165:24, 167:15
largely [3] - 67:2, 110:23, 145:12
last [10] - 119:6, 133:1, 180:24, 186:1, 193:7, 194:16, 217:25, 242:18, 277:4
late [6] - 40:23, 72:5, 170:22, 170:24, 267:15, 278:19
late-breaking [1] - 72:5
latitude [2] - 148:17, 148:18
launch [2] - 109:9, 213:7
launched [7] - 159:7, 159:8, 165:18, 189:14, 196:6, 212:23, 213:1
launches [2] - 201:6, 223:14
law [29] - 6:7, 6:12, 6:13, 6:17, 11:23, 13:17, 13:20, 17:9, 22:23, 26:16, 27:20, 29:12, 32:10, 32:19, 33:17, 38:8, 49:7, 49:8, 55:8, 57:13, 64:19, 129:13, 130:6, 160:23, 160:24, 161:3, 274:20, 278:11, 283:3
laws [1] - 28:16
lawyer [5] - 41:18, 131:21, 132:13, 239:9, 258:25
lay [3] - 6:1, 154:10, 275:11
layperson [1] - 17:7
lead [5] - 23:1, 175:23, 194:13, 265:13, 266:6
leader [2] - 44:24, 45:13
leaders [1] - 60:4
learn [1] - 272:18
learned [2] - 45:15, 162:6
leased [1] - 103:7
least [31] - 4:17, 31:13, 34:13, 35:10, 59:19, 61:19, 84:25, 85:22, 88:20, 89:3, 90:9, 95:13, 96:22, 97:1, 97:16, 125:15, 125:19, 133:19, 139:2, 143:4, 204:25, 205:21, 244:8, 244:19, 245:9, 245:17, 246:14, 246:15, 261:5, 265:2, 276:5
leave [6] - 4:15, 17:22, 17:23, 49:17, 263:9, 283:4
lectures [1] - 161:23
led [1] - 109:8
left [10] - 14:20, 67:25, 84:1, 113:22, 197:17, 214:3, 214:4, 280:11, 280:13, 280:14
legal [11] - 29:22, 53:5, 55:5, 131:20, 132:23, 267:18, 268:7, 268:9, 268:19, 271:15, 274:18
LELAND [2] - 1:5, 1:11
length [3] - 114:17, 148:10, 151:4
lengths [1] - 163:11
lens [1] - 55:6
less [9] - 30:1, 36:7, 99:16, 100:21, 102:4, 104:5, 111:4, 173:1, 250:3
lesson [2] - 137:6, 137:13
letter [4] - 10:15, 14:5, 278:8, 278:10
lettering [1] - 126:25
letters [6] - 82:10, 91:14, 91:15, 91:16, 91:18, 95:15
level [11] - 27:5, 46:7,

62:16, 78:6, 98:7, 104:4, 112:11, 127:24, 169:14, 172:4, 213:16
levels [4] - 102:14, 130:21, 170:10, 170:18
lexicon [1] - 43:14
liar [1] - 261:7
liberation [1] - 39:18
libraries [2] - 183:8, 183:9
library [4] - 190:18, 226:5, 226:14, 226:25
lied [1] - 206:9
Life [1] - 92:6
light [2] - 4:9, 4:22
likely [2] - 107:14, 115:25
limit [9] - 68:3, 97:12, 97:20, 98:4, 101:14, 102:17, 143:14, 144:20
limitation [14] - 30:10, 36:15, 99:15, 112:24, 113:5, 172:10, 200:9, 216:4, 230:6, 248:25, 249:3, 249:17, 249:20, 260:8
limitations [65] - 23:20, 26:7, 26:8, 26:21, 36:14, 93:17, 93:20, 93:21, 94:1, 94:11, 121:2, 121:8, 121:10, 129:14, 139:23, 142:19, 142:22, 143:6, 143:16, 156:19, 156:21, 156:22, 156:25, 157:5, 157:20, 157:23, 158:3, 175:16, 180:11, 181:17, 189:17, 191:19, 191:20, 191:22, 191:24, 193:4, 194:6, 194:14, 195:1, 195:9, 196:13, 196:14, 197:23, 199:7, 199:8, 201:16, 225:23, 230:5, 230:10, 230:17, 235:1, 239:20, 241:21, 246:20, 247:21, 259:16, 259:19, 259:24, 260:3, 260:10, 260:14, 261:25, 262:15, 278:22
limited [15] - 11:13, 33:23, 35:21, 68:10, 143:13, 157:7, 175:17, 180:12, 181:22, 196:24, 196:25, 201:5, 253:23, 270:7
limiting [1] - 181:14
limits [1] - 278:17
line [22] - 47:12, 126:22, 139:13, 154:3, 180:22, 181:4, 185:16, 219:22, 220:2, 231:21, 234:1, 234:2, 236:2, 244:15, 244:16, 246:10, 247:17, 247:18, 253:18, 264:18
lines [13] - 92:23, 121:23, 130:12, 136:12, 180:7, 182:1, 183:22, 186:5, 231:22, 233:7, 239:1, 241:23
link [1] - 85:5
liquid [3] - 212:15, 212:18
list [9] - 90:6, 93:8, 96:16, 96:17, 103:24, 106:5, 127:16, 134:8, 157:9
listed [5] - 112:6, 156:20, 186:17, 187:7, 223:25
listen [3] - 20:17, 136:4, 141:2
listening [1] - 272:18
listing [1] - 96:11
lists [2] - 90:18, 119:7
literally [2] - 32:24, 59:18
literature [9] - 10:8, 10:12, 37:7, 62:18, 101:3, 136:17, 136:22, 137:22, 146:2
litigation [1] - 29:17
Liu [3] - 33:9, 126:19, 127:3
live [2] - 61:19, 124:22
liver [1] - 31:17
LLP [11] - 2:2, 2:6, 2:10, 2:14, 2:18, 2:22, 3:2, 3:6, 3:12, 3:16, 3:20
Lo [16] - 32:24, 33:3, 33:10, 35:11, 36:18, 36:25, 37:1, 39:16, 125:14, 125:16, 125:20, 126:7, 135:16, 135:24, 136:23, 136:25
Lo's [2] - 31:15, 32:1
load [5] - 98:8, 98:24, 98:25
local [2] - 67:7, 76:18
location [1] - 89:14
locations [2] - 104:7, 104:11
logic [1] - 59:24
logical [10] - 78:17, 118:25, 120:3, 120:10, 121:7, 123:10, 127:18, 128:5, 128:19, 271:23
look [78] - 11:17, 18:7, 27:14, 27:19, 27:22, 29:4, 33:19, 48:1, 49:16, 52:6, 65:3, 68:13, 69:20, 71:13, 77:22, 77:24, 82:6, 86:18, 103:10, 104:25, 112:15, 120:1, 120:6, 122:22, 127:14, 127:15, 134:25, 136:22, 136:24, 137:15, 137:16, 137:22, 142:16, 143:25, 144:7, 146:5, 148:1, 148:22, 148:23, 161:2, 161:14, 164:20, 165:5, 165:21, 166:5, 166:7, 171:17, 171:19, 171:22, 171:23, 173:21, 174:20, 181:25, 184:13, 185:2, 185:13, 194:16, 198:6, 199:3, 213:21, 214:20, 215:6, 217:20, 217:21, 219:1, 219:20, 219:22, 220:23, 228:9, 239:24, 248:10, 250:15, 255:1, 258:6, 267:25, 272:6, 272:9, 278:11
looked [9] - 33:2, 98:23, 104:9, 136:17, 141:16, 165:10, 218:1, 230:23, 238:12
looking [34] - 34:15, 36:20, 36:22, 44:5, 48:20, 62:18, 71:1, 77:15, 84:3, 104:14, 109:2, 109:10, 110:17, 111:19, 134:21, 165:2, 165:24, 166:11, 167:8, 170:10, 182:12, 184:7, 184:11, 184:25, 185:14, 190:6, 209:10, 213:24, 220:1, 228:14, 264:13, 264:14, 268:19
looks [2] - 45:21, 51:10
loops [1] - 54:6
los [1] - 3:3
lose [3] - 109:19, 137:9, 266:4
lost [1] - 21:12
low [12] - 43:16, 43:20, 101:14, 102:17, 139:9, 140:13, 140:14, 140:24, 141:6, 141:8, 215:2
lower [3] - 63:4, 84:1, 112:16
Lui [1] - 33:12
Lui's [1] - 33:12
lunch [3] - 123:23, 167:24, 168:2
luncheon [1] - 168:8
luxury [1] - 199:11
lyse [2] - 171:5, 171:6

M

machine [14] - 47:20, 97:22, 98:3, 98:8, 100:3, 101:11, 101:12, 101:16, 101:25, 102:1, 119:10, 133:23, 191:19, 199:9
machines [16] - 22:17, 25:10, 25:20, 28:7, 78:9, 86:14, 88:24, 88:25, 95:25, 96:1, 100:10, 105:23, 119:11, 146:25, 195:4, 195:6
Magistrate [1] - 6:14
Magistrate's [1] - 6:6
magnitude [3] - 70:12, 198:14, 198:16
major [4] - 61:8, 70:25, 71:7, 215:4
male [16] - 34:12, 34:15, 35:4, 35:5, 37:2, 37:3, 37:5, 37:8, 37:15, 37:16, 38:22, 38:25, 127:7, 127:8, 167:9, 171:16
male/female [3] - 34:15, 177:17, 180:12
male/organ [1] - 181:24
males [1] - 167:11
management [1] - 8:1
managing [1] - 268:18
Manges [1] - 5:4
MANGES [3] - 2:6, 2:10, 2:14
manner [5] - 44:6, 123:10, 134:13, 231:14, 231:23
manners [1] - 134:13
manual [7] - 66:6, 66:20, 94:22, 94:23, 147:10, 186:17, 186:23
Manual [1] - 24:8
manually [2] - 220:24, 221:7
manuals [1] - 146:11
manufacturer [8] - 97:24, 100:16, 100:18, 101:2, 101:4, 146:1, 148:1, 157:15
manufacturer's [7] - 22:18, 94:21, 95:3, 103:16, 104:13, 111:4, 134:7
manufacturers [9] - 96:17, 101:18, 121:5, 147:22, 148:4, 148:5, 156:16, 157:10, 161:6
map [2] - 165:3, 165:9
mapping [8] - 76:4, 183:19, 184:22, 190:20, 229:6, 229:9, 229:16, 259:17
March [1] - 193:11
mark [1] - 31:22
marker [4] - 32:2, 125:24, 171:19, 172:23
markers [3] - 50:19, 171:22, 174:22

market [2] - 102:24, 103:1
marketed [2] - 105:25, 149:18
marketing [1] - 143:15
Markman [3] - 13:11, 16:22, 271:3
mask [5] - 4:12, 4:13, 4:14, 4:19, 9:3
masks [2] - 4:11, 133:20
mass [7] - 72:3, 72:8, 72:12, 133:21, 133:23, 151:10, 206:12
Massachusetts [2] - 3:17, 109:2
massive [4] - 163:15, 165:13, 166:21, 203:6
match [2] - 30:3, 207:3
matched [1] - 165:10
material [13] - 18:24, 22:4, 22:10, 25:1, 48:5, 100:13, 169:15, 169:17, 172:7, 174:19, 210:15, 269:17
materials [1] - 195:6
maternal [5] - 242:22, 243:6, 247:3, 247:23, 248:7
math [1] - 97:3
mathematical [1] - 49:9
matter [14] - 11:23, 13:4, 14:4, 20:8, 20:9, 22:23, 24:24, 29:12, 62:6, 267:18, 272:20, 272:21, 274:20, 275:10
matters [3] - 12:5, 274:17, 275:10
mc [1] - 59:17
mean [77] - 9:5, 12:7, 12:25, 16:20, 17:17, 23:16, 23:23, 24:2, 24:3, 24:5, 32:22, 34:19, 34:22, 35:22, 36:21, 51:16, 51:18, 60:20, 63:5, 64:4, 64:20, 66:16, 69:13, 69:18, 72:5, 88:7, 97:2, 99:3, 99:10, 107:3, 107:10, 125:9, 126:3, 130:4, 160:11, 163:17, 163:21, 165:2, 166:24, 169:21, 179:9, 179:16, 195:2, 203:7, 203:20, 218:15, 218:23, 222:8, 228:20, 242:24, 255:6, 255:11, 258:25, 266:6, 266:18, 266:23, 267:12, 267:16, 267:20, 267:24, 273:18, 274:6, 274:10, 274:16, 274:18, 275:22, 276:5, 276:18, 277:1, 278:3, 278:12, 278:24, 280:13, 281:10, 282:17, 282:21
meaning [3] - 89:11, 218:18, 271:10
meaningful [1] - 10:20
means [15] - 34:23, 35:23, 36:12, 41:15, 45:10, 89:19, 95:17, 98:21, 104:13, 107:11, 107:15, 130:2, 166:10, 187:4, 267:14
meant [3] - 92:2, 277:24, 280:4
meantime [1] - 281:7
measure [17] - 13:21, 34:12, 40:4, 40:16, 40:20, 56:20, 66:25, 71:19, 98:16, 107:12, 119:24, 119:25, 122:25, 123:1, 174:14, 174:20, 180:14
measured [2] - 60:25, 61:1
measurement [14] - 13:22, 44:16, 55:11, 55:19, 55:24, 57:5, 58:14, 60:23, 98:15, 98:16, 99:4, 129:11, 130:21, 164:3
measurements [7] - 99:4, 119:22, 119:24, 123:2, 128:18, 130:24
measuring [12] - 40:17, 46:7, 60:1, 60:17, 61:16, 65:10, 99:11, 99:12, 107:11, 107:15, 127:22, 172:5
mechanism [1] - 6:24
Medicaid [1] - 159:2
medical [1] - 44:22
Medicare [1] - 159:2
Medicine [1] - 75:18
medicine [1] - 172:21
meet [1] - 4:21
meetings [1] - 93:25
meets [2] - 61:22, 61:23
member [1] - 154:14
men [1] - 36:23
Mendy [1] - 226:8
mention [3] - 28:15, 90:5, 112:1
mentioned [17] - 87:15, 92:13, 95:24, 108:24, 120:23, 171:1, 172:24, 180:17, 189:5, 189:9, 193:20, 193:22, 199:13, 200:11, 206:19, 211:9, 211:19
merely [2] - 36:7, 57:24
merits [2] - 268:12, 269:12
Merriam [1] - 202:22
message [1] - 27:4
messenger [1] - 148:22
messing [1] - 148:6
met [2] - 216:21, 255:20
method [70] - 28:6, 29:24, 36:10, 43:23, 46:16, 51:19, 55:1, 55:11, 56:21, 57:5, 61:1, 61:15, 62:1, 63:22, 66:10, 81:9, 81:17, 83:19, 83:21, 95:13, 111:6, 112:3, 112:7, 114:5, 117:14, 118:4, 120:21, 121:12, 121:19, 122:16, 127:19, 127:20, 128:16, 135:15, 136:8, 136:16, 139:16, 140:2, 151:15, 158:20, 163:8, 172:16, 172:17, 177:2, 178:18, 178:19, 178:21, 182:16, 183:7, 184:22, 215:13, 215:15, 223:21, 223:25, 224:3, 224:11, 224:15, 231:8, 231:17, 232:3, 234:11, 242:22, 243:2, 243:6, 245:20, 250:18, 251:11, 261:20, 271:21
methodically [1] - 175:3
methodologies [3] - 224:18, 234:24, 253:15
methodology [2] - 95:22, 202:17
methods [93] - 29:4, 65:8, 69:24, 78:6, 78:10, 78:15, 78:16, 78:17, 83:22, 83:24, 96:16, 106:3, 108:16, 111:8, 111:23, 117:5, 118:20, 119:1, 120:14, 120:16, 123:3, 123:10, 128:18, 129:9, 129:23, 130:19, 133:1, 133:16, 137:1, 139:20, 140:4, 140:5, 151:9, 156:14, 163:14, 164:11, 165:12, 166:7, 166:17, 166:20, 170:23, 175:3, 178:8, 179:24, 180:20, 182:17, 186:20, 195:10, 208:21, 210:6, 210:21, 223:18, 223:23, 223:25, 224:19, 224:24, 225:2, 225:10, 225:14, 225:18, 226:13, 226:22, 230:3, 230:6, 232:4, 232:12, 232:20, 233:12, 233:14, 233:17, 233:20, 234:4, 234:6, 234:19, 234:22, 235:18, 235:21, 236:8, 237:23, 239:5, 239:20, 240:23, 240:25, 241:2, 242:23, 242:24, 242:25, 243:5, 243:8, 250:22, 251:4, 251:5, 263:23
mettle [1] - 153:16
MGH [1] - 77:15
microbiology [1] - 122:1
microchimerism [5] - 33:24, 34:1, 35:3, 172:3, 181:7
microfluid [1] - 212:21
microfluidics [2] - 212:25, 213:15
microfluidity [1] - 212:20
microscope [1] - 98:23
might [30] - 9:14, 35:5, 39:9, 41:13, 46:2, 46:16, 50:6, 82:21, 91:10, 91:19, 91:20, 121:2, 121:8, 125:17, 125:19, 139:23, 146:9, 162:7, 173:15, 181:8, 184:2, 185:12, 186:8, 186:14, 198:23, 208:6, 220:18, 229:6, 261:9, 266:7
migrating [1] - 201:17
million [8] - 85:1, 85:4, 94:6, 98:6, 101:15, 122:22, 147:10, 161:25
millions [1] - 160:19
mind [7] - 7:6, 260:19, 262:17, 272:17, 272:24, 273:1, 276:12
mine [1] - 47:15
minimally [1] - 72:11
minimum [3] - 18:7, 64:5, 269:16
Minnesota [2] - 169:3, 201:8
minor [1] - 137:17
minute [1] - 210:9
minutes [3] - 113:25, 214:5, 255:16
mis [1] - 137:3
mis-answered [1] - 137:3
miscalled [1] - 99:20
miscalling [1] - 99:19
mischaracterizations [1] - 137:16
mischaracterize [1] - 138:8
mischaracterizing [1] - 137:20
mismatch [7] - 171:15, 172:11, 177:16, 177:18, 180:13, 181:23
mismatching [1] - 209:18

misprime [2] - 207:5
mispriming [2] - 207:13, 209:6
misread [1] - 234:10
missing [2] - 193:25, 269:10
misspoke [1] - 70:11
misspoken [1] - 131:10
mistake [2] - 20:6, 37:24
mistaken [1] - 131:6
mistakes [1] - 264:10
misunderstanding [1] - 39:9
misunderstood [2] - 38:12, 233:19
mitigate [1] - 69:23
mixing [3] - 102:17, 207:7, 207:21
model [1] - 8:4
modification [2] - 106:19, 106:20
modifications [5] - 78:15, 90:19, 90:20, 112:9, 122:18
modify [4] - 131:4, 220:18, 220:20, 220:21
molecular [9] - 64:15, 68:22, 122:1, 139:14, 179:23, 185:10, 186:17, 186:18, 194:18
molecule [6] - 26:16, 27:17, 105:4, 105:5, 107:20, 212:19
molecules [9] - 98:6, 98:21, 99:2, 99:5, 99:6, 99:8, 105:13, 107:20, 108:19
moment [4] - 43:2, 44:8, 44:12, 144:8
Monday [1] - 1:19
money [4] - 194:9, 194:11, 198:25, 261:9
monitor [6] - 43:1, 164:7, 170:13, 172:18, 176:13, 177:11
monitored [1] - 170:7
monitoring [2] - 116:6, 172:16
months [5] - 35:5, 51:12, 77:10, 161:1, 165:14
Moore's [2] - 160:23, 161:3
morbidities [1] - 170:17
moreover [2] - 144:18
morning [9] - 4:6, 4:25, 5:1, 5:7, 5:13, 73:16, 73:17, 74:13, 74:14
Morris [1] - 5:8
MORRIS [1] - 2:18
Mortgage [1] - 23:14
mortgage [1] - 162:5
most [12] - 8:10, 12:8, 31:17, 40:7, 56:18, 90:18, 90:20, 148:3, 170:8, 172:10, 205:14, 205:17
mostly [5] - 11:21, 72:3, 129:19, 169:9, 170:15
mother [2] - 110:7, 114:18
motion [23] - 6:20, 6:21, 7:3, 7:7, 7:15, 7:17, 7:25, 8:17, 9:8, 9:9, 16:20, 18:18, 19:14, 19:19, 20:1, 21:8, 21:21, 113:9, 268:12, 269:18, 269:19, 276:14
motions [5] - 7:16, 9:10, 23:6, 60:9
motivation [1] - 245:12
mouse [2] - 146:16, 146:18
mouthful [1] - 216:2
movant [3] - 7:3, 7:9, 277:3
move [7] - 63:23, 80:11, 88:5, 132:2, 235:15, 242:19, 249:12
moved [4] - 76:3, 76:5, 77:7, 154:21
moving [2] - 33:2, 277:21
MPEP [2] - 24:8, 28:16
MR [335] - 4:25, 5:2, 5:6, 5:7, 8:20, 8:22, 11:1, 11:11, 11:15, 11:21, 13:6, 14:9, 14:12, 14:18, 14:21, 14:24, 15:2, 15:6, 15:8, 15:11, 15:24, 16:11, 17:16, 18:1, 18:12, 19:10, 20:13, 20:18, 20:23, 21:3, 21:5, 21:16, 21:23, 23:24, 24:3, 29:18, 29:23, 31:8, 31:11, 32:5, 32:8, 32:10, 32:13, 32:16, 32:22, 32:24, 33:2, 34:1, 35:22, 36:13, 36:20, 36:25, 37:6, 37:11, 37:13, 37:17, 37:25, 38:9, 38:20, 38:24, 39:8, 39:12, 39:22, 40:3, 40:10, 40:15, 40:20, 41:2, 41:5, 41:17, 44:15, 44:21, 45:22, 47:8, 47:14, 48:14, 48:16, 48:19, 49:24, 50:1, 50:5, 51:4, 51:8, 51:15, 51:18, 51:23, 53:1, 53:4, 53:12, 53:23, 53:25, 54:5, 54:12, 54:14, 54:16, 54:20, 54:22, 54:25, 55:3, 56:1, 56:5, 56:17, 57:21, 57:24, 58:8, 58:13, 58:20, 58:22, 58:25, 59:21, 59:23, 60:14, 60:19, 60:25, 64:1, 66:9, 66:15, 66:18, 69:1, 69:6, 73:7, 73:9, 73:13, 74:3, 74:6, 74:12, 87:25, 123:15, 123:18, 123:20, 123:25, 124:14, 124:20, 130:10, 131:15, 132:2, 132:16, 132:18, 137:18, 138:1, 138:7, 138:10, 141:4, 141:5, 142:7, 142:16, 142:18, 151:16, 151:19, 151:20, 152:21, 152:23, 152:25, 153:6, 153:7, 153:8, 153:9, 153:11, 154:10, 154:12, 154:17, 155:20, 155:23, 159:16, 159:24, 168:1, 168:3, 168:6, 168:7, 168:21, 168:23, 174:3, 174:4, 174:7, 174:9, 180:6, 180:8, 180:25, 181:3, 182:19, 182:21, 183:21, 183:24, 184:13, 184:15, 185:3, 185:5, 186:4, 186:10, 187:19, 187:21, 189:23, 189:25, 190:10, 190:12, 197:12, 197:14, 197:18, 197:20, 198:6, 198:8, 204:18, 207:23, 207:25, 208:6, 208:22, 208:25, 209:7, 209:8, 209:13, 209:16, 213:18, 213:20, 214:4, 214:8, 214:9, 216:6, 216:9, 216:14, 216:15, 216:18, 216:20, 234:7, 234:9, 234:10, 234:12, 234:15, 234:16, 235:8, 235:13, 235:15, 235:16, 235:25, 239:14, 239:16, 240:3, 242:11, 242:20, 255:7, 255:16, 255:19, 256:10, 256:13, 257:9, 257:11, 259:3, 259:7, 259:13, 259:14, 260:15, 265:20, 265:23, 265:24, 266:19, 266:25, 267:5, 267:14, 267:21, 267:24, 268:4, 268:10, 268:13, 268:20, 268:24, 269:3, 269:7, 269:16, 269:21, 269:24, 270:1, 270:4, 270:11, 270:18, 270:22, 270:25, 271:2, 271:5, 271:7, 271:11, 271:13, 272:14, 272:23, 273:2, 273:6, 273:10, 273:13, 273:18, 273:21, 274:23, 275:4, 275:7, 275:19, 275:22, 276:1, 276:18, 276:23, 277:2, 277:9, 277:12, 277:14, 277:20, 278:1, 278:6, 278:10, 278:13, 278:17, 278:21, 278:23, 279:6, 279:21, 279:22, 280:1, 280:5, 280:6, 280:8, 280:13, 280:18, 280:20, 280:24, 281:2, 281:6, 281:9, 281:11, 281:15, 281:17, 281:20, 281:23, 282:4, 282:7, 282:10, 282:13, 282:14, 282:18, 282:25, 283:7
MS [29] - 5:13, 21:15, 73:16, 73:18, 73:21, 74:2, 74:24, 80:15, 80:17, 88:6, 88:10, 101:6, 113:7, 113:21, 113:24, 114:2, 114:4, 123:11, 142:5, 152:20, 152:22, 153:3, 155:25, 156:3, 159:12, 159:20, 167:19, 168:15, 168:18
Mullis [3] - 86:1, 88:16
multiple [16] - 35:1, 71:2, 71:14, 175:5, 185:20, 187:10, 188:5, 191:16, 208:11, 210:18, 211:14, 219:7, 236:13, 250:11, 263:23
multiplex [29] - 47:9, 56:8, 60:20, 71:6, 71:12, 71:23, 79:23, 88:3, 91:6, 202:5, 205:2, 205:4, 205:20, 206:18, 206:20, 208:14, 209:5, 209:23, 210:19, 211:16, 215:3, 221:24, 225:23, 229:2, 236:3, 236:6, 237:18, 244:13, 257:24
multiplex/high [1] - 258:13
multiplex/high-throughput [1] - 258:13
multiplexed [9] - 70:24, 116:10, 208:5, 209:1, 210:5, 210:23, 210:25, 211:3, 211:11
multiplexing [1] - 71:21
multiplying [1] - 176:15
must [3] - 49:11, 87:7, 200:11
muster [1] - 64:8
mutation [5] - 166:3,

166:8, 166:10, 166:12
mutations [3] - 72:10, 148:24, 162:7

N

naked [1] - 58:19
name [3] - 169:1, 266:4, 266:5
named [1] - 99:7
narrow [3] - 130:4, 218:20, 218:22
narrowed [1] - 275:8
narrower [1] - 218:10
narrowness [1] - 225:20
Natera [14] - 3:10, 5:8, 5:10, 18:13, 49:3, 70:15, 179:9, 208:13, 210:2, 210:5, 212:4, 214:17, 214:19, 217:1
NATERA [1] - 1:8
Natera's [2] - 70:14, 70:23
National [3] - 160:22, 169:7, 178:9
natural [64] - 17:19, 31:25, 32:4, 33:17, 37:20, 38:2, 40:21, 42:6, 49:5, 53:14, 53:21, 53:22, 54:4, 55:8, 57:1, 57:2, 57:13, 57:22, 58:11, 58:19, 59:1, 59:4, 59:9, 59:10, 59:20, 60:7, 61:25, 64:19, 71:25, 107:24, 107:25, 109:20, 114:25, 115:3, 115:20, 117:6, 117:9, 117:25, 118:17, 120:11, 124:23, 124:24, 125:2, 125:4, 125:7, 126:6, 126:10, 129:5, 129:6, 129:11, 129:24, 131:17, 131:19, 132:22, 133:2, 133:9, 133:12, 133:13, 136:7, 167:12, 169:16, 271:23
naturally [16] - 19:2, 80:20, 107:13, 108:4, 108:7, 109:16, 115:2, 115:11, 116:1, 116:25, 117:21, 118:12, 118:13, 125:9, 130:15, 130:22
nature [3] - 26:16, 49:7, 49:8
NDS [1] - 141:23
nearly [1] - 205:24
necessarily [11] - 7:5, 133:13, 138:23, 173:20, 185:21, 193:14, 206:14, 218:24, 235:2, 241:15, 259:25
necessary [11] - 6:2, 7:2, 8:16, 12:3, 13:23, 14:15, 21:9, 52:8, 275:12, 279:9
need [44] - 9:23, 11:18, 17:21, 20:11, 24:10, 29:16, 37:22, 39:9, 52:2, 59:6, 80:14, 119:20, 119:22, 132:13, 142:11, 142:17, 148:1, 148:23, 163:21, 164:22, 165:21, 166:17, 172:15, 172:17, 176:15, 178:3, 180:10, 193:7, 194:14, 195:10, 199:2, 208:6, 218:19, 238:16, 259:23, 264:7, 266:8, 269:9, 270:16, 274:21, 274:25, 275:2, 276:25, 277:22
needed [10] - 19:7, 19:8, 100:22, 151:9, 163:14, 165:12, 166:21, 188:12, 210:22, 238:12
needle [5] - 33:14, 34:9, 43:6, 43:21, 63:16
needle-in-the-haystack [2] - 43:6, 43:21
needs [7] - 70:1, 123:21, 179:21, 234:12, 242:9, 252:19, 252:25
neonatal [1] - 78:21
NESS [1] - 168:12
Ness [27] - 26:20, 30:6, 31:1, 63:16, 168:24, 169:1, 174:11, 181:5, 182:3, 183:6, 183:11, 183:17, 183:25, 184:16, 185:18, 186:11, 190:13, 193:24, 197:4, 197:15, 198:9, 208:19, 209:9, 210:3, 210:16, 215:9, 216:21
Ness' [2] - 112:20, 113:1
Nether [1] - 164:6
network [1] - 169:8
Network [1] - 75:18
never [18] - 7:9, 7:12, 19:12, 26:3, 29:9, 29:20, 48:6, 65:20, 113:10, 145:18, 145:21, 145:23, 146:2, 254:16, 258:22, 261:23
New [2] - 2:15
new [79] - 5:17, 11:8, 30:8, 30:11, 41:21, 45:9, 45:21, 45:22, 45:25, 47:6, 47:20, 48:8, 49:16, 49:21, 49:22, 51:17, 51:19, 51:23, 51:24, 52:22, 54:25, 55:11, 55:19, 55:24, 57:5, 60:1, 65:22, 67:16, 67:21, 67:25, 71:8, 72:20, 94:7, 94:8, 107:4, 122:8, 122:9, 149:13, 149:16, 150:3, 150:8, 150:12, 150:15, 150:17, 151:9, 151:15, 152:6, 152:13, 153:4, 153:10, 159:19, 159:22, 160:6, 160:9, 161:8, 161:19, 162:17, 163:3, 163:8, 163:14, 165:12, 165:20, 165:21, 166:3, 166:17, 166:20, 188:24, 189:1, 190:14, 213:14, 221:20, 223:18, 223:21, 223:23, 223:25, 270:1
newly [1] - 50:8
newswire [1] - 197:6
NexGen [1] - 266:4
next [76] - 22:24, 25:3, 25:11, 26:19, 27:12, 29:3, 29:15, 30:4, 31:3, 31:20, 33:19, 44:4, 45:9, 45:25, 68:8, 68:19, 72:20, 73:8, 76:18, 77:11, 78:4, 79:19, 79:22, 95:18, 95:19, 124:10, 142:25, 143:11, 143:17, 145:6, 150:9, 151:21, 152:8, 152:17, 157:20, 158:3, 158:7, 167:22, 187:23, 188:9, 188:20, 191:10, 193:10, 193:18, 194:4, 194:22, 197:24, 198:12, 199:23, 200:18, 201:21, 202:8, 202:13, 203:2, 203:19, 204:12, 208:23, 218:7, 218:25, 219:10, 219:13, 220:12, 221:2, 221:7, 221:16, 228:15, 228:20, 256:17, 256:23, 257:21, 258:3, 258:13, 258:15, 262:7, 277:16
NGF [2] - 68:18
NGS [31] - 11:8, 46:6, 60:3, 69:12, 69:22, 69:24, 70:12, 144:18, 145:3, 150:8, 194:19, 217:12, 218:21, 219:6, 219:18, 220:9, 220:11, 220:15, 221:13, 227:20, 227:21, 227:25, 228:4, 228:12, 228:19, 228:20, 266:23, 267:3, 270:8, 270:17
nice [2] - 162:21, 261:3
NICHOLS [1] - 2:18
Nichols [1] - 5:8
night [1] - 86:13
nine [1] - 141:23
NO [2] - 1:9, 1:15
nobody [9] - 52:5, 52:6, 52:15, 52:16, 59:3, 93:23, 178:16, 182:6, 263:16
noisier [1] - 101:17
non [8] - 22:20, 35:15, 42:15, 104:8, 123:8, 210:22, 246:20, 247:21
non-conventional [2] - 104:8, 123:8
non-invasive [2] - 35:15, 42:15
non-routine [2] - 246:20, 247:21
non-standard [1] - 22:20
non-target [1] - 210:22
nonconventional [10] - 26:9, 28:22, 30:25, 81:21, 93:22, 99:1, 103:8, 103:19, 106:18, 260:9
none [6] - 64:15, 106:24, 121:11, 158:5, 178:22, 237:17
noninvasive [1] - 208:21
nonobvious [1] - 63:19
nontarget [1] - 71:15
noon [1] - 5:22
normal [7] - 10:19, 16:12, 109:7, 192:2, 192:3, 192:6, 276:4
normally [2] - 16:15, 275:24
note [1] - 209:3
noted [2] - 11:6, 182:13
nothing [19] - 24:20, 24:25, 25:5, 25:18, 25:19, 30:24, 49:15, 52:21, 64:19, 81:23, 88:1, 105:10, 121:15, 123:7, 123:8, 149:2, 166:11, 242:7, 243:23
nothingness [1] - 62:8
notice [1] - 68:6
noticed [1] - 170:21
notion [1] - 29:9
novel [6] - 63:18, 175:9, 178:15, 178:24, 188:24, 189:1
novelty [2] - 182:5, 187:12
November [31] - 79:8, 81:5, 83:10, 83:14, 92:17, 93:19, 96:1,

96:6, 102:3, 105:19, 108:9, 108:22, 110:21, 119:1, 121:18, 158:18, 222:7, 222:12, 222:16, 223:2, 232:16, 237:13, 237:21, 238:2, 238:6, 240:23, 241:5, 246:12, 251:14, 253:4, 254:5
novo [1] - 6:11
nuances [1] - 131:22
nucleic [18] - 28:1, 67:10, 108:17, 114:8, 116:8, 116:9, 117:15, 117:18, 117:19, 129:20, 156:12, 249:6, 250:19, 250:23, 251:5, 251:9, 252:19
nucleotide [12] - 34:23, 48:21, 49:18, 50:20, 79:21, 82:19, 82:24, 82:25, 89:3, 89:7, 205:10
nucleotides [2] - 82:24, 91:14
nucleus [2] - 114:16, 114:20
number [45] - 11:20, 15:9, 28:6, 28:8, 67:1, 75:14, 84:23, 90:6, 90:18, 92:4, 92:25, 105:21, 108:18, 132:7, 137:2, 141:13, 145:9, 146:15, 152:20, 152:22, 152:23, 154:22, 157:9, 184:22, 184:23, 184:24, 185:1, 201:25, 209:11, 210:19, 212:24, 212:25, 217:1, 217:4, 217:7, 223:10, 223:15, 234:25, 235:18, 235:21, 236:8, 237:14, 237:16, 237:17, 262:2
numbers [1] - 72:21

O

o'clock [1] - 1:19
object [10] - 10:8, 60:17, 67:16, 87:25, 142:5, 150:14, 154:4, 160:6, 242:11, 255:7
objection [5] - 10:9, 137:11, 152:20, 267:12, 271:7
objections [5] - 267:14, 267:17, 267:24, 276:15, 276:21
observant [1] - 11:5
observation [18] - 17:18, 32:3, 32:12, 51:11, 52:7, 53:14, 57:22, 58:7, 58:10, 58:11, 58:13, 59:10, 59:16, 59:20, 60:7, 60:15, 60:16, 118:21
observational [1] - 58:14
observations [1] - 51:22
observe [2] - 80:19, 120:11
observing [5] - 53:16, 53:20, 107:17, 118:17
obtain [9] - 81:12, 81:14, 81:21, 83:19, 84:14, 96:16, 98:14, 102:18, 247:25
obtaining [17] - 30:1, 30:8, 30:9, 79:17, 80:24, 81:3, 81:9, 129:9, 130:19, 137:2, 170:2, 174:15, 234:4, 234:19, 236:18, 236:21, 236:23
obvious [17] - 47:20, 50:25, 51:3, 53:18, 55:18, 57:16, 57:18, 61:2, 61:6, 62:19, 63:3, 63:5, 63:13, 64:25, 241:13, 241:15, 242:3
obviously [4] - 11:2, 17:8, 69:13, 170:17
obviousness [9] - 10:19, 56:23, 63:2, 63:3, 63:9, 64:21, 272:1, 272:5, 272:11
occur [8] - 82:12, 91:10, 105:14, 115:2, 118:12, 121:8, 126:11, 170:17
occurred [4] - 48:17, 67:24, 137:9, 253:7
occurring [6] - 19:2, 80:20, 116:2, 130:15, 130:23, 170:23
occurs [4] - 100:19, 109:16, 115:1, 118:13
OF [5] - 1:2, 1:5, 1:11
offended [1] - 63:22
offer [3] - 22:7, 22:21, 159:1
offering [1] - 19:18
office [1] - 5:16
Official [1] - 1:25
often [12] - 45:2, 95:10, 100:12, 100:13, 100:19, 115:24, 135:22, 165:23, 172:4, 191:1, 203:5, 205:13
oftentimes [6] - 170:21, 170:24, 171:15, 172:7, 172:8, 184:24
old [6] - 42:8, 46:1, 49:13, 72:14
on-its-face-style [1] - 13:19
once [5] - 64:23, 92:20, 207:12, 207:13, 211:12
one [202] - 4:13, 5:20, 8:18, 11:20, 15:9, 18:14, 20:6, 26:7, 27:15, 27:19, 28:12, 28:14, 31:13, 34:20, 34:21, 36:4, 36:16, 37:12, 37:13, 37:21, 39:6, 39:14, 46:18, 46:22, 47:3, 47:24, 48:16, 50:24, 56:6, 56:7, 56:14, 58:9, 60:4, 60:20, 62:22, 65:18, 65:23, 66:10, 67:17, 69:11, 70:20, 70:22, 71:2, 71:13, 71:19, 71:25, 76:25, 77:3, 77:7, 77:8, 78:18, 79:12, 80:18, 81:15, 82:20, 84:19, 85:22, 86:5, 86:10, 86:18, 88:13, 90:4, 90:7, 90:17, 91:9, 93:5, 94:7, 94:8, 94:22, 97:19, 98:24, 99:20, 100:21, 101:16, 103:7, 103:11, 104:17, 104:25, 105:12, 105:25, 106:13, 109:11, 109:25, 114:17, 114:18, 116:19, 118:20, 119:4, 119:5, 119:9, 128:6, 129:18, 131:4, 133:1, 133:20, 138:14, 140:8, 143:9, 145:13, 145:23, 146:14, 148:19, 151:2, 153:11, 154:12, 159:25, 160:16, 160:18, 161:18, 164:13, 164:18, 164:21, 166:6, 166:11, 171:1, 173:20, 177:14, 178:2, 178:12, 181:1, 186:1, 189:12, 190:25, 193:14, 193:18, 193:20, 195:7, 195:9, 195:15, 196:16, 200:12, 201:18, 201:25, 204:5, 204:9, 205:8, 205:19, 205:23, 206:4, 209:3, 209:4, 209:21, 211:7, 211:9, 212:2, 212:4, 212:24, 213:24, 219:2, 219:12, 221:3, 226:4, 229:4, 232:2, 232:11, 232:20, 234:23, 235:17, 235:19, 235:20, 238:14, 241:15, 241:17, 242:3, 243:9, 243:20, 243:24, 244:1, 244:5, 247:3, 247:23, 248:7, 248:20, 251:9, 252:12, 258:5, 259:15, 261:6, 263:7, 264:9, 264:11, 267:2, 268:16, 270:22, 271:17, 272:6, 273:19, 273:21, 278:1, 282:19
one-and-a-half [1] - 99:20
one-dimensional [1] - 70:22
one-thousand [1] - 85:22
ones [1] - 105:16
open [5] - 8:24, 14:20, 66:6, 114:21, 230:19
opening [7] - 20:24, 87:22, 141:16, 179:10, 182:23, 221:19, 244:6
operating [2] - 21:13, 273:23
operation [1] - 188:14
opined [1] - 29:11
opinion [28] - 81:2, 83:7, 91:5, 105:17, 108:8, 112:23, 113:4, 122:13, 127:12, 134:18, 134:20, 158:16, 159:5, 167:11, 169:15, 179:16, 189:8, 189:13, 198:22, 199:6, 209:3, 225:22, 238:18, 249:16, 249:19, 264:11, 265:2, 276:15
opinions [13] - 22:6, 75:5, 75:7, 78:3, 78:24, 91:1, 130:6, 132:9, 132:11, 134:17, 169:12, 276:13, 283:5
opportunities [3] - 67:25, 68:2, 152:11
opportunity [14] - 5:25, 6:1, 12:2, 14:17, 17:21, 19:25, 167:6, 229:13, 239:9, 271:19, 273:9, 273:12, 273:14, 275:11
oppose [2] - 269:2, 276:3
opposed [6] - 29:9, 113:11, 120:22, 121:13, 156:6, 156:12
opposition [1] - 113:13
optimization [1] - 111:3
optimized [2] - 70:2, 193:8
oral [1] - 7:11
order [18] - 6:15, 6:16, 7:1, 33:6, 52:24, 56:16, 56:17, 121:3, 121:4, 121:6, 121:7, 135:14, 136:7, 136:15, 145:23, 179:20, 255:3, 259:23
ordered [1] - 65:20
ordering [1] - 261:19
orderliness [1] - 9:15
ordinary [13] - 30:25,

43:22, 46:2, 46:3, 50:5, 139:16, 140:1, 209:21, 218:19, 224:22, 253:21, 265:3, 271:10
organ [64] - 35:4, 35:15, 37:2, 39:17, 42:1, 44:23, 60:2, 70:21, 114:6, 116:1, 117:16, 117:18, 117:25, 121:13, 125:1, 125:3, 125:6, 125:13, 127:6, 127:19, 135:6, 135:14, 136:7, 136:15, 155:16, 170:1, 170:6, 170:13, 171:5, 171:6, 171:10, 171:16, 172:6, 172:12, 172:18, 173:16, 173:21, 174:14, 174:21, 174:22, 175:10, 176:10, 176:13, 177:3, 177:7, 177:11, 180:14, 180:20, 206:16, 215:25, 237:2, 242:4, 242:23, 242:25, 243:6, 247:3, 247:7, 247:23, 248:7, 248:18, 249:6, 253:14, 254:18, 263:14
origin [2] - 41:24, 181:9
original [1] - 165:8
otherwise [26] - 22:12, 22:14, 22:15, 25:14, 25:19, 26:2, 28:22, 50:12, 64:17, 65:4, 69:14, 71:6, 121:24, 122:9, 180:3, 180:4, 182:13, 182:15, 183:13, 184:3, 184:20, 185:25, 187:9, 188:11
ought [2] - 7:22, 22:3
outcome [1] - 116:6
outline [2] - 21:23, 259:22
outlined [2] - 21:7, 248:4
output [2] - 60:16, 60:19
outright [1] - 261:7
outside [2] - 153:4, 189:6
outweighs [1] - 198:21
ovarian [3] - 77:10, 77:17, 109:10
oven [1] - 45:19
over-lawyer [1] - 41:18
overall [2] - 86:21, 175:20
overcame [5] - 241:21, 260:2, 260:5, 260:14, 262:1
overcome [19] - 22:23, 23:3, 121:2, 121:7, 121:9, 139:22, 155:14, 157:4, 174:24, 176:11, 177:9, 194:14, 196:13, 226:13, 226:22, 240:6, 260:8, 261:25, 276:9
overcoming [9] - 152:16, 226:24, 229:15, 238:22, 239:3, 239:6, 240:5, 240:12, 240:16
overlay [1] - 42:6
overload [1] - 34:22
overnight [2] - 86:13, 211:20
overrepresented [1] - 207:16
oversees [1] - 169:5
oversight [1] - 74:4
oversimplified [2] - 38:18, 59:3
overturn [1] - 6:14
overview [2] - 78:25, 79:13
owe [1] - 26:14
own [10] - 6:13, 7:4, 71:4, 109:9, 159:6, 164:3, 164:10, 170:17, 196:1
owners [2] - 134:4, 134:11

P

p.m [1] - 283:11
Pacific [1] - 134:14
Pack [3] - 51:6, 55:15, 58:3
package [1] - 114:19
packaged [2] - 114:14, 114:15
page [17] - 130:12, 136:12, 144:13, 231:22, 233:6, 234:1, 236:2, 238:25, 241:23, 244:15, 246:10, 247:17, 254:23, 257:14, 278:17, 278:22, 280:6
pair [2] - 52:11, 206:22
pairs [1] - 71:14
panel [1] - 13:11
Paper [1] - 178:10
paper [24] - 41:23, 42:12, 70:5, 70:10, 92:14, 95:12, 125:21, 149:11, 149:21, 149:22, 152:3, 157:11, 172:20, 172:21, 173:14, 178:7, 178:17, 190:2, 197:22, 208:2, 214:13, 255:23, 256:4, 256:7
papers [12] - 22:8, 68:6, 80:8, 106:13, 106:17, 126:19, 127:3, 127:11, 127:17, 178:13, 188:19
paragraph [15] - 140:10, 150:2, 150:12, 181:13, 182:18, 183:10, 184:14, 186:8, 186:9, 194:13, 198:7, 208:24, 209:15, 210:15, 258:7
paragraphs [2] - 187:20, 188:5
parallel [1] - 203:6
parameters [3] - 148:4, 148:11, 148:13
parse [1] - 37:17
part [32] - 10:21, 10:23, 15:23, 15:24, 19:5, 19:18, 36:3, 37:19, 76:2, 76:15, 88:19, 109:20, 115:5, 115:24, 125:7, 129:6, 180:10, 182:15, 184:18, 208:23, 241:20, 247:16, 249:2, 249:3, 251:16, 255:12, 261:7, 264:16, 267:2, 274:22, 280:22, 283:2
partial [1] - 41:13
partially [1] - 69:25
particle [2] - 212:15, 212:16
particles [1] - 212:18
particular [19] - 19:21, 35:20, 52:17, 67:5, 81:8, 83:13, 83:15, 83:21, 90:12, 92:2, 154:3, 161:16, 182:7, 183:14, 187:5, 212:16, 238:22, 239:3, 241:14
particularly [4] - 71:18, 85:17, 211:15, 253:6
particulars [1] - 27:5
parties [9] - 9:13, 12:18, 13:25, 16:23, 256:22, 270:5, 273:24, 276:13, 277:19
parties' [1] - 7:19
partly [1] - 198:16
party [1] - 280:16
pass [6] - 57:8, 62:1, 123:11, 215:14, 216:6
passage [10] - 112:15, 179:4, 179:14, 180:24, 182:11, 182:23, 187:18, 194:4, 253:20
passages [1] - 188:2
passes [1] - 64:8
passing [1] - 199:13
past [1] - 219:12
pat [1] - 188:23
paten [1] - 112:3
Patent [1] - 24:8
patent [282] - 12:4, 12:8, 12:12, 22:16, 22:19, 23:1, 23:5, 23:21, 24:11, 24:15, 25:13, 25:18, 25:20, 25:24, 26:2, 26:5, 26:23, 26:25, 27:8, 27:20, 27:22, 27:24, 27:25, 28:4, 28:11, 28:13, 30:7, 32:6, 32:11, 33:2, 33:9, 33:16, 37:8, 39:18, 41:21, 43:18, 47:6, 49:10, 49:22, 50:1, 50:4, 50:7, 50:8, 50:11, 51:12, 51:17, 52:4, 52:21, 52:23, 53:14, 54:1, 54:6, 54:9, 55:9, 55:13, 57:3, 58:10, 58:11, 58:18, 59:9, 59:10, 59:15, 59:16, 59:17, 59:18, 60:5, 64:18, 65:2, 65:13, 65:17, 66:1, 66:25, 67:1, 67:2, 67:4, 67:19, 68:24, 69:4, 70:2, 72:2, 72:4, 72:5, 72:6, 77:25, 78:25, 80:4, 80:25, 81:1, 85:17, 86:22, 87:6, 87:13, 87:17, 87:18, 88:19, 89:1, 91:4, 92:9, 92:22, 92:23, 92:25, 93:3, 93:13, 94:12, 95:4, 96:20, 99:14, 102:8, 103:3, 103:9, 104:15, 104:19, 105:21, 106:2, 106:9, 106:10, 109:14, 111:5, 111:25, 112:24, 113:5, 113:9, 114:3, 114:5, 116:4, 117:4, 117:12, 117:14, 117:24, 118:3, 118:4, 118:16, 120:21, 121:1, 121:23, 122:6, 123:9, 124:24, 126:16, 126:19, 126:22, 128:22, 128:25, 129:13, 130:7, 130:8, 131:21, 132:13, 134:1, 134:4, 134:5, 134:11, 135:24, 149:6, 149:10, 157:14, 172:25, 173:3, 174:8, 174:11, 174:24, 175:8, 175:14, 175:17, 176:1, 176:3, 176:5, 176:11, 176:19, 176:22, 176:24, 176:25, 177:20, 178:6, 178:8, 178:22, 178:23, 179:4, 182:7, 183:7, 183:12, 183:18, 184:3, 184:10, 184:18, 184:25, 185:9, 186:3, 187:5, 187:8, 187:12, 187:14, 188:2, 188:13, 188:25, 189:6, 189:10, 193:21, 193:22, 195:10, 197:22,

204:20, 208:13, 208:20, 209:10, 210:8, 210:13, 213:12, 213:19, 214:18, 217:20, 218:5, 218:15, 219:18, 219:25, 220:16, 222:3, 223:13, 223:21, 224:1, 224:19, 224:22, 225:19, 226:12, 226:21, 226:23, 226:24, 227:2, 228:14, 229:15, 229:24, 230:1, 230:13, 230:22, 231:13, 231:23, 232:6, 232:23, 233:3, 233:4, 233:9, 236:5, 237:4, 238:12, 240:13, 240:14, 241:5, 241:16, 241:25, 243:3, 243:11, 244:18, 244:23, 245:25, 246:25, 247:6, 247:11, 248:9, 249:12, 249:20, 250:2, 250:5, 250:14, 252:25, 254:10, 254:11, 254:12, 254:14, 254:25, 261:15, 261:25, 263:15, 263:20, 272:8, 275:13, 280:21

patent's [3] - 224:2, 224:8, 224:14

patent-in-suit [1] - 175:14

patentable [3] - 32:15, 38:4, 58:21

patented [4] - 30:25, 32:25, 157:2, 225:15

patentee [5] - 23:4, 23:6, 24:14, 28:18

patents [118] - 6:3, 17:18, 18:25, 19:21, 27:14, 29:25, 30:17, 42:4, 43:12, 50:10, 53:5, 53:19, 61:8, 66:22, 75:24, 77:22, 77:23, 78:11, 78:14, 79:4, 79:6, 79:11, 79:14, 80:19, 81:20, 84:11, 84:16, 85:12, 91:23, 94:15, 94:19, 96:13, 106:23, 107:1, 118:25, 119:7, 120:13, 120:17, 121:9, 122:4, 126:7, 128:4, 128:14, 130:6, 133:10, 133:13, 135:22, 137:1, 139:21, 156:5, 156:11, 156:23, 157:4, 157:22, 158:2, 158:17, 159:10, 163:2, 170:6, 174:6, 177:24, 179:19, 183:4, 184:6, 185:20, 187:1, 187:4, 187:10, 188:19, 188:23, 210:12, 213:1, 213:14, 217:1, 217:2, 217:16, 217:17, 219:4, 221:23, 223:10, 223:12, 223:15, 223:19, 223:24, 225:13, 225:15, 227:9, 228:8, 228:20, 228:23, 231:5, 232:13, 236:12, 238:13, 238:21, 239:3, 241:6, 241:20, 241:24, 244:7, 246:7, 248:14, 250:18, 250:22, 250:25, 251:3, 251:8, 254:4, 262:19, 266:20, 266:21, 269:5, 282:21

patents-in-suit [5] - 128:14, 133:10, 184:6, 187:1, 219:4

paternal [5] - 36:8, 36:21, 36:22, 127:4, 127:6

paternity [1] - 48:1

path [1] - 48:1

paths [1] - 23:1

pathways [1] - 166:7

patient [7] - 31:18, 109:6, 166:9, 166:25, 170:18, 247:4, 247:24

patients [6] - 31:17, 44:23, 135:7, 158:12, 158:16, 173:12

Pause [1] - 270:24

pay [2] - 137:14, 162:9

payers [1] - 159:1

PCR [81] - 33:11, 35:11, 47:9, 48:23, 50:23, 66:12, 70:18, 70:20, 71:12, 71:15, 71:21, 71:23, 79:25, 85:23, 85:25, 86:7, 87:7, 88:11, 88:15, 88:21, 90:20, 90:23, 95:17, 104:20, 104:24, 105:8, 105:13, 105:18, 105:20, 105:22, 105:25, 106:3, 106:4, 106:9, 106:11, 106:15, 106:19, 106:23, 107:2, 107:3, 128:4, 128:5, 131:12, 205:7, 207:14, 207:21, 208:11, 209:5, 210:6, 211:10, 211:14, 211:18, 211:20, 212:6, 215:1, 215:10, 215:24, 229:2, 230:24, 231:5, 231:7, 231:9, 231:14, 231:24, 232:2, 232:11, 232:17, 237:5, 237:6, 237:9, 237:11, 237:13, 237:20, 238:1, 238:5, 238:19, 238:22, 239:4

PCRs [6] - 86:13, 87:16, 104:21, 208:14, 210:23, 211:12

PCS [1] - 209:1

pending [2] - 7:25, 269:18

people [42] - 5:24, 34:7, 34:16, 36:16, 36:19, 36:23, 37:7, 39:22, 39:24, 40:4, 40:10, 46:2, 47:23, 47:25, 58:23, 62:17, 63:16, 65:5, 65:18, 66:5, 69:7, 82:13, 119:14, 120:4, 160:17, 161:18, 164:17, 172:8, 178:20, 184:24, 195:14, 195:16, 195:17, 204:8, 209:24, 210:1, 240:24, 261:4, 267:25, 272:2, 282:6

people's [1] - 171:20

per [1] - 161:10

percent [28] - 13:13, 45:3, 96:23, 97:1, 97:16, 98:4, 99:17, 100:4, 101:10, 102:5, 104:6, 110:6, 110:8, 111:7, 111:10, 111:11, 111:21, 112:16, 112:19, 161:10, 249:13, 249:16, 249:20, 250:3, 250:7, 263:24, 264:1, 272:25

perception [1] - 45:10

perfect [2] - 40:7, 40:8

perform [11] - 22:17, 28:24, 84:19, 88:12, 127:5, 134:12, 157:16, 195:10, 227:10, 231:17, 232:17

performance [3] - 97:20, 101:21, 146:6

performed [7] - 28:6, 70:17, 158:15, 195:7, 237:9, 248:8

performing [9] - 44:16, 49:19, 78:10, 83:16, 85:19, 223:24, 231:8, 231:14, 231:24

perhaps [2] - 9:24, 36:2

period [4] - 11:7, 61:19, 193:2, 213:16

permit [2] - 154:3, 215:21

permitting [1] - 23:10

person [36] - 34:20, 43:22, 46:3, 46:22, 50:5, 66:18, 67:6, 81:2, 83:7, 85:11, 88:11, 98:11, 105:17, 108:8, 112:5, 118:23, 121:17, 122:5, 139:15, 140:1, 154:8, 157:14, 185:11, 185:23, 194:25, 218:19, 224:22, 232:15, 242:21, 243:4, 245:6, 245:14, 246:12, 251:3, 253:20

person's [2] - 209:3, 209:4

personal [3] - 108:21, 200:13, 200:16

personally [1] - 272:18

persons [3] - 88:14, 143:10, 265:3

perspective [3] - 37:20, 53:5, 55:5

persuade [2] - 17:6, 17:9

persuading [1] - 275:23

persuasively [1] - 56:18

pertain [3] - 172:25, 182:11, 210:11

pertinent [1] - 257:23

Ph.D.s [1] - 46:2

pharmacokinetic [1] - 169:2

phenomena [47] - 19:2, 31:25, 32:4, 37:20, 38:3, 40:21, 42:6, 49:6, 53:15, 53:16, 53:21, 54:4, 57:1, 57:2, 57:22, 58:11, 58:19, 59:1, 59:4, 59:9, 59:11, 59:20, 60:7, 61:25, 71:25, 107:24, 115:1, 117:6, 117:9, 117:25, 124:23, 124:24, 125:4, 125:8, 126:6, 126:11, 129:5, 129:6, 129:12, 129:24, 131:17, 131:19, 132:22, 133:2, 136:7, 271:23

phenomenon [12] - 53:22, 80:20, 107:25, 115:3, 116:2, 118:17, 120:11, 125:2, 130:23, 161:23, 169:16

phone [4] - 7:18, 16:14, 21:12, 280:16

phrase [7] - 183:13, 184:1, 184:17, 185:8, 185:19, 185:23, 203:6

physical [2] - 139:7, 197:24

physician [2] - 135:8, 166:13

pick [4] - 44:16, 48:24, 65:14, 67:8

picked [1] - 16:21

pico [1] - 65:24

picture [1] - 164:11

piece [11] - 34:25,

42:23, 91:18, 95:16, 105:9, 105:11, 147:11, 162:2, 164:25, 165:5, 178:2
pieces [3] - 53:7, 105:6, 206:3
place [7] - 31:25, 34:21, 67:4, 76:5, 89:8, 100:24
placed [4] - 67:20, 145:23, 150:16, 160:8
places [4] - 82:13, 85:4, 120:1, 191:16
plain [1] - 271:9
Plaintiff [1] - 2:16
plaintiff [6] - 5:3, 5:25, 18:5, 19:24, 20:15, 279:12
Plaintiffs [2] - 1:6, 1:12
plaintiffs [1] - 4:24
plaintiffs' [2] - 153:25, 271:9
plans [1] - 125:17
plant [1] - 206:12
plasma [6] - 31:16, 31:22, 41:24, 41:25, 125:24, 173:10
plasma-free [1] - 41:25
plate [1] - 65:25
platform [8] - 122:23, 197:2, 199:13, 200:1, 200:8, 212:20, 236:16, 243:9
platforms [27] - 69:23, 69:24, 101:9, 155:12, 188:3, 188:7, 189:10, 189:18, 190:3, 193:6, 193:19, 193:20, 198:12, 198:17, 200:6, 200:24, 201:2, 201:15, 201:24, 202:18, 219:7, 225:14, 225:19, 234:25, 235:1, 245:20, 250:7
play [2] - 195:5, 275:16
player [1] - 147:3
plenty [3] - 9:23, 70:8, 233:17
ploidy [1] - 209:11
plug [1] - 195:5
plurality [1] - 85:21
PNAS [5] - 42:15, 57:7, 178:7, 178:12, 178:25
point [70] - 20:14, 25:17, 26:13, 26:14, 26:21, 29:9, 31:4, 36:15, 38:21, 43:2, 49:4, 52:13, 52:16, 52:20, 56:25, 57:10, 59:2, 62:7, 62:19, 67:15, 70:9, 72:10, 91:9, 94:11, 98:17, 101:7, 135:12, 135:17, 135:18, 136:5, 136:13, 136:21, 137:6, 137:8, 137:13, 137:19, 137:21, 150:14, 157:10, 160:6, 161:4, 162:4, 162:9, 167:1, 181:14, 185:19, 187:14, 188:13, 189:22, 190:17, 193:4, 195:2, 201:23, 210:24, 217:19, 219:21, 221:5, 225:17, 232:10, 241:12, 241:23, 252:17, 258:23, 259:1, 259:6, 260:18, 261:14, 262:3, 270:12, 273:23
pointed [3] - 9:2, 211:6, 228:14
pointing [3] - 143:16, 156:16, 224:5
points [5] - 18:7, 26:3, 84:24, 195:2, 272:7
poised [1] - 162:19
pollution [1] - 164:7
polymerase [13] - 50:23, 85:25, 191:14, 192:2, 192:4, 192:17, 192:18, 192:20, 213:22, 214:1, 214:11, 214:23
polymorphic [2] - 174:19, 205:14
polymorphism [20] - 34:23, 48:21, 50:20, 81:25, 82:16, 82:19, 82:24, 83:3, 83:4, 83:9, 83:16, 86:6, 87:2, 87:3, 89:7, 104:25, 107:8, 205:1, 205:10, 256:2
polymorphisms [10] - 35:1, 49:19, 79:20, 82:14, 82:25, 89:3, 91:20, 161:15, 236:19, 236:24
polymorphs [1] - 79:21
polynucleotide [1] - 205:1
pool [1] - 40:24
population [5] - 36:10, 161:14, 164:20, 165:25, 205:15
populations [2] - 162:14, 167:16
portion [4] - 93:1, 122:6, 172:12, 179:4
posed [1] - 136:13
position [9] - 6:9, 12:15, 62:16, 89:10, 102:23, 113:13, 271:25, 276:7, 279:11
positive [1] - 35:7
possess [1] - 144:19
possibility [1] - 211:10
possible [7] - 71:1, 89:13, 89:20, 159:16, 159:22, 215:5, 252:8
post [2] - 9:25, 273:4
post-hearing [1] - 9:25
post-trial [1] - 273:4
posture [2] - 12:22, 12:25
potential [6] - 36:9, 70:16, 170:5, 174:14, 174:22, 192:20
potentially [2] - 40:7, 166:8
power [1] - 160:25
powerful [1] - 88:18
PowerPoint [1] - 9:17
practical [8] - 20:9, 68:22, 71:5, 110:17, 194:17, 211:15, 211:18, 275:9
practice [8] - 22:12, 25:13, 43:10, 99:3, 121:24, 179:21, 267:12, 279:3
practiced [1] - 25:9
practices [1] - 157:11
practicing [4] - 85:13, 90:4, 184:3, 253:21
practitioner [1] - 56:7
pre [3] - 36:18, 38:14, 60:23
pre-existed [1] - 60:23
pre-existing [2] - 36:18, 38:14
preamble [2] - 114:3, 117:13
precedent [1] - 14:22
precise [1] - 104:14
precisely [1] - 126:10
preclude [2] - 20:1
predicting [2] - 116:5, 209:24
preempt [1] - 132:21
preemption [6] - 132:19, 132:20, 132:24, 134:18, 134:21, 135:3
preference [1] - 9:25
preferred [1] - 211:17
pregnant [7] - 232:18, 245:8, 245:16, 246:3, 246:14, 248:17, 248:18
premature [6] - 6:18, 11:18, 11:24, 11:25, 268:22, 279:13
prematurity [4] - 15:13, 268:10, 279:24, 279:25
prenatal [7] - 72:11, 78:21, 120:4, 208:21, 209:11, 211:1, 215:1
prep [1] - 143:13
preparation [8] - 68:10, 143:13, 194:19, 195:3, 195:5, 195:12, 226:14, 226:25
prepare [1] - 74:15
prepared [3] - 113:7, 113:14, 257:14
preposterous [1] - 65:2
presence [8] - 34:13, 107:18, 115:16, 125:12, 127:8, 130:23, 208:10, 251:8
present [23] - 11:19, 20:24, 21:25, 23:9, 27:23, 31:6, 31:16, 43:15, 73:3, 78:16, 78:24, 80:14, 116:24, 121:24, 122:3, 139:9, 140:13, 141:6, 152:10, 172:4, 176:4, 186:15, 222:8
presentation [6] - 9:17, 41:6, 147:21, 173:20, 179:10, 182:23
presented [7] - 7:16, 8:13, 10:10, 18:8, 18:23, 22:7, 28:9
presenting [1] - 42:22
presents [1] - 22:9
preserve [1] - 10:14
press [1] - 213:8
presumably [2] - 9:4, 154:9
presumptuous [1] - 9:5
presupposition [1] - 10:2
pretty [7] - 8:24, 72:19, 108:19, 119:3, 123:22, 266:21, 275:4
prevalence [1] - 173:9
prevent [1] - 115:11
previewed [1] - 22:1
previous [1] - 176:5
previously [2] - 174:16, 261:23
primarily [5] - 41:8, 56:18, 188:18, 188:19, 220:10
primer [8] - 71:16, 105:6, 207:2, 207:11, 207:22, 209:18, 209:19, 210:18
primers [15] - 47:1, 48:23, 48:25, 71:14, 86:8, 205:7, 206:22, 207:7, 207:9, 207:10, 207:22, 208:11, 210:18
priming [2] - 207:13, 207:17
principle [1] - 70:16
priority [8] - 79:6, 159:9, 172:25, 210:7, 210:9, 210:10, 210:12, 210:13
probing [1] - 272:19
problem [31] - 6:7, 21:13, 21:17, 33:14, 33:18, 35:12, 37:19, 43:6, 43:21, 44:15, 130:9, 166:4, 180:14, 191:5, 192:7, 192:8, 192:20, 198:14, 198:16, 202:3, 206:22, 227:7, 229:9, 229:17, 229:24, 230:14, 254:18, 260:3,

260:5, 262:23, 281:25
problematic [3] - 222:24, 252:12, 252:13
problems [23] - 34:18, 46:24, 53:1, 70:1, 94:2, 94:15, 119:11, 119:12, 180:21, 181:7, 181:10, 182:9, 192:4, 193:6, 193:13, 194:10, 198:17, 207:22, 208:9, 209:5, 215:3, 215:19, 230:2
procedural [3] - 268:8, 268:13, 279:23
procedurally [2] - 21:9, 21:19
procedure [5] - 16:12, 20:19, 156:6, 156:11, 268:21
Procedures [1] - 24:8
procedures [4] - 16:16, 94:21, 170:16, 179:25
proceed [3] - 103:13, 216:14, 216:17
proceeding [4] - 31:14, 37:19, 43:11, 44:3
Proceedings [1] - 168:10
proceedings [5] - 4:3, 43:13, 124:8, 178:9, 270:5
process [16] - 9:23, 20:21, 40:6, 49:6, 49:9, 76:2, 122:16, 158:21, 158:22, 169:19, 169:21, 170:22, 170:24, 192:6, 206:12, 273:3
processing [1] - 160:25
Procter [2] - 5:18
PROCTER [2] - 3:16, 3:20
produced [1] - 214:16
product [5] - 47:15, 47:16, 47:18, 76:1, 135:23
products [8] - 22:17, 22:20, 28:23, 28:25, 71:15, 93:15, 156:17, 210:23
Professor [1] - 75:12
professor [5] - 42:15, 75:15, 75:17, 169:1, 257:12
professors [1] - 261:3
proffer [1] - 19:13
proffered [1] - 12:19
profile [10] - 83:4, 176:8, 177:3, 177:4, 178:13, 241:18, 242:22, 243:5
profiles [9] - 72:14, 79:21, 81:25, 83:3, 83:9, 83:17, 107:8, 151:4, 163:12
prohibited [1] - 145:13
project [4] - 100:20, 109:1, 146:17, 165:17
proliferated [1] - 152:5
prominent [2] - 42:19, 44:24
promises [1] - 150:4
pronounced [1] - 83:1
proof [4] - 58:2, 59:1, 70:16, 260:12
proper [1] - 10:11
propose [2] - 16:3, 276:10
proposed [1] - 133:20
prostate [2] - 109:3, 110:18
protecting [1] - 110:4
protection [1] - 49:10
protein [2] - 91:21, 171:21
protocol [13] - 81:9, 88:20, 93:10, 100:13, 104:12, 109:25, 110:20, 111:3, 120:13, 120:15, 120:17, 122:8, 122:18
protocols [15] - 78:12, 94:19, 96:13, 96:15, 106:14, 106:16, 106:21, 110:23, 111:1, 112:8, 122:14, 146:5, 147:13, 147:18, 186:18
prove [2] - 63:8, 63:19
provide [44] - 35:13, 46:10, 68:1, 81:11, 81:12, 81:13, 83:15, 83:18, 83:20, 83:24, 87:9, 87:14, 88:19, 88:23, 90:2, 90:6, 93:8, 93:9, 96:11, 96:13, 96:15, 96:17, 98:13, 99:9, 100:6, 103:13, 103:23, 106:14, 106:16, 106:20, 112:23, 113:4, 121:1, 122:14, 122:18, 147:22, 153:25, 159:3, 177:13, 178:14, 226:13, 249:16, 249:19, 252:22
provided [9] - 101:2, 146:11, 176:16, 235:10, 254:16, 254:17, 256:25, 257:5, 263:15
provider [1] - 103:1
provides [8] - 65:5, 72:21, 94:23, 112:14, 182:8, 231:16, 244:12, 254:14
providing [10] - 30:8, 50:18, 79:17, 80:6, 81:3, 88:20, 114:7, 119:5, 218:17, 223:19
PTO [2] - 24:9, 24:12
Public [1] - 75:13
public [4] - 4:19, 23:7, 66:1, 77:4
publication [9] - 31:15, 32:1, 42:21, 67:13, 72:7, 136:25, 153:12, 173:6, 197:21
publications [9] - 100:19, 105:21, 128:8, 154:22, 162:25, 184:20, 186:15, 186:16, 261:24
publicly [1] - 161:24
publish [1] - 42:16
published [12] - 154:22, 160:14, 167:10, 178:7, 190:2, 190:8, 197:16, 197:23, 208:2, 214:13, 225:16, 260:13
puff [1] - 42:22
pull [9] - 61:11, 86:11, 92:22, 114:2, 117:12, 117:13, 118:3, 144:17, 159:14
pulled [2] - 74:18, 151:1
pulling [1] - 46:19
purchase [3] - 145:14, 145:16, 201:1
pure [1] - 13:19
purport [1] - 157:4
purports [2] - 58:10, 59:3
purpose [4] - 135:10, 144:5, 153:16, 271:22
purposes [4] - 91:5, 257:23, 270:6, 270:18
pursue [2] - 19:14, 127:4
pushing [1] - 101:18
put [67] - 6:8, 7:1, 7:3, 8:17, 14:5, 16:1, 20:10, 20:11, 27:12, 42:4, 45:16, 48:23, 55:17, 61:6, 61:12, 62:8, 62:9, 62:12, 65:11, 66:24, 69:9, 73:24, 93:2, 103:11, 105:1, 105:2, 110:18, 119:17, 126:3, 126:20, 132:3, 132:12, 141:15, 147:4, 149:20, 159:23, 164:10, 164:16, 164:18, 164:22, 165:7, 174:10, 175:8, 185:23, 200:23, 209:20, 217:24, 224:7, 225:5, 230:21, 233:6, 233:23, 238:14, 238:16, 238:25, 239:18, 253:19, 259:1, 259:8, 265:8, 268:21, 269:22, 272:21, 276:21, 278:10
put-together [1] - 269:22
puts [3] - 69:1, 180:19, 224:17
putting [5] - 42:8, 63:18, 118:22, 165:4, 221:4
puzzle [1] - 165:5

Q

Quackenbush [44] - 24:20, 25:17, 27:1, 31:6, 43:11, 46:4, 46:24, 49:1, 67:14, 68:6, 68:17, 71:12, 73:11, 74:13, 77:20, 92:25, 118:7, 122:5, 124:21, 156:4, 179:3, 187:24, 189:4, 195:21, 196:15, 198:1, 199:12, 199:22, 200:13, 200:20, 201:3, 206:5, 211:9, 211:19, 256:25, 257:13, 257:19, 258:2, 258:15, 258:21, 261:7, 270:8, 270:12, 271:20
QUACKENBUSH [1] - 74:8
Quackenbush's [3] - 65:20, 68:14, 200:16
Quake [11] - 42:13, 44:24, 45:13, 45:15, 47:19, 57:6, 60:1, 60:4, 71:22, 106:13, 178:6
Quake's [1] - 106:6
qualifications [4] - 75:11, 75:23, 200:22, 246:25
qualifier [1] - 233:24
qualify [4] - 26:17, 180:1, 235:19, 262:3
qualifying [1] - 246:24
quality [3] - 103:18, 103:22, 103:25
quantification [8] - 26:16, 107:21, 108:15, 208:3, 208:12, 243:1, 246:6, 263:2
quantified [2] - 107:23, 177:4
quantify [2] - 96:21, 250:16
quantifying [22] - 30:2, 30:20, 50:18, 80:2, 104:19, 107:7, 107:9, 107:11, 108:10, 108:17, 108:22, 109:7, 112:10, 118:5, 137:2, 174:13, 185:1, 243:2, 250:18, 250:22, 251:4, 260:12
quantitate [5] - 68:11, 119:19, 119:21, 175:8, 176:9
quantitation [3] - 68:11, 70:22, 143:14
quantitative [7] - 68:21, 68:25, 69:2,

69:5, 75:19, 93:18, 144:20
quantities [2] - 165:20, 179:24
quantity [12] - 27:17, 104:4, 107:18, 116:7, 116:11, 116:20, 116:23, 174:21, 175:10, 177:5, 252:25, 262:22
quarter [2] - 35:9, 161:10
quarters [1] - 101:15
query [1] - 206:1
questioning [3] - 154:4, 215:18, 272:18
questions [43] - 11:25, 16:6, 37:18, 43:10, 56:24, 67:22, 70:18, 73:2, 73:10, 78:23, 85:16, 139:14, 140:16, 142:11, 142:12, 147:8, 150:18, 153:23, 155:3, 155:13, 156:1, 156:18, 157:18, 157:20, 158:10, 159:12, 160:10, 161:14, 179:12, 189:21, 193:16, 198:5, 204:21, 214:10, 229:13, 255:17, 256:10, 256:15, 256:18, 259:16, 259:18, 272:19, 277:19
quick [4] - 123:22, 123:23, 167:23, 168:2
quickly [9] - 12:6, 63:24, 111:2, 152:5, 168:3, 168:15, 258:12, 277:1, 277:11
QUINN [3] - 2:22, 3:2, 3:6
Quinn [2] - 5:9, 282:10
quite [8] - 25:25, 64:5, 67:15, 142:21, 150:13, 160:5, 178:10, 225:1
quoting [2] - 126:1, 151:14

R

Rachel [1] - 164:6
Rafael [4] - 152:18, 153:1, 154:21, 155:12
RainDance [8] - 47:19, 71:8, 212:6, 212:12, 212:23, 213:3, 213:7, 231:3
raise [8] - 21:8, 23:13, 23:21, 24:25, 198:23, 211:5, 215:12, 268:1
raised [10] - 7:14, 15:13, 15:14, 16:13, 212:4, 212:9, 212:10, 258:23, 274:17, 279:23
raises [1] - 194:8
raising [1] - 21:21
random [4] - 100:25, 138:18, 138:20, 227:19
rang [1] - 40:11
rapid [6] - 76:12, 91:25, 151:25, 162:10, 162:11, 258:8
rapidity [1] - 67:24
rapidly [6] - 88:17, 92:19, 93:24, 94:5, 94:10, 152:1
rare [1] - 162:5
rate [23] - 45:3, 91:25, 99:16, 99:17, 99:18, 100:2, 100:3, 100:7, 100:8, 100:10, 100:13, 100:21, 101:5, 101:14, 101:19, 101:20, 102:4, 104:5, 111:11, 115:13, 161:11, 250:6, 250:12
rates [14] - 99:24, 99:25, 100:23, 101:8, 102:2, 103:18, 103:20, 151:4, 162:13, 163:11, 190:22, 198:2, 200:9, 250:3
rather [4] - 15:11, 34:15, 35:11, 45:2
ratios [1] - 173:9
reach [3] - 101:13, 136:14, 213:15
reached [4] - 67:15, 150:14, 160:5, 221:5
reaching [1] - 185:19
reaction [15] - 11:13, 49:20, 71:15, 85:25, 91:17, 99:16, 102:12, 105:3, 105:8, 211:16, 213:22, 214:1, 214:11, 214:23, 215:3
reactions [11] - 50:23, 70:25, 105:2, 209:23, 210:20, 211:1, 211:14, 211:20, 212:7, 221:25, 237:18
read [34] - 17:18, 33:11, 35:19, 50:4, 52:4, 61:9, 127:11, 127:13, 127:14, 128:7, 128:10, 128:11, 137:14, 138:4, 148:10, 151:3, 160:5, 163:11, 163:21, 163:22, 164:15, 164:16, 217:21, 220:7, 231:20, 234:12, 236:1, 245:14, 276:14, 278:8, 282:21
reader [1] - 188:14
readily [2] - 196:22, 270:8
reading [7] - 49:11, 85:11, 103:15, 105:25, 122:6, 218:23, 282:20
reads [7] - 57:8, 121:23, 194:16, 229:6, 229:9, 229:16, 259:17
ready [2] - 73:6, 153:18
reagents [1] - 147:1
real [12] - 18:8, 42:8, 137:14, 167:23, 178:3, 180:11, 195:1, 201:16, 202:2, 213:16, 263:9, 272:1
realistically [1] - 11:3
realized [2] - 52:13, 265:4
really [58] - 6:17, 11:21, 12:5, 24:18, 31:1, 35:8, 38:6, 39:3, 41:19, 51:20, 63:1, 64:4, 64:18, 72:4, 78:17, 90:16, 92:21, 94:8, 101:13, 101:18, 104:2, 107:19, 108:5, 111:4, 116:19, 116:21, 122:24, 123:9, 131:7, 132:12, 134:21, 162:16, 162:19, 162:23, 164:22, 164:25, 166:4, 175:2, 175:22, 178:4, 178:10, 178:19, 182:4, 182:6, 189:12, 198:12, 199:1, 200:6, 266:15, 270:14, 271:25, 273:2, 274:17, 274:20, 276:1, 277:1, 283:4
really.. [1] - 271:6
reason [13] - 8:11, 35:8, 35:10, 38:13, 59:23, 91:19, 107:13, 115:24, 123:24, 161:5, 178:11, 202:24, 220:21
reasonable [1] - 23:10
reasons [3] - 14:1, 72:25, 85:21
rebuttal [1] - 9:22
received [6] - 114:8, 116:7, 145:14, 145:16, 145:21, 147:9
receiving [1] - 263:14
recent [3] - 4:22, 69:22, 193:5
recently [2] - 48:17, 51:11
recess [4] - 124:6, 124:8, 168:8, 168:10
recipe [1] - 94:24
recipient [46] - 33:6, 33:13, 34:12, 35:4, 37:2, 37:3, 37:9, 37:15, 37:16, 38:17, 38:25, 40:18, 60:2, 79:18, 102:15, 107:20, 116:25, 117:7, 117:16, 117:18, 118:1, 118:6, 118:11, 118:19, 125:6, 125:23, 170:1, 170:2, 171:23, 172:9, 173:10, 174:17, 175:6, 176:7, 181:24, 205:25, 232:19, 242:10, 247:9, 251:10, 262:24, 263:3, 263:4, 263:14, 264:3, 264:9
recipient's [14] - 31:22, 40:5, 97:10, 97:13, 97:14, 107:12, 107:16, 120:12, 125:1, 127:10, 245:10, 245:18, 246:4, 246:16
recipients [8] - 35:15, 110:14, 115:10, 115:22, 120:1, 125:13, 181:16, 242:4
recite [16] - 78:5, 96:21, 106:2, 117:4, 117:24, 118:16, 120:21, 121:12, 156:5, 156:11, 156:14, 157:24, 231:8, 241:25, 243:11, 252:17
recited [9] - 78:15, 81:4, 82:1, 83:9, 88:12, 109:14, 118:25, 158:7, 158:17
recites [11] - 85:19, 89:2, 95:6, 99:15, 111:6, 114:5, 116:5, 117:8, 117:14, 118:4
reciting [1] - 89:17
recognition [3] - 128:23, 189:19, 207:3
recognize [7] - 38:2, 39:23, 71:23, 139:21, 229:11, 236:12, 236:14
recognized [11] - 45:4, 161:22, 176:14, 178:3, 178:15, 195:8, 196:12, 205:23, 250:14, 262:14, 282:2
recognizing [6] - 16:4, 191:14, 193:12, 201:15, 201:25, 230:14
recollection [2] - 225:5, 228:10
recombinant [1] - 122:2
recommendation [1] - 278:20
reconcile [1] - 132:10
reconsider [2] - 267:11, 267:21
reconsideration [5] - 8:2, 18:17, 18:18, 19:19, 21:20

record [35] - 10:4, 10:7, 10:10, 10:12, 10:21, 10:23, 12:20, 15:19, 15:23, 15:25, 17:9, 18:19, 18:20, 20:10, 20:11, 22:22, 22:23, 22:25, 24:20, 24:21, 24:24, 25:10, 30:23, 45:24, 48:22, 73:23, 73:24, 73:25, 153:5, 153:20, 255:12, 269:2, 275:11, 275:14, 280:2
recruited [2] - 76:11, 76:13
redirect [3] - 155:24, 256:11, 260:18
REDIRECT [2] - 156:2, 256:12
reduce [2] - 100:25, 210:22
reduces [1] - 208:11
redundant [1] - 203:8
Redwood [1] - 2:7
refer [20] - 73:25, 79:23, 82:14, 86:16, 92:14, 95:8, 98:22, 99:17, 128:4, 163:5, 203:5, 205:4, 205:13, 216:25, 221:19, 225:15, 231:16, 238:9, 244:6, 244:13
reference [17] - 6:1, 50:22, 66:4, 72:1, 72:13, 72:18, 96:25, 144:7, 149:5, 165:3, 165:11, 213:21, 220:4, 240:8, 240:11, 248:2, 277:6
referenced [4] - 93:1, 111:11, 205:16, 248:6
references [7] - 96:8, 96:18, 141:13, 183:15, 224:5, 231:16, 244:12
referred [12] - 82:25, 91:15, 95:12, 100:1, 103:4, 127:16, 147:13, 178:18, 182:23, 182:24, 229:19, 238:11
referring [18] - 41:9, 66:21, 91:10, 95:21, 99:18, 100:3, 101:4, 106:6, 111:14, 136:10, 139:13, 150:8, 150:9, 160:4, 166:23, 204:22, 210:1, 250:25
refers [14] - 26:10, 87:3, 91:24, 99:25, 104:19, 127:2, 149:10, 150:12, 156:8, 159:19, 164:21, 182:13, 227:25, 267:3
reflected [3] - 153:20, 247:9, 247:10
reflecting [1] - 170:20
reflects [1] - 171:4
refocus [1] - 273:22
reframe [1] - 9:17
refresh [2] - 225:5, 228:9
refreshed [1] - 268:25
refused [1] - 29:8
regard [3] - 9:12, 10:13, 267:8
regarding [14] - 44:3, 75:5, 78:3, 108:8, 112:23, 134:18, 179:4, 189:6, 194:4, 197:7, 199:4, 208:4, 209:1, 214:22
regardless [3] - 35:14, 35:24, 145:21
region [5] - 82:17, 86:5, 86:18, 105:7, 205:14
regret [1] - 6:5
regular [1] - 95:2
regulatory [1] - 215:20
REINES [193] - 2:6, 8:20, 8:22, 11:1, 11:11, 11:15, 11:21, 13:6, 14:9, 14:12, 14:18, 14:21, 14:24, 15:2, 15:6, 15:8, 15:11, 15:24, 16:11, 17:16, 18:1, 31:8, 31:11, 32:5, 32:8, 32:10, 32:13, 32:16, 32:22, 32:24, 33:2, 34:1, 35:22, 36:13, 36:20, 36:25, 37:6, 37:11, 37:13, 37:17, 37:25, 38:9, 38:20, 38:24, 39:8, 39:12, 39:22, 40:3, 40:10, 40:15, 40:20, 41:2, 41:5, 41:17, 44:15, 44:21, 45:22, 47:8, 47:14, 48:14, 48:16, 48:19, 49:24, 50:1, 50:5, 51:4, 51:8, 51:15, 51:18, 51:23, 53:1, 53:4, 53:12, 53:23, 53:25, 54:5, 54:12, 54:14, 54:16, 54:20, 54:22, 54:25, 55:3, 56:1, 56:5, 56:17, 57:21, 57:24, 58:8, 58:13, 58:20, 58:22, 58:25, 59:21, 59:23, 60:14, 60:19, 60:25, 64:1, 66:9, 66:15, 66:18, 69:1, 69:6, 73:7, 74:3, 74:6, 87:25, 123:15, 123:18, 123:20, 124:14, 124:20, 130:10, 131:15, 132:2, 132:16, 132:18, 137:18, 138:1, 138:7, 138:10, 141:4, 141:5, 142:7, 142:16, 142:18, 151:16, 151:19, 151:20, 152:21, 152:23, 152:25, 153:6, 153:8, 153:11, 154:10, 154:12, 154:17, 155:20, 155:23, 159:16, 168:1, 168:7, 265:24, 267:14, 267:21, 267:24, 268:4, 268:10, 268:13, 268:20, 268:24, 269:3, 269:7, 269:16, 269:21, 269:24, 270:1, 270:4, 270:11, 270:25, 271:2, 271:5, 271:11, 271:13, 272:14, 272:23, 273:2, 273:6, 273:10, 273:13, 273:18, 273:21, 274:23, 275:4, 275:7, 275:19, 275:22, 276:1, 276:18, 276:23, 277:20, 278:10, 279:22, 280:1, 280:5, 280:18, 280:20, 281:9, 281:11, 281:15, 283:7
Reines [19] - 5:3, 19:5, 20:20, 29:6, 87:23, 94:5, 105:22, 120:7, 120:23, 123:4, 129:16, 133:6, 142:1, 146:14, 152:3, 158:10, 159:13, 221:19, 244:6
Reines' [1] - 87:22
reiterate [1] - 279:2
reiterates [1] - 198:11
reject [3] - 109:23, 111:16, 115:12
rejected [10] - 107:14, 108:3, 108:6, 115:8, 115:17, 115:19, 116:14, 117:2, 118:15, 125:10
rejection [44] - 31:23, 32:3, 33:7, 40:6, 42:1, 43:1, 52:8, 70:21, 108:2, 114:6, 115:7, 115:20, 116:12, 116:22, 117:7, 125:1, 125:6, 125:24, 127:19, 129:19, 129:21, 133:23, 135:6, 136:8, 136:15, 155:16, 170:5, 170:7, 170:20, 170:21, 170:23, 171:10, 173:16, 174:15, 174:23, 176:13, 177:11, 178:4, 180:14, 180:20, 182:9, 206:12, 215:25, 260:12
rejections [1] - 170:14
relate [5] - 86:25, 109:13, 116:12, 180:16, 210:11
related [5] - 67:18, 174:22, 176:9, 177:7, 196:3
relates [3] - 70:18, 130:2, 249:4
relating [2] - 43:11, 53:19
relative [7] - 140:14, 141:8, 151:5, 163:12, 221:10, 221:11, 248:2
relatively [5] - 9:16, 63:24, 149:16, 152:5, 152:13
relatives [1] - 115:25
release [11] - 97:5, 97:8, 108:1, 108:7, 109:22, 125:3, 133:15, 196:24, 196:25, 197:8, 213:8
released [5] - 47:14, 47:17, 114:23
releases [2] - 109:23, 201:5
releasing [1] - 115:14
relevant [6] - 26:23, 75:23, 76:24, 108:21, 154:5, 167:9
reliability [1] - 208:12
reliable [1] - 240:2
reliance [2] - 28:23, 28:25
relied [7] - 18:4, 42:23, 68:4, 141:9, 141:12, 141:14, 179:14
reluctant [1] - 6:14
rely [8] - 15:22, 36:7, 64:13, 72:1, 72:13, 72:18, 72:20, 266:21
relying [1] - 72:5
remain [1] - 155:3
remainder [1] - 181:12
remember [10] - 111:1, 221:21, 222:25, 223:1, 231:2, 249:14, 250:5, 250:8, 251:19, 251:20
removed [1] - 4:19
render [1] - 26:9
Renee [1] - 95:1
repeat [5] - 103:19, 191:3, 236:21, 245:11, 267:15
repeatedly [2] - 271:20, 271:24
repeats [3] - 227:15, 227:19
repetitive [7] - 190:24, 191:1, 191:4, 192:4, 192:6, 227:7, 227:8
rephrase [1] - 250:20
replace [1] - 81:8
replicate [1] - 198:19
replicated [1] - 192:19
replicating [1] - 192:6
replication [1] - 198:19
reply [1] - 276:4
report [24] - 6:7, 68:7, 68:14, 96:10, 127:16, 141:9, 141:16, 141:18, 142:16, 142:17, 143:23, 144:1, 144:2, 144:8, 147:21, 194:3, 197:6, 213:6, 256:4, 256:7, 257:5, 257:13
reported [3] - 125:16, 178:16, 206:15
Reporter [1] - 1:25

reporter [2] - 101:23, 123:21
reporter's [1] - 226:10
reporting [2] - 255:23, 256:1
reports [9] - 15:20, 15:21, 62:17, 175:22, 177:22, 178:4, 200:7, 232:1, 232:10
representations [1] - 23:7
representative [6] - 29:8, 29:10, 29:13, 113:10, 113:12, 113:14
represents [4] - 102:2, 122:16, 205:17, 262:22
request [2] - 7:9, 274:19
require [15] - 4:11, 4:14, 87:18, 87:23, 88:1, 88:8, 153:14, 155:9, 226:24, 229:8, 229:15, 240:4, 240:6, 241:6, 243:1
required [12] - 4:13, 4:17, 227:8, 227:12, 227:14, 227:16, 227:21, 228:12, 235:4, 236:4, 243:23, 246:6
requirement [4] - 4:18, 4:20, 9:3, 240:15
requirements [1] - 254:12
requires [1] - 221:24
Research [3] - 76:6, 77:3, 160:22
research [10] - 67:20, 75:19, 76:20, 150:17, 160:8, 164:25, 165:22, 166:16, 167:3, 167:7
researcher [1] - 200:21
researchers [1] - 42:11
resequencing [2] - 103:18, 250:11
residual [1] - 35:5
resistance [1] - 169:8
resolution [2] - 205:13, 281:5
resolve [3] - 8:10, 12:6, 157:22
resort [1] - 279:4
resources [4] - 7:19, 7:20, 186:22, 188:13
respect [8] - 9:3, 10:4, 13:8, 18:18, 111:10, 132:6, 237:18, 274:13
respectful [1] - 36:1
respond [3] - 167:12, 279:12, 283:10
response [5] - 29:21, 139:13, 217:11, 251:17, 260:18
responses [1] - 277:5
rest [3] - 51:9, 63:24, 113:17
restrictions [1] - 238:17
result [6] - 39:17, 78:19, 173:11, 178:23, 189:17, 207:4
resulted [1] - 175:9
results [6] - 163:15, 171:7, 248:22, 248:24, 256:5, 256:8
resumed [2] - 124:8, 168:10
rethink [1] - 8:13
retired [1] - 146:24
returned [4] - 146:19, 146:20, 146:22, 146:23
revealing [1] - 189:1
reverse [1] - 170:25
review [2] - 6:11, 112:20
reviewed [4] - 6:6, 146:4, 257:3, 257:13
reviewing [1] - 6:10
ridiculous [1] - 49:14
rights [1] - 279:17
Riken [4] - 146:13, 146:15, 146:22
ripples [1] - 20:7
risk [1] - 199:13
risks [1] - 161:16
RNA [2] - 67:3, 148:22
robotic [1] - 42:17
robust [1] - 155:11
robustness [1] - 208:11
roll [1] - 4:8
routine [73] - 26:13, 77:25, 78:2, 78:5, 117:5, 169:18, 173:21, 175:21, 175:24, 176:20, 177:20, 177:22, 177:25, 178:14, 179:18, 181:11, 187:5, 188:4, 188:8, 188:21, 189:2, 189:10, 189:20, 193:11, 193:14, 194:11, 194:15, 194:23, 195:13, 195:18, 196:18, 196:21, 198:15, 199:24, 200:2, 200:4, 200:18, 201:22, 201:25, 202:1, 206:14, 209:24, 211:4, 211:7, 211:13, 212:21, 213:3, 213:11, 213:16, 215:16, 215:21, 215:24, 216:4, 222:9, 222:22, 230:16, 246:20, 247:21, 251:13, 252:4, 252:13, 253:16, 254:21, 255:8, 255:9, 259:25, 260:19, 260:23, 261:11, 261:13, 261:21
routinely [2] - 147:22, 206:6
Rubio [1] - 95:1
rubric [1] - 16:24
rule [6] - 42:8, 276:22, 279:9, 279:13, 279:16
Rule [16] - 9:4, 13:4, 18:18, 18:20, 18:21, 20:4, 21:6, 21:8, 21:21, 23:6, 23:12, 273:23, 274:17, 279:3
ruled [3] - 12:10, 12:22, 279:3
rules [2] - 10:1, 142:9
ruling [1] - 272:5
rulings [1] - 8:2
run [13] - 86:14, 98:9, 103:10, 103:23, 104:3, 105:8, 121:6, 147:2, 147:5, 148:21, 191:6, 247:25, 281:25
running [4] - 91:17, 105:13, 107:3, 119:15
runs [1] - 199:9

S

safeguards [1] - 63:9
Safeway [1] - 67:7
Saiki [1] - 28:2
sake [1] - 15:3
sale [1] - 65:23
sales [1] - 100:12
Salk [1] - 76:1
sample [45] - 30:9, 30:20, 46:11, 46:12, 46:20, 68:10, 71:20, 79:17, 79:18, 80:6, 80:24, 81:4, 81:9, 81:14, 96:24, 103:12, 104:24, 107:7, 107:18, 111:2, 114:7, 119:5, 119:20, 119:23, 139:3, 139:6, 143:12, 143:13, 156:12, 156:13, 170:2, 194:19, 195:12, 226:5, 226:14, 226:25, 232:18, 245:23, 245:25, 246:2, 246:21, 247:22, 250:16, 264:15, 264:19
samples [12] - 30:9, 102:12, 103:11, 108:10, 129:10, 130:20, 137:2, 139:2, 139:3, 145:11, 212:13, 232:18
san [2] - 3:8, 3:21
Sandra [2] - 5:9, 73:13
SANDRA [1] - 3:3
Sanger [9] - 84:6, 149:5, 149:8, 164:15, 220:10, 220:12, 220:23, 221:5
satellite [1] - 164:8
satisfied [1] - 59:25
satisfy [1] - 17:5
save [1] - 29:19
saw [5] - 42:25, 58:18, 58:19, 125:21, 146:2
scaffold [1] - 165:4
scalability [3] - 68:10, 93:18, 143:13
scale [3] - 76:6, 76:22, 167:15
scenario [2] - 39:4, 52:6
scenarios [1] - 35:9
schedule [2] - 278:22, 282:24
schedules [1] - 93:25
scheduling [1] - 7:1
School [1] - 75:13
school [2] - 44:23, 58:3
science [3] - 4:10, 46:6, 187:10
Science [1] - 178:10
sciences [1] - 187:2
Sciences [1] - 92:6
scientific [9] - 65:21, 65:22, 68:18, 100:19, 141:19, 146:4, 150:5, 169:4, 215:15
scientist [5] - 70:14, 70:23, 132:4, 132:12, 258:25
scientists [4] - 67:21, 101:2, 150:17, 160:9
score [1] - 103:25
scores [2] - 103:18, 103:22
scratch [1] - 17:23
screen [5] - 124:11, 126:24, 159:14, 159:23
screening [2] - 215:7, 215:13
search [2] - 159:17, 163:7
seated [3] - 4:6, 124:9, 168:11
second [9] - 21:11, 150:2, 150:11, 164:24, 164:25, 181:1, 255:10, 263:19, 270:22
secondary [2] - 39:16, 63:9
section [4] - 52:13, 52:14, 188:6, 230:21
Section [5] - 19:1, 26:18, 75:5, 257:22, 269:6
sections [1] - 188:4
securities [1] - 144:25
security [1] - 143:20
see [61] - 5:23, 11:7, 16:19, 17:4, 17:11, 18:10, 24:19, 25:2, 27:23, 27:25, 34:14, 35:16, 35:25, 40:5, 40:15, 53:5, 57:16, 62:12, 63:21, 80:5, 81:20, 99:7, 102:17, 104:23, 115:25, 123:24, 124:21, 127:14, 130:25, 137:16, 140:10, 140:14, 142:21, 144:22, 146:3, 150:6, 153:17,

154:9, 155:5, 165:6, 186:16, 194:20, 213:23, 218:3, 218:8, 220:2, 221:18, 257:19, 257:25, 266:15, 267:8, 272:11, 274:6, 277:18, 277:22, 277:25, 278:6, 281:14
seeing [2] - 52:18, 161:20
seeking [3] - 57:11, 57:12, 57:15
sees [1] - 124:12
segment [3] - 104:22, 212:14, 212:16
segments [2] - 190:19, 190:20
segue [1] - 38:11
selected [7] - 85:20, 86:8, 86:17, 88:12, 88:15, 90:8, 104:22
selecting [3] - 44:17, 47:3, 86:9
selection [2] - 47:7, 48:15
selective [26] - 46:23, 47:2, 58:15, 64:16, 66:11, 85:19, 85:23, 86:2, 86:15, 86:17, 86:21, 87:3, 88:20, 90:11, 90:14, 90:16, 90:22, 105:5, 204:22, 205:21, 206:11, 237:5, 243:11, 243:14, 243:21, 243:24
selectively [11] - 46:12, 46:18, 243:17, 244:8, 244:19, 245:7, 245:9, 245:15, 245:17, 246:14, 246:15
self [1] - 42:22
self-serving [1] - 42:22
sell [1] - 147:23
selling [3] - 102:19, 146:25, 147:5
sells [3] - 84:2, 102:21, 171:5
send [2] - 145:11, 148:6
sense [12] - 7:25, 10:5, 11:11, 11:24, 13:2, 14:4, 20:9, 63:11, 116:16, 123:13, 139:5, 152:13
sensitive [2] - 240:2, 264:17
sensitivity [45] - 97:13, 98:7, 98:11, 98:14, 98:20, 99:2, 99:5, 99:9, 111:6, 111:7, 111:9, 111:11, 111:12, 111:15, 111:16, 111:20, 112:6, 112:8, 112:11, 112:13, 112:17, 112:23, 113:4, 169:9, 175:19, 177:13, 178:15, 235:3, 235:10, 241:19, 248:10, 249:13, 249:24, 250:1, 263:16, 263:21, 263:24, 263:25, 264:1, 264:2, 264:6, 264:21, 264:24, 265:5, 265:13
sensor [1] - 164:7
sent [1] - 12:24
sentence [10] - 35:21, 64:13, 101:7, 101:25, 144:17, 160:3, 163:17, 163:20, 164:24, 194:16
sentences [1] - 163:22
separate [5] - 109:21, 211:11, 212:1
separately [1] - 87:12
September [3] - 83:13, 162:4, 283:4
sequence [65] - 43:5, 68:22, 69:24, 76:2, 77:6, 77:13, 91:16, 91:25, 95:2, 95:20, 96:16, 98:6, 98:14, 99:6, 99:21, 99:23, 100:25, 116:21, 119:25, 134:2, 134:4, 134:5, 134:6, 149:24, 151:9, 152:9, 161:21, 162:6, 163:14, 166:9, 169:25, 170:1, 170:4, 176:7, 177:5, 184:23, 188:9, 190:3, 190:23, 190:25, 191:7, 191:14, 191:15, 191:17, 194:17, 196:2, 200:18, 202:25, 204:9, 205:8, 205:12, 205:16, 205:17, 206:23, 207:3, 207:15, 239:23, 241:16, 243:9, 248:1, 254:11, 254:15, 254:17
sequenced [6] - 77:9, 77:14, 85:2, 157:12, 160:13, 161:13
sequencer [22] - 55:16, 65:22, 76:17, 76:18, 77:10, 77:11, 92:11, 98:22, 103:2, 103:5, 103:23, 145:15, 145:17, 145:19, 145:22, 148:20, 149:17, 157:15, 164:14, 196:18
Sequencer [1] - 258:11
sequencers [12] - 77:5, 77:8, 95:9, 101:21, 102:20, 102:21, 149:15, 191:5, 196:16, 196:17, 222:6, 222:11
sequences [26] - 31:16, 46:13, 50:18, 85:20, 86:6, 148:9, 170:3, 175:5, 176:15, 191:1, 191:2, 192:5, 192:6, 203:4, 203:9, 203:10, 203:14, 203:25, 205:9, 208:3, 219:10, 221:7, 223:14, 227:7, 227:8, 264:8
sequencing [261] - 11:7, 11:8, 30:2, 30:17, 45:13, 45:16, 45:25, 49:20, 50:4, 50:16, 50:24, 54:20, 55:1, 56:9, 60:3, 60:20, 64:16, 65:7, 65:14, 65:15, 66:24, 67:3, 67:10, 67:12, 67:16, 68:8, 68:9, 68:19, 68:20, 72:12, 72:17, 72:21, 72:22, 76:2, 76:4, 76:7, 76:25, 77:4, 79:22, 79:24, 84:6, 91:2, 91:7, 91:12, 91:17, 91:22, 91:24, 92:3, 92:5, 92:9, 92:15, 92:16, 93:2, 93:5, 93:6, 93:15, 93:19, 94:14, 94:16, 94:20, 95:7, 95:8, 95:11, 95:17, 95:25, 96:2, 96:4, 96:5, 96:10, 96:14, 97:22, 98:3, 98:12, 98:21, 99:2, 99:8, 99:12, 99:13, 99:15, 99:16, 99:25, 100:11, 100:22, 101:8, 101:13, 101:19, 102:2, 102:4, 102:8, 102:9, 102:13, 102:24, 103:9, 103:14, 104:16, 110:15, 110:18, 116:10, 119:6, 128:3, 129:10, 130:20, 134:12, 142:23, 143:1, 143:11, 143:18, 145:3, 145:6, 145:9, 146:16, 149:5, 149:8, 149:13, 149:15, 150:4, 150:9, 150:15, 150:25, 151:3, 151:22, 152:17, 155:2, 156:11, 156:15, 157:8, 157:10, 157:21, 158:4, 158:6, 158:7, 160:7, 160:18, 161:3, 162:23, 163:3, 163:4, 163:10, 164:1, 164:13, 164:15, 165:14, 166:2, 183:8, 183:20, 185:22, 187:16, 187:23, 188:3, 188:21, 189:9, 190:4, 190:5, 190:7, 190:16, 190:20, 191:10, 193:11, 193:19, 194:5, 194:23, 195:24, 197:24, 198:19, 199:14, 199:24, 201:21, 202:8, 202:10, 202:14, 202:16, 202:18, 202:25, 203:3, 203:6, 203:19, 203:24, 204:9, 204:12, 205:6, 218:2, 218:6, 218:7, 218:21, 218:22, 218:25, 219:1, 219:6, 219:8, 219:12, 219:13, 219:17, 220:3, 220:12, 220:13, 220:16, 220:23, 221:2, 221:20, 221:25, 222:2, 222:4, 222:17, 223:2, 223:11, 223:19, 223:24, 224:3, 224:9, 224:15, 224:23, 225:9, 225:14, 225:18, 225:24, 226:14, 226:25, 227:23, 228:3, 228:21, 229:5, 229:21, 229:25, 236:4, 236:6, 243:8, 243:10, 243:12, 250:2, 250:6, 250:11, 256:5, 256:8, 256:16, 256:17, 256:23, 256:24, 257:22, 257:24, 258:3, 258:4, 258:8, 258:9, 258:13, 258:16, 259:16, 264:24, 265:4, 265:9, 265:12, 270:7
Sequenom [2] - 27:3, 58:22
series [10] - 82:9, 91:13, 91:16, 91:18, 105:16, 108:16, 175:9, 176:17, 177:12, 240:6
serum [2] - 171:8, 171:24
serve [2] - 169:4, 169:7
served [1] - 169:3
serves [1] - 71:10
service [1] - 148:6
Services [1] - 13:10
serving [3] - 11:6, 42:22, 60:18
session [1] - 149:25
set [19] - 28:11, 55:11, 57:15, 65:18, 86:13, 102:12, 127:18, 128:6, 129:17, 148:8, 148:11, 148:13, 158:24, 166:21, 242:2, 242:5, 267:15, 267:17, 269:9
sets [8] - 16:2, 112:16, 151:10, 151:11,

158:24, 163:15, 165:13, 166:24
setting [2] - 100:17, 211:14
settings [2] - 148:8, 148:16
settled [1] - 24:14
Seventh [2] - 268:7, 279:5
several [3] - 69:9, 211:6, 239:19
sex [1] - 127:7
sexes [1] - 38:17
shake [1] - 226:11
share [2] - 79:4, 79:6
sharp [2] - 161:4, 161:5
Shaw [1] - 5:14
SHAW [1] - 3:12
shelf [1] - 121:3
shift [1] - 202:4
shifting [1] - 32:18
shoes [1] - 272:16
Shores [1] - 2:7
short [11] - 9:16, 124:6, 124:8, 168:10, 190:20, 213:16, 229:6, 229:9, 229:16, 259:17, 269:4
shortcomings [2] - 26:21, 230:8
shorthand [1] - 272:5
shortly [1] - 258:11
show [30] - 22:11, 23:17, 29:1, 35:7, 42:23, 43:3, 44:14, 44:15, 45:11, 46:9, 47:17, 50:1, 62:20, 63:6, 63:14, 63:15, 71:5, 72:10, 72:20, 80:3, 121:22, 126:1, 152:15, 154:8, 231:18, 241:22, 246:9, 247:14, 268:17, 276:25
showed [9] - 37:8, 46:25, 47:24, 72:8, 89:24, 98:24, 133:4, 227:25, 266:14
showing [11] - 162:21, 162:22, 162:24, 176:2, 176:23, 178:25, 183:25, 184:16, 185:6, 186:11, 187:17
shown [4] - 37:1, 48:21, 185:18, 262:5
shows [6] - 50:24, 55:4, 70:19, 70:22, 72:15, 141:15
shuffling [1] - 10:12
side [14] - 9:18, 10:8, 18:15, 24:13, 28:4, 28:17, 29:6, 38:6, 42:23, 50:13, 59:12, 64:2, 64:3, 68:4
sides [5] - 18:7, 20:10, 80:13, 153:21, 255:13
Siebel [1] - 282:5
signal [1] - 104:12
significance [7] - 198:13, 259:9, 266:3, 266:15, 266:16, 266:18, 267:7
significant [8] - 172:10, 188:10, 190:16, 195:2, 217:7, 217:8, 226:16, 230:11
significantly [1] - 170:16
silent [1] - 90:16
Silicon [2] - 2:11, 2:23
similar [8] - 50:21, 82:11, 134:12, 172:9, 176:5, 176:6, 177:1, 205:6
simple [11] - 44:2, 47:2, 59:24, 90:19, 108:19, 116:15, 117:9, 119:3, 167:8, 260:25
simplifying [1] - 44:6
simplistic [1] - 198:23
simply [64] - 49:7, 59:19, 67:19, 77:24, 78:6, 81:16, 82:16, 83:19, 84:13, 85:5, 85:14, 87:21, 89:25, 90:17, 90:22, 91:24, 93:10, 94:17, 95:21, 96:16, 97:11, 97:19, 98:14, 98:20, 98:24, 99:6, 99:25, 100:1, 100:22, 101:4, 103:10, 103:16, 104:10, 104:13, 106:4, 106:17, 107:5, 107:15, 107:17, 108:17, 111:20, 112:7, 112:10, 116:23, 117:8, 117:24, 118:9, 118:17, 118:20, 120:15, 120:19, 121:2, 134:6, 134:24, 150:15, 151:8, 156:7, 157:24, 160:7, 163:13, 165:1, 165:9, 185:9, 209:22
simultaneous [3] - 206:10, 275:24, 277:5
simultaneously [4] - 70:1, 193:7, 203:1, 203:5
single [26] - 34:22, 34:23, 48:20, 49:18, 50:20, 79:20, 82:18, 82:22, 82:24, 82:25, 84:9, 84:10, 87:4, 89:3, 89:7, 99:19, 105:4, 122:15, 205:10, 205:13, 205:18, 205:19, 211:16, 240:19, 242:5
siren [1] - 56:6
sit [2] - 162:12, 279:22
sites [2] - 174:19, 197:11
sitting [2] - 113:17, 276:24
situ [1] - 183:19
situation [8] - 12:8, 22:9, 25:13, 71:18, 182:24, 274:8, 274:9, 275:5
situations [1] - 38:16
Six [3] - 51:6, 55:15, 58:3
six [3] - 42:10, 51:12, 114:20
Six-Pack [3] - 51:6, 55:15, 58:3
size [2] - 264:15, 264:19
skeptical [6] - 6:3, 6:5, 57:5, 276:7, 276:8, 276:11
skepticism [3] - 8:14, 59:5, 276:20
skill [42] - 17:8, 22:13, 25:16, 43:23, 46:3, 50:5, 69:8, 81:3, 83:8, 85:11, 88:11, 88:14, 98:11, 105:17, 108:9, 112:5, 118:24, 121:18, 122:3, 122:5, 139:16, 140:1, 157:14, 185:11, 185:24, 209:21, 218:19, 224:23, 229:10, 232:15, 241:16, 242:21, 243:5, 243:20, 245:6, 245:14, 246:12, 251:4, 253:21, 265:3, 267:1
skilled [15] - 65:19, 67:7, 125:13, 126:14, 138:21, 143:3, 143:10, 195:1, 207:19, 232:2, 232:11, 241:13, 242:3, 244:1, 272:2
skip [2] - 24:3, 24:4
slide [31] - 22:24, 24:4, 25:3, 25:11, 26:19, 27:12, 27:13, 27:23, 28:8, 29:3, 29:15, 30:4, 31:3, 31:20, 33:19, 39:14, 39:25, 44:4, 65:12, 70:24, 75:10, 78:4, 80:9, 81:19, 89:16, 95:6, 96:19, 98:23, 191:11, 191:12, 191:22
slides [6] - 21:5, 37:1, 74:15, 114:10, 168:16, 168:20
slightly [2] - 95:14, 163:25
slope [1] - 161:2
slowing [1] - 193:24
small [9] - 200:2, 200:3, 206:16, 212:13, 212:15, 212:18, 260:1, 262:22, 262:23
smaller [7] - 97:6, 97:8, 97:10, 114:22, 120:24, 138:15, 138:17
snips [1] - 83:1
SNP [23] - 34:22, 34:24, 34:25, 71:1, 81:25, 83:3, 83:4, 83:9, 83:16, 89:7, 104:7, 104:11, 107:7, 122:22, 177:3, 177:4, 215:5, 241:13, 241:18, 242:9, 242:21, 243:5
SNP-based [2] - 71:1, 215:5
SNPs [83] - 66:11, 71:2, 71:14, 72:15, 79:20, 83:1, 83:13, 84:3, 84:7, 84:8, 84:9, 84:16, 84:19, 84:23, 85:6, 85:7, 85:9, 85:12, 85:15, 85:22, 87:6, 87:11, 87:16, 88:21, 89:2, 89:4, 89:5, 89:6, 89:12, 89:13, 89:18, 89:19, 89:20, 89:23, 90:1, 90:4, 90:5, 90:6, 90:7, 90:9, 91:3, 104:19, 108:10, 108:22, 174:16, 176:8, 205:13, 205:21, 206:11, 209:23, 211:3, 221:25, 236:16, 239:23, 240:21, 240:24, 241:1, 241:2, 241:7, 241:9, 241:11, 241:19, 242:1, 242:2, 242:6, 244:7, 244:9, 244:14, 244:19, 245:7, 245:9, 245:16, 245:18, 246:14, 246:16, 256:2, 263:23
so.. [1] - 140:25
software [3] - 62:11, 63:21, 103:25
sold [4] - 65:17, 146:14, 146:15, 212:5
solely [1] - 53:19
Solexa [16] - 92:9, 92:10, 95:10, 195:20, 195:21, 195:23, 195:24, 196:3, 196:6, 196:9, 196:12, 196:24, 197:8, 197:10, 199:9
Solid [1] - 258:11
solid [3] - 117:16, 117:18, 249:6
solution [5] - 94:15, 229:8, 230:2, 240:16, 254:17
solutions [4] - 156:22, 156:25, 158:3, 240:5
solve [3] - 199:8, 229:18, 229:24
solved [1] - 260:3
solving [4] - 36:8, 36:9, 230:1, 230:14
someone [5] - 36:9, 42:3, 46:16, 47:24, 53:8
sometimes [11] - 110:24, 130:8, 130:9, 132:8,

153:17, 190:23, 191:2, 202:7, 207:9
somewhat [4] - 20:4, 25:12, 135:21, 198:23
somewhere [1] - 207:4
son [3] - 93:25, 110:10, 162:5
song [1] - 56:6
soon [3] - 94:8, 281:8, 283:1
sorry [25] - 28:14, 40:24, 41:17, 54:19, 70:7, 133:14, 142:2, 151:17, 159:23, 180:23, 186:7, 197:5, 213:24, 217:20, 224:11, 233:18, 233:19, 234:11, 234:15, 240:20, 242:8, 249:18, 256:7, 270:9, 280:5
sort [16] - 24:13, 28:3, 88:1, 88:23, 97:3, 103:20, 112:15, 116:15, 131:11, 149:16, 193:1, 196:20, 216:24, 277:9, 278:6, 280:22
sound [1] - 272:1
sounds [6] - 13:25, 38:18, 48:10, 73:12, 203:20, 235:11
source [2] - 83:6, 121:19
sources [2] - 164:8, 164:9
space [2] - 144:21, 188:10
spaces [1] - 99:20
spec [4] - 72:12, 133:22, 133:23, 267:2
special [10] - 33:23, 84:12, 98:3, 120:13, 120:21, 121:12, 121:15, 122:20, 156:5, 156:11
specific [50] - 14:24, 16:3, 25:6, 31:16, 33:5, 84:16, 85:12, 85:16, 93:9, 95:22, 96:21, 101:10, 101:12, 101:20, 101:25, 102:1, 104:18, 106:2, 117:15, 117:17, 139:14, 148:13, 189:4, 219:16, 224:3, 224:15, 231:8, 231:14, 231:23, 236:18, 236:19, 236:23, 236:24, 238:4, 238:8, 238:10, 240:2, 240:4, 241:7, 241:9, 242:2, 242:9, 243:4, 249:5, 249:8, 252:8, 252:17, 252:24, 253:2, 259:19
specifically [14] - 86:15, 89:2, 92:2, 96:14, 103:4, 144:13, 153:9, 156:19, 157:20, 222:11, 224:9, 227:14, 228:12, 239:5
specification [10] - 24:11, 25:6, 26:5, 34:17, 65:3, 87:9, 134:9, 240:13, 240:14, 250:25
specificity [15] - 175:18, 176:17, 177:14, 178:16, 195:9, 235:4, 241:20, 263:16, 264:7, 264:11, 264:12, 264:22, 264:24, 265:5, 265:13
specifics [1] - 44:6
specified [1] - 27:5
specifies [1] - 242:9
specify [3] - 232:24, 241:9, 243:19
spectrometric [3] - 72:3, 72:9, 179:24
speed [2] - 161:10, 204:13
spend [3] - 194:9, 194:11, 198:24
spending [1] - 281:3
spends [1] - 50:7
spent [3] - 188:10, 259:4, 282:20
spill [1] - 171:6
spilled [1] - 177:6
sponte [5] - 8:1, 19:18, 21:9, 21:20, 267:11
spot [1] - 52:17
spreading [1] - 94:10
square [1] - 13:13
squared [1] - 59:17
squarely [2] - 7:12, 7:16
stage [3] - 6:19, 275:13, 279:13
stand [3] - 223:9, 233:11, 245:2
standard [20] - 22:20, 23:11, 27:8, 27:25, 62:25, 63:4, 63:5, 78:9, 78:15, 94:20, 99:3, 122:18, 123:9, 131:8, 131:20, 148:8, 186:23, 187:11, 252:8
standardized [1] - 198:3
standards [4] - 32:19, 61:2, 100:17, 158:24
standpoint [3] - 18:17, 277:2, 280:9
Stanford [8] - 42:14, 76:3, 86:12, 87:15, 200:14, 200:17, 211:21, 261:8
STANFORD [2] - 1:5, 1:11
start [20] - 4:24, 20:22, 31:11, 31:14, 44:11, 110:24, 141:1, 161:14, 168:4, 168:24, 169:12, 174:5, 189:3, 195:8, 207:6, 210:17, 216:24, 224:12, 240:20, 256:14
started [14] - 4:8, 10:20, 45:5, 62:10, 75:25, 76:3, 109:11, 160:21, 161:21, 164:15, 182:12, 196:1, 196:13, 201:16
starters [1] - 267:9
starting [7] - 17:23, 40:11, 52:19, 108:3, 161:20, 182:14, 207:14
starts [1] - 115:12
state [21] - 11:8, 31:12, 37:6, 38:14, 68:13, 68:15, 69:1, 89:25, 98:10, 135:13, 136:6, 141:10, 141:15, 143:24, 144:5, 144:10, 150:24, 173:18, 189:6, 268:22
statement [23] - 7:1, 7:3, 19:12, 43:22, 48:7, 64:1, 81:15, 121:22, 122:3, 125:4, 128:17, 155:8, 183:3, 193:7, 198:13, 205:9, 237:22, 238:3, 238:14, 246:24, 251:23, 252:16, 261:17
statements [3] - 36:2, 103:17, 219:3
states [3] - 31:21, 43:8, 106:17
STATES [1] - 1:1
stating [1] - 143:23
status [6] - 116:6, 116:12, 117:1, 170:20, 176:10, 177:7
stay [6] - 5:21, 152:14, 280:24, 281:1, 281:4, 282:16
stayed [2] - 280:10, 280:15
steer [1] - 64:11
Step [30] - 9:1, 11:14, 11:16, 11:23, 19:1, 19:2, 55:21, 55:22, 55:23, 57:11, 57:18, 57:20, 58:12, 58:24, 61:21, 61:22, 61:23, 62:7, 64:4, 73:1, 114:3, 116:3, 116:5, 132:9, 132:10, 204:20, 204:22, 213:21
step [13] - 48:19, 59:8, 85:24, 86:22, 95:21, 122:16, 127:20, 128:15, 131:16, 206:5, 239:6, 260:8, 260:21
steps [64] - 22:18, 25:8, 26:15, 26:22, 27:7, 27:8, 27:16, 28:24, 30:1, 30:5, 30:25, 44:17, 44:20, 57:15, 79:16, 80:4, 80:11, 80:16, 80:18, 80:19, 108:16, 108:17, 118:25, 122:24, 128:3, 128:6, 129:17, 155:10, 169:22, 169:23, 169:24, 174:12, 175:4, 175:9, 175:12, 175:16, 175:20, 175:23, 176:4, 176:17, 176:20, 176:24, 177:9, 177:12, 177:20, 177:25, 179:5, 195:7, 195:8, 240:6, 248:9, 254:12, 254:13, 254:16, 254:17, 254:20, 259:23, 260:2, 260:4, 260:5, 260:7, 260:10, 261:19, 262:21
stepwise [1] - 259:22
Steve [7] - 42:13, 44:23, 45:13, 45:15, 57:6, 60:1, 282:4
still [14] - 18:3, 102:19, 131:13, 139:6, 146:25, 151:13, 152:5, 152:13, 155:2, 193:5, 194:18, 195:1, 230:7, 230:18
stipulate [1] - 29:7
stop [2] - 271:14, 281:3
store [3] - 165:15, 165:18
story [1] - 243:10
straight [1] - 168:5
straightforward [6] - 78:18, 119:1, 120:3, 120:10, 123:10, 271:24
strand [2] - 204:5, 219:12
strategic [1] - 47:3
strategies [3] - 41:10, 41:13, 76:4
strategy [9] - 40:17, 44:17, 46:18, 48:2, 76:14, 127:4, 181:7, 181:10, 181:14
strength [1] - 22:25
stretch [2] - 138:5, 272:25
strike [2] - 60:8, 229:2
string [1] - 95:15
strokes [1] - 279:23
strong [1] - 35:22
strongly [2] - 269:11, 273:2
structure [1] - 49:9
studied [2] - 6:4, 164:6
studies [3] - 33:21, 33:22, 70:16
study [3] - 33:8, 159:3, 165:22
stuff [10] - 10:19, 42:8, 63:1, 63:7, 64:4, 64:12, 67:17, 69:20,

271:15, 282:22
stupid [1] - 272:19
style [1] - 13:19
sua [5] - 8:1, 19:18, 21:8, 21:20, 267:11
sub [1] - 80:6
sub-element [1] - 80:6
subject [9] - 10:2, 36:3, 62:6, 114:8, 116:6, 116:9, 130:7, 236:19, 236:24
subject-specific [2] - 236:19, 236:24
submission [1] - 10:15
submissions [1] - 14:3
submit [2] - 227:19, 278:24
submitted [6] - 11:2, 15:21, 43:12, 75:4, 112:21, 269:17
subpoena [1] - 16:4
subpoenas [1] - 11:6
subsequent [2] - 178:6, 178:17
subsequently [1] - 177:4
subset [1] - 266:24
substance [1] - 169:11
substantively [2] - 266:17, 266:18
substitution [2] - 102:14, 250:6
substitutions [1] - 101:9
successful [5] - 149:17, 178:10, 189:16, 260:11, 260:13
successfully [2] - 259:24, 261:25
succession [1] - 152:1
succumb [1] - 272:4
suggest [5] - 92:6, 196:18, 213:2, 252:7, 273:4
suggesting [1] - 220:22
suggests [1] - 92:8
suit [9] - 43:15, 128:14, 130:15, 132:21, 133:10, 175:14, 184:6, 187:1, 219:4
suitable [2] - 37:2, 251:11
suited [1] - 138:23
SULLIVAN [3] - 2:22, 3:2, 3:6
summarized [1] - 78:4
summary [37] - 6:22, 6:23, 6:24, 7:3, 7:7, 7:16, 7:17, 8:7, 10:7, 10:15, 12:11, 12:18, 12:21, 12:22, 13:1, 15:19, 16:19, 18:20, 19:19, 19:20, 20:1, 22:8, 52:25, 53:11, 60:8, 113:8, 131:3, 131:11, 153:5, 257:6, 267:11, 267:22, 268:12, 268:14, 268:18, 269:18, 269:19
supplement [1] - 162:20
support [3] - 11:2, 134:18, 188:12
supporting [2] - 188:16, 188:18
supports [1] - 279:11
supposed [2] - 207:7, 241:25
Supreme [5] - 32:16, 48:7, 49:4, 63:2, 64:8
surface [1] - 171:19
surreply [2] - 277:4, 277:22
surveillance [2] - 111:8, 111:23
survive [1] - 49:15
sworn/affirmed [2] - 74:9, 168:13
Syndrome [2] - 44:25, 45:1
synonym [4] - 35:21, 35:22, 41:14, 202:9
synonymous [1] - 91:8
synonymously [1] - 270:21
synthesis [16] - 95:8, 95:11, 95:17, 95:25, 96:2, 96:4, 96:6, 96:10, 97:22, 99:16, 191:13, 192:3, 192:18, 202:19, 258:9
synthesize [3] - 95:16, 206:23, 207:8
synthesized [1] - 191:16
synthesizing [1] - 95:20
synthetic [1] - 105:6
syringe [1] - 81:17
syringes [1] - 120:20
system [24] - 21:14, 46:2, 47:11, 65:18, 71:8, 72:24, 109:16, 115:9, 115:15, 126:12, 143:6, 195:24, 201:18, 203:13, 220:9, 220:11, 220:15, 220:16, 221:6, 221:13, 221:16, 252:14, 267:3
systematic [3] - 69:11, 191:9, 229:20
systematically [1] - 65:8
systemic [1] - 152:16
systems [16] - 26:12, 46:1, 46:5, 143:4, 154:20, 217:13, 219:5, 219:6, 219:17, 219:18, 220:3, 222:13, 246:8, 267:2

T

table [1] - 18:15
tack [1] - 62:20
tactically [1] - 272:17
tactics [1] - 35:12
takeaway [1] - 271:18
talented [1] - 283:2
talks [9] - 89:18, 129:18, 134:21, 135:16, 179:5, 194:6, 237:4, 249:13, 250:2
tandem [2] - 227:15
tangential [1] - 23:19
tapes [1] - 147:4
TaqMan [1] - 84:3
target [12] - 46:13, 47:3, 47:21, 67:10, 85:20, 86:5, 86:18, 205:8, 205:24, 210:22, 237:5, 243:12
targeted [2] - 47:3, 238:14
targeting [1] - 185:15
targets [1] - 205:1
Taub [1] - 152:15
taught [1] - 39:16
teach [8] - 47:6, 51:17, 78:11, 78:14, 224:2, 224:5, 224:8, 224:14
teaches [1] - 51:20
teaching [2] - 54:18, 183:11
team [4] - 11:2, 42:10, 42:13, 63:14
technical [11] - 17:7, 70:12, 169:22, 191:18, 191:20, 191:22, 192:14, 197:5, 198:2, 198:11, 230:8
technicians [1] - 148:6
technique [55] - 30:8, 36:25, 37:1, 42:25, 45:9, 45:21, 48:12, 48:14, 50:25, 51:16, 51:17, 51:19, 55:19, 55:25, 58:14, 58:15, 61:11, 63:21, 65:7, 70:19, 70:20, 79:24, 81:6, 81:8, 84:4, 86:1, 86:2, 95:16, 111:20, 119:16, 122:9, 138:22, 155:14, 183:20, 215:22, 223:20, 223:21, 231:1, 231:3, 232:23, 238:22, 239:3, 243:15, 245:7, 245:15, 248:21, 251:15, 251:16, 251:23, 252:18, 252:24, 253:2, 260:13, 261:13, 266:7
techniques [109] - 19:3, 22:13, 25:9, 25:15, 25:21, 26:11, 27:25, 28:5, 28:21, 28:22, 40:16, 41:12, 42:17, 43:17, 43:18, 43:25, 44:13, 44:16, 45:16, 51:10, 51:21, 52:20, 52:24, 54:10, 55:12, 56:3, 60:23, 61:15, 63:17, 64:14, 64:25, 65:10, 67:16, 67:18, 70:3, 71:11, 71:24, 78:7, 83:22, 90:17, 90:18, 90:24, 92:21, 109:25, 110:12, 121:25, 122:10, 122:12, 131:8, 131:12, 131:19, 138:25, 139:11, 139:14, 150:15, 160:7, 163:3, 163:5, 164:14, 170:13, 177:15, 179:17, 180:2, 180:17, 182:25, 183:14, 184:2, 184:19, 185:10, 185:21, 185:25, 186:13, 186:14, 186:24, 187:5, 187:7, 187:11, 215:19, 232:17, 232:25, 245:22, 245:24, 246:1, 246:2, 246:5, 246:13, 246:17, 246:19, 247:19, 247:20, 248:16, 248:19, 251:2, 251:13, 251:22, 252:4, 252:9, 252:22, 253:22, 253:24, 254:1, 254:2, 254:3, 260:22, 261:21, 263:12
technologies [47] - 26:1, 26:7, 26:8, 68:1, 76:8, 76:13, 77:1, 77:24, 78:13, 84:7, 92:5, 92:19, 93:12, 94:4, 109:5, 142:24, 143:16, 144:11, 144:18, 150:4, 151:3, 156:8, 157:25, 161:8, 162:18, 162:19, 162:20, 162:22, 162:23, 163:10, 164:2, 171:12, 172:11, 188:12, 188:25, 189:14, 190:15, 201:6, 201:11, 224:23, 225:9, 230:15, 255:2, 255:4, 257:21, 265:7
technology [86] - 17:10, 23:20, 26:22, 30:12, 31:13, 37:14, 37:19, 45:9, 45:23, 45:24, 50:17, 65:16, 66:7, 66:25, 67:16, 68:19, 68:24, 69:4, 69:12, 77:23, 87:17, 88:17, 88:24, 91:11, 92:13, 93:20, 94:10, 94:14, 99:21, 110:19, 117:9, 120:8, 120:11, 120:20, 122:9, 134:1, 134:3, 135:13, 136:5, 136:14, 146:18, 149:7, 149:9, 149:10, 149:13,

149:16, 150:14, 151:24, 152:4, 160:6, 161:5, 169:13, 171:14, 178:14, 182:13, 188:8, 188:15, 188:21, 189:18, 189:19, 191:23, 192:21, 193:3, 193:13, 194:9, 196:1, 201:15, 201:21, 206:14, 212:11, 212:12, 212:19, 212:21, 213:3, 213:6, 213:7, 213:11, 213:14, 215:16, 216:4, 230:7, 230:18, 245:20, 247:12, 259:17
tee [1] - 19:11
telephone [3] - 7:11, 8:5
temporal [1] - 131:9
temptation [1] - 272:5
ten [10] - 34:6, 47:22, 87:17, 98:5, 112:9, 152:8, 196:25, 197:1, 197:11, 204:9
ten-year [1] - 34:6
tend [2] - 82:12, 100:14
term [19] - 107:9, 129:13, 140:14, 141:8, 159:21, 198:10, 205:4, 219:11, 221:14, 221:16, 227:19, 228:4, 228:11, 228:15, 228:19, 228:22, 230:9, 257:23, 266:12
terminology [2] - 44:9, 221:4
terms [36] - 9:25, 11:3, 15:17, 16:1, 16:16, 17:7, 59:24, 65:10, 90:6, 91:8, 109:24, 123:19, 125:21, 126:5, 127:17, 128:13, 129:22, 132:20, 134:17, 145:24, 147:7, 147:24, 148:25, 149:5, 169:22, 181:18, 181:21, 188:16, 197:24, 218:15, 218:18, 222:21, 258:16, 259:10, 271:18
terribly [1] - 212:24
test [19] - 32:19, 69:19, 71:4, 71:10, 84:2, 84:23, 131:16, 135:9, 135:20, 153:16, 155:16, 158:15, 158:19, 158:25, 159:4, 159:7, 179:24, 192:16
tested [2] - 85:3, 122:23
testified [7] - 74:9, 144:6, 168:13, 177:24, 199:18, 226:1, 258:21
testify [8] - 9:19, 195:21, 196:15, 198:2, 199:12, 206:5, 226:4
testifying [1] - 179:3
testimony [57] - 8:12, 12:19, 13:1, 23:13, 24:19, 29:14, 29:16, 74:16, 136:9, 136:19, 136:20, 139:13, 140:14, 147:21, 180:18, 187:25, 199:16, 199:20, 200:13, 206:7, 211:22, 216:25, 223:8, 224:7, 224:20, 225:5, 225:11, 229:21, 231:4, 232:7, 233:10, 235:7, 235:12, 236:10, 238:9, 238:25, 239:7, 242:13, 245:2, 246:9, 246:22, 246:23, 247:15, 248:3, 252:15, 253:18, 255:12, 255:14, 257:1, 257:3, 261:12, 262:3, 262:4, 270:9, 270:11, 274:10
testing [4] - 53:20, 78:21, 209:12
tests [4] - 44:25, 67:5, 135:5, 158:11
THAT [1] - 182:14
THE [406] - 1:1, 1:2, 1:4, 1:5, 1:10, 1:11, 4:6, 5:1, 5:5, 5:12, 5:19, 8:21, 10:23, 11:10, 11:12, 11:16, 12:1, 14:8, 14:10, 14:14, 14:19, 14:23, 14:25, 15:3, 15:7, 15:9, 15:22, 16:8, 17:13, 17:17, 18:10, 19:8, 19:11, 20:14, 20:21, 20:25, 21:4, 21:11, 21:22, 23:22, 24:2, 29:16, 29:19, 31:7, 31:9, 32:2, 32:6, 32:9, 32:11, 32:14, 32:21, 32:23, 33:1, 33:25, 35:19, 36:11, 36:17, 36:23, 37:4, 37:10, 37:12, 37:14, 37:23, 38:1, 38:10, 38:23, 39:6, 39:11, 39:21, 40:1, 40:9, 40:14, 40:19, 41:1, 41:4, 41:16, 44:7, 44:20, 45:20, 47:6, 47:12, 48:10, 48:15, 48:17, 49:22, 49:25, 50:3, 51:2, 51:5, 51:9, 51:16, 51:20, 51:24, 53:3, 53:10, 53:13, 53:24, 54:3, 54:9, 54:13, 54:15, 54:17, 54:21, 54:23, 55:2, 55:24, 56:3, 56:15, 57:19, 57:22, 58:6, 58:10, 58:17, 58:21, 58:24, 59:2, 59:22, 60:13, 60:15, 60:22, 63:25, 66:8, 66:13, 66:16, 68:24, 69:3, 73:6, 73:8, 73:12, 73:15, 73:17, 73:20, 73:22, 74:5, 74:7, 74:23, 80:8, 80:12, 80:13, 80:16, 88:4, 88:7, 88:9, 100:9, 100:12, 100:16, 100:18, 113:17, 113:19, 113:20, 113:22, 114:1, 123:12, 123:16, 123:19, 123:21, 124:1, 124:4, 124:5, 124:9, 124:15, 124:18, 129:15, 129:16, 130:1, 131:2, 131:4, 131:24, 132:3, 132:5, 132:6, 137:5, 137:23, 138:2, 140:18, 140:20, 140:21, 140:24, 141:1, 142:8, 142:13, 142:14, 142:15, 151:14, 151:18, 153:13, 154:11, 154:14, 154:16, 155:22, 155:24, 159:13, 159:15, 159:22, 159:25, 160:2, 160:3, 160:12, 163:1, 163:4, 163:7, 166:20, 166:22, 166:23, 167:2, 167:5, 167:6, 167:18, 167:20, 167:21, 167:22, 168:4, 168:11, 168:17, 168:19, 173:24, 174:1, 174:2, 180:23, 181:1, 191:11, 191:13, 191:18, 191:20, 191:21, 191:23, 191:25, 192:1, 192:8, 192:9, 192:10, 192:12, 192:13, 192:15, 197:19, 202:6, 202:9, 202:11, 202:13, 202:15, 202:17, 202:21, 202:24, 203:7, 203:11, 203:12, 203:13, 203:16, 203:17, 203:18, 203:22, 203:23, 204:2, 204:3, 204:4, 204:7, 204:8, 204:11, 204:12, 204:14, 204:16, 204:17, 208:8, 214:3, 214:6, 216:8, 216:11, 216:17, 234:8, 234:14, 235:6, 235:11, 235:14, 239:13, 239:15, 239:17, 239:18, 242:16, 255:10, 255:18, 256:11, 258:20, 259:5, 259:8, 260:16, 260:20, 260:21, 260:25, 261:2, 261:16, 261:18, 261:23, 262:2, 262:11, 262:12, 262:14, 262:16, 262:20, 262:25, 263:4, 263:5, 263:6, 263:8, 263:10, 263:11, 263:13, 263:18, 263:22, 264:5, 264:6, 264:15, 264:16, 264:18, 264:21, 264:23, 264:25, 265:1, 265:6, 265:8, 265:11, 265:12, 265:15, 265:16, 265:18, 265:19, 265:21, 265:25, 266:2, 266:22, 267:4, 267:7, 267:16, 267:23, 268:3, 268:6, 268:11, 268:16, 268:23, 269:1, 269:4, 269:9, 269:20, 269:23, 269:25, 270:3, 270:10, 270:14, 270:20, 270:23, 271:1, 271:3, 271:8, 271:12, 272:9, 272:15, 272:24, 273:5, 273:8, 273:11, 273:15, 273:20, 274:5, 274:25, 275:6, 275:9, 275:21, 275:24, 276:11, 276:20, 277:1, 277:7, 277:11, 277:13, 277:15, 277:24, 278:5, 278:8, 278:11, 278:14, 278:18, 278:22, 278:24, 279:7, 279:25, 280:3, 280:7, 280:11, 280:15, 280:19, 280:23, 280:25, 281:3, 281:7, 281:10, 281:12, 281:16, 281:19, 281:22, 281:24, 282:6, 282:9, 282:11, 282:15, 282:19, 283:1, 283:8
theme [2] - 185:22, 192:15
themselves [10] - 64:4, 78:11, 92:1, 169:24, 188:23, 191:3, 192:7, 223:16, 235:1, 241:24
theoretically [1] - 34:13
therapy [1] - 162:7
there' [1] - 206:25
thereafter [1] - 258:11
therefore [6] - 7:17, 48:6, 70:1, 189:1,

193:7, 268:1
they've [6] - 8:6, 29:17, 48:21, 50:6, 266:22, 278:15
thinking [5] - 9:12, 167:17, 271:18, 274:24, 282:1
thinks [3] - 6:2, 19:25, 132:14
third [2] - 57:8, 280:16
thoughts [1] - 13:6
Thousand [1] - 165:17
thousand [36] - 47:5, 48:19, 48:20, 49:18, 71:4, 85:22, 88:2, 100:21, 162:8, 164:16, 165:16, 174:19, 203:9, 204:25, 205:3, 205:21, 205:25, 206:3, 206:11, 209:20, 209:22, 209:23, 211:3, 211:11, 211:17, 212:6, 239:23, 239:25, 244:6, 244:9, 245:7, 245:9, 245:16, 245:18, 264:10
thousands [13] - 77:5, 102:21, 167:3, 203:1, 203:4, 203:10, 203:14, 203:24, 205:9, 241:19
three [9] - 29:25, 59:19, 66:22, 95:13, 98:25, 101:15, 114:17, 239:24, 255:16
three-quarters [1] - 101:15
through-put [2] - 93:2, 110:18
throughout [4] - 188:6, 216:25, 238:11, 270:5
throughput [135] - 30:17, 49:20, 49:21, 50:4, 50:16, 50:23, 52:2, 52:4, 54:19, 54:20, 60:3, 64:16, 65:13, 65:15, 66:14, 66:24, 67:3, 68:9, 68:19, 76:17, 76:25, 79:24, 91:2, 91:6, 91:22, 91:24, 92:3, 92:5, 92:15, 92:16, 93:5, 93:6, 93:15, 93:19, 94:16, 94:20, 95:7, 95:9, 96:5, 96:14, 98:3, 98:12, 102:4, 102:8, 102:9, 102:20, 102:24, 103:8, 103:14, 104:16, 110:15, 129:10, 130:20, 149:9, 149:10, 149:13, 149:14, 149:15, 149:17, 150:3, 150:25, 155:2, 157:7, 157:9, 157:11, 158:4, 158:6, 183:19, 185:22, 190:6, 190:7, 190:15, 195:24, 196:2, 202:10, 202:14, 202:16, 202:25, 203:3, 203:7, 203:20, 204:5, 217:13, 218:2, 218:6, 218:21, 218:22, 218:25, 219:5, 219:8, 219:17, 220:3, 220:12, 220:16, 220:25, 221:1, 221:6, 221:8, 221:19, 221:24, 222:2, 222:4, 222:6, 222:11, 222:16, 223:2, 223:11, 223:14, 223:19, 223:24, 224:3, 224:9, 224:15, 225:23, 227:23, 228:2, 229:5, 229:20, 229:25, 248:1, 256:5, 256:8, 256:16, 256:24, 257:24, 258:4, 258:13, 258:16, 262:8, 267:2, 270:7, 270:17
throw [1] - 62:20
thrust [1] - 130:15
tied [1] - 114:20
timing [1] - 213:13
tipping [10] - 135:12, 135:17, 135:18, 136:5, 136:13, 136:21, 137:5, 137:8, 137:13, 137:21
tips [3] - 94:23, 94:25
tissue [2] - 39:16, 40:5
titer [1] - 65:25
title [1] - 149:25
toaster [1] - 45:18
today [38] - 4:17, 5:15, 8:24, 9:14, 12:2, 15:18, 18:22, 20:9, 20:14, 21:25, 22:7, 23:17, 34:24, 47:17, 63:14, 63:20, 73:5, 74:16, 75:24, 77:1, 91:5, 94:11, 102:20, 113:11, 140:22, 147:20, 147:21, 147:22, 151:13, 159:10, 160:22, 162:2, 167:8, 171:2, 179:15, 230:25, 235:7, 277:12
today's [1] - 31:14
together [23] - 9:13, 27:3, 27:12, 45:17, 61:6, 61:12, 63:18, 65:12, 69:1, 69:9, 71:24, 86:11, 101:1, 119:17, 164:4, 164:10, 164:17, 164:19, 164:23, 165:5, 269:22, 281:25, 282:22
Tom [1] - 282:4
took [11] - 32:24, 47:22, 77:10, 143:22, 152:8, 161:4, 161:5, 204:9, 219:13, 219:15
tool [3] - 41:20, 215:10, 215:13
tools [2] - 69:24, 83:12
top [5] - 62:8, 155:1, 209:15, 247:17, 279:1
topics [1] - 25:15
total [4] - 96:23, 97:1, 251:23, 268:5
totally [1] - 252:16
tow [1] - 103:13
toward [1] - 129:19
towards [3] - 136:14, 188:24, 201:17
trace [1] - 72:22
track [1] - 266:5
tracking [1] - 225:4
trade [1] - 94:7
traditional [4] - 61:2, 88:11, 151:5, 163:12
transcript [10] - 9:23, 136:12, 137:15, 233:6, 236:1, 241:22, 244:15, 273:14, 273:16, 277:10
transform [1] - 150:4
translational [3] - 67:20, 150:16, 160:8
transpire [1] - 275:18
transplant [99] - 25:7, 31:17, 31:19, 44:23, 79:17, 80:21, 97:7, 97:8, 97:9, 107:13, 108:2, 110:5, 110:9, 111:17, 111:18, 111:21, 114:6, 114:8, 115:7, 115:8, 115:9, 115:14, 115:17, 115:18, 115:20, 115:22, 116:6, 116:7, 116:12, 116:14, 116:18, 116:22, 116:25, 117:1, 117:2, 117:6, 117:7, 117:16, 117:18, 117:20, 118:1, 118:5, 118:6, 118:7, 118:13, 118:14, 118:18, 118:19, 120:12, 121:13, 121:20, 125:1, 125:9, 126:11, 127:9, 129:20, 133:23, 135:8, 135:14, 136:2, 136:7, 136:15, 170:1, 170:7, 170:13, 171:10, 172:18, 173:13, 174:13, 174:20, 174:21, 175:11, 177:8, 177:11, 180:14, 206:17, 215:25, 232:19, 241:9, 242:25, 243:7, 245:10, 245:18, 246:4, 246:16, 247:4, 247:7, 247:24, 248:8, 248:18, 249:6, 251:9, 251:10, 254:18, 262:24, 263:15
transplant-derived [1] - 118:18
transplanted [6] - 39:17, 118:10, 125:3, 171:16, 176:10, 253:14
transplants [10] - 41:25, 108:6, 115:24, 120:5, 133:15, 158:1, 170:11, 172:12, 177:18, 242:23
traveled [1] - 5:24
treat [10] - 10:6, 16:8, 36:10, 113:12, 202:12, 202:13, 204:14, 266:21, 266:23, 270:21
treated [2] - 19:22, 35:24
treating [6] - 9:9, 15:24, 166:13, 186:2, 258:3, 258:15
treatment [1] - 253:6
treats [2] - 24:12, 50:25
tree [2] - 52:14, 52:17
trial [26] - 9:1, 9:11, 10:11, 12:5, 13:5, 13:24, 14:16, 15:4, 15:6, 15:10, 16:9, 16:10, 16:15, 16:16, 16:18, 17:2, 64:7, 269:5, 273:4, 275:16, 278:3, 279:18, 281:8, 281:9, 281:17
tricky [1] - 43:4
tried [8] - 14:6, 33:10, 34:16, 43:8, 47:15, 58:18, 281:23
tries [1] - 53:14
trivia [2] - 42:7
trivial [4] - 42:5, 42:16, 62:15, 63:20
true [9] - 39:24, 136:8, 137:24, 139:12, 151:13, 238:4, 248:11, 273:24, 279:21
TRUSTEES [2] - 1:5, 1:11
truth [1] - 153:17
try [18] - 12:6, 18:14, 22:21, 35:1, 36:5, 43:14, 50:14, 50:15, 63:13, 63:15, 63:24, 109:5, 115:10, 125:22, 136:3, 146:17, 152:14, 171:9
trying [23] - 15:15, 23:4, 33:9, 34:7, 37:7, 37:17, 48:1, 51:5, 52:12, 82:5, 127:23, 147:1, 201:24, 203:23, 205:23, 210:20, 229:18, 261:2, 266:20, 272:10, 276:9, 276:19, 282:16

tube [15] - 71:4, 71:10, 71:13, 81:18, 87:8, 105:3, 105:9, 105:10, 179:24, 192:16, 211:16, 212:2, 243:24, 244:5, 247:9
tubes [11] - 87:12, 88:2, 105:1, 105:2, 105:7, 211:17, 212:1, 247:3, 247:13, 247:23
tumor [16] - 76:16, 77:16, 97:6, 109:1, 109:7, 109:13, 109:18, 109:23, 110:3, 110:4, 110:6, 121:14, 162:5, 253:7
tumors [4] - 78:20, 109:17, 133:14
tune [1] - 148:15
TUNNELL [1] - 2:18
turn [16] - 31:5, 62:13, 74:19, 75:2, 76:9, 81:24, 95:4, 96:19, 99:14, 104:18, 107:6, 132:19, 133:22, 150:2, 218:5, 232:21
turndown [2] - 161:4, 161:5
turned [1] - 148:22
turns [2] - 154:5, 196:23
twice [1] - 266:8
two [42] - 7:5, 26:6, 45:16, 53:9, 70:16, 77:10, 77:12, 86:6, 98:25, 106:13, 112:1, 114:17, 140:9, 152:9, 153:21, 160:16, 160:18, 160:25, 161:1, 161:18, 162:22, 163:22, 163:24, 167:25, 196:5, 207:10, 210:13, 212:25, 239:24, 247:2, 247:22, 248:5, 256:21, 258:24, 259:10, 261:3, 272:13, 277:5, 277:12, 283:5
tying [1] - 130:5
type [4] - 108:12, 148:21, 201:21, 213:10
types [18] - 67:22, 76:22, 120:22, 123:4, 139:4, 139:6, 150:18, 160:10, 163:16, 164:2, 164:17, 164:19, 164:22, 181:17, 207:19, 237:15, 248:5, 259:20
typewriter [1] - 65:14
typical [5] - 9:10, 101:8, 102:2, 103:20, 250:5
typically [5] - 43:15, 47:9, 139:9, 140:13, 141:6

U

U.S [1] - 66:1
U.S.D.C.J [1] - 1:22
ultimately [7] - 53:14, 64:9, 190:19, 195:25, 262:21, 272:20, 274:5
ultra [2] - 39:8, 62:19
ultrasound [1] - 112:2
unaffordable [1] - 199:11
unaware [1] - 67:25
unborn [1] - 27:11
uncomfortable [1] - 170:18
uncommon [1] - 207:9
unconventional [5] - 25:24, 94:3, 230:4, 254:10, 254:25
under [22] - 8:6, 12:4, 16:22, 16:24, 21:8, 21:21, 26:18, 32:10, 32:19, 38:8, 57:11, 58:22, 60:25, 61:1, 73:1, 132:9, 142:9, 243:22, 267:19, 268:20, 269:5, 275:13
undergoing [1] - 173:12
undergone [1] - 262:24
underlined [1] - 149:6
underlying [1] - 15:5
understandable [1] - 48:12
understood [13] - 20:13, 24:15, 25:9, 52:3, 80:15, 88:6, 138:1, 138:7, 138:8, 198:3, 244:1, 271:2, 272:23
undisputed [1] - 48:13
unequivocal [1] - 18:23
unfamiliar [5] - 67:21, 150:12, 150:17, 159:24, 160:9
unified [1] - 164:11
unique [5] - 34:9, 43:5, 72:22, 177:5, 190:23
UNITED [1] - 1:1
universal [19] - 35:13, 35:20, 35:23, 36:7, 36:8, 36:15, 38:13, 41:7, 41:9, 41:10, 41:14, 42:15, 65:5, 172:13, 177:16, 181:20, 182:8, 182:16
universality [1] - 181:19
universally [1] - 177:15
universe [3] - 36:5, 85:8, 89:13
university [1] - 200:12
UNIVERSITY [2] - 1:5, 1:11
University [2] - 169:2, 201:8
unknown [1] - 26:9
unless [21] - 22:12, 25:14, 26:2, 50:4, 64:17, 65:4, 73:9, 121:24, 122:7, 147:3, 159:2, 180:3, 182:14, 183:13, 184:3, 184:20, 185:25, 187:8, 248:8, 248:13, 274:6
unlike [2] - 43:13, 139:8
unnecessarily [1] - 7:20
unpatentable [1] - 49:6
unprecedented [1] - 162:13
unusual [3] - 25:12, 182:24, 183:2
up [152] - 4:15, 5:22, 12:23, 12:24, 14:10, 16:21, 19:5, 19:11, 21:5, 21:11, 24:21, 26:6, 30:19, 34:24, 35:7, 36:9, 37:1, 37:21, 38:13, 40:16, 41:13, 42:3, 42:20, 45:11, 45:17, 47:10, 48:5, 48:8, 52:1, 55:11, 56:21, 57:4, 58:15, 59:24, 60:1, 60:3, 61:25, 63:24, 65:14, 65:23, 66:6, 67:8, 73:19, 74:18, 81:16, 81:21, 82:8, 86:13, 87:11, 89:25, 92:22, 96:22, 97:1, 102:12, 110:20, 113:12, 114:2, 114:20, 116:3, 117:12, 117:13, 118:3, 119:11, 119:12, 126:3, 126:20, 126:21, 130:5, 140:22, 141:23, 144:17, 148:6, 149:20, 151:1, 159:14, 168:15, 172:19, 173:4, 173:5, 174:7, 174:10, 175:25, 176:22, 179:13, 179:23, 180:4, 180:6, 180:7, 180:22, 182:20, 183:5, 183:10, 183:23, 184:9, 184:14, 185:3, 185:16, 186:1, 186:4, 186:6, 186:8, 187:13, 187:15, 187:19, 189:23, 190:11, 190:18, 192:22, 193:23, 197:3, 197:12, 197:18, 198:7, 202:7, 204:19, 206:9, 207:23, 208:18, 208:22, 208:23, 209:7, 209:14, 210:15, 211:14, 213:5, 213:18, 214:11, 215:7, 215:8, 217:24, 224:7, 225:5, 230:21, 233:6, 233:23, 234:14, 238:25, 239:18, 250:10, 250:13, 251:21, 253:19, 257:9, 258:7, 259:21, 261:3, 263:8, 263:18, 272:24, 274:13, 281:8
upfront [3] - 33:16, 33:17, 68:2
upgrade [1] - 76:21
URQUHART [3] - 2:22, 3:2, 3:6
usable [1] - 85:6
useful [5] - 94:9, 181:21, 210:24, 253:5, 253:10
user [2] - 147:24, 147:25
uses [6] - 27:24, 28:4, 58:13, 72:15, 110:12, 221:14
utilize [1] - 171:9
utilizing [2] - 174:19, 224:18

V

vacuum [1] - 81:17
vague [1] - 225:1
Valentine [7] - 42:14, 42:19, 44:22, 45:14, 57:6, 59:25, 123:5
Valerie [1] - 1:24
validated [1] - 135:9
validity [1] - 274:12
Valley [2] - 2:11, 2:23
Van [29] - 26:20, 30:6, 31:1, 63:15, 112:20, 113:1, 168:24, 169:1, 174:11, 181:5, 182:3, 183:5, 183:11, 183:16, 183:25, 184:16, 185:18, 186:11, 190:13, 193:24, 197:4, 197:15, 198:9, 208:19, 209:9, 210:3, 210:16, 215:9, 216:21
VAN [1] - 168:12
variables [1] - 265:7
variance [2] - 82:17, 161:15
variant [2] - 110:17, 205:1
variation [4] - 70:12, 172:8, 205:12, 206:25
variations [11] - 85:1, 171:21, 184:23, 184:24, 190:21, 198:12, 205:18, 205:19, 248:2, 248:6
varied [1] - 250:6
varies [2] - 43:5, 85:5
variety [8] - 36:4, 155:10, 185:20, 222:17, 222:20, 223:3, 223:4, 262:9
various [7] - 6:12, 45:5, 151:3, 151:10, 163:10, 163:16,

164:1
vary [1] - 101:9
vasculopathy [3] - 111:8, 111:19, 111:24
vehement [1] - 153:21
vehicle [1] - 13:3
vendor [1] - 267:3
Venter [9] - 92:15, 95:12, 157:11, 160:16, 220:4, 220:14, 221:12, 221:17
verbatim [4] - 183:4, 184:8, 185:8, 185:23
verdict [1] - 47:16
versa [1] - 37:10
verse [1] - 33:21
versions [1] - 201:2
versus [3] - 27:3, 147:25, 267:1
vessel [1] - 105:3
VHF [1] - 147:3
via [3] - 10:14, 10:15, 37:8
Viacor [2] - 3:23, 179:9
VIACOR [1] - 1:14
vice [1] - 37:10
vice-versa [1] - 37:10
view [9] - 19:17, 20:2, 49:19, 59:14, 62:1, 132:25, 221:10, 274:7
viewed [1] - 18:17
violated [1] - 279:17
virtually [1] - 53:6
virtue [1] - 175:18
voice [1] - 18:14
voila [2] - 44:2, 61:12
volunteering [1] - 276:13
vs [2] - 1:7, 1:13
Vymetalova [3] - 172:20, 255:20, 255:23

W

wait [9] - 32:9, 210:9, 267:16, 277:25, 281:22, 282:1, 282:9
waived [3] - 13:25, 113:13, 268:1
walk [3] - 79:13, 126:21, 176:4
walking [1] - 31:12
wALTER [1] - 207:23
WALTER [64] - 2:10, 159:24, 168:21, 168:23, 174:3, 174:4, 174:7, 174:9, 180:6, 180:8, 180:25, 181:3, 182:19, 182:21, 183:21, 183:24, 184:13, 184:15, 185:3, 185:5, 186:4, 186:10, 187:19, 187:21, 189:23, 189:25, 190:10, 190:12, 197:12, 197:14, 197:18, 197:20, 198:6, 198:8, 204:18, 207:25, 208:6, 208:22, 208:25, 209:7, 209:8, 209:13, 209:16, 213:18, 213:20, 214:4, 214:8, 214:9, 216:6, 216:15, 234:7, 234:9, 234:12, 242:11, 255:7, 256:13, 257:9, 257:11, 259:3, 259:7, 259:13, 259:14, 260:15, 271:7
Walter [2] - 5:3, 63:14
wants [3] - 9:24, 16:6, 86:18
warranted [1] - 155:4
Warren [2] - 126:20, 127:3
waste [2] - 7:19
waving [1] - 16:3
ways [17] - 22:20, 36:4, 36:5, 36:6, 76:10, 110:4, 110:13, 133:8, 147:11, 157:25, 164:18, 165:21, 170:8, 171:21, 236:13, 252:10, 252:11
wear [2] - 4:12, 4:13
website [1] - 160:23
Webster [2] - 202:22, 203:2
week [1] - 281:13
weekend [4] - 6:4, 57:8, 61:10, 282:20
weeks [4] - 77:12, 152:9, 165:14, 277:12
Weil [1] - 5:4
WEIL [3] - 2:6, 2:10, 2:14
welcome [3] - 4:7, 4:12, 4:23
well-known [20] - 19:3, 24:10, 24:15, 24:22, 25:8, 25:21, 28:18, 50:12, 62:25, 81:7, 83:11, 98:15, 99:10, 233:20, 237:13, 237:15, 250:19, 253:13, 254:20, 266:13
well-taken [1] - 259:1
wells [1] - 212:2
West [1] - 148:14
whatsoever [8] - 78:12, 85:14, 88:19, 90:3, 121:1, 121:11, 158:5, 266:3
whereas [2] - 23:17, 39:4
wherein [1] - 85:22
whole [27] - 33:20, 36:3, 46:14, 46:15, 46:16, 46:20, 49:16, 66:10, 67:11, 108:5, 139:1, 142:11, 153:15, 162:1, 162:3, 166:13, 172:2, 175:9, 185:20, 188:6, 190:14, 195:17, 201:23, 206:2, 209:18, 212:20
wide [5] - 222:17, 222:20, 223:3, 223:4, 262:9
widely [10] - 90:23, 92:16, 92:19, 96:6, 96:7, 119:13, 120:8, 152:2, 197:2
widespread [1] - 162:18
wife [1] - 162:5
Wild [1] - 148:14
wildlife [1] - 120:9
willfulness [1] - 278:14
willing [2] - 8:9, 270:20
Wilmington [1] - 1:18
win [1] - 275:1
wind [2] - 119:11
wish [4] - 19:11, 19:12, 19:15, 39:13
wishes [1] - 71:19
withdraw [1] - 143:8
withdrawn [1] - 6:21
WITNESS [67] - 74:23, 80:12, 80:16, 88:9, 100:12, 100:18, 113:19, 124:4, 129:16, 131:4, 132:5, 140:20, 140:24, 142:13, 142:15, 154:14, 160:2, 160:12, 163:4, 166:22, 167:2, 167:6, 167:21, 174:1, 191:13, 191:20, 191:23, 192:1, 192:9, 192:12, 192:15, 197:19, 202:9, 202:13, 202:17, 202:24, 203:11, 203:13, 203:17, 203:22, 204:2, 204:4, 204:8, 204:12, 204:16, 208:8, 239:18, 260:20, 260:25, 261:16, 261:23, 262:11, 262:14, 262:20, 263:4, 263:6, 263:10, 263:13, 263:22, 264:6, 264:16, 264:21, 264:25, 265:6, 265:11, 265:15, 265:18
Witness [1] - 266:1
witness [19] - 73:10, 74:9, 74:22, 123:11, 124:10, 124:12, 124:17, 130:5, 132:14, 137:8, 153:15, 153:17, 167:23, 168:13, 216:6, 216:13, 259:10, 265:22, 266:7
witnessed [1] - 153:20
witnesses [4] - 4:14, 9:3, 17:11, 62:18
wits [1] - 53:8
woman [4] - 232:18, 246:3, 248:17, 248:18
woman's [3] - 245:8, 245:16, 246:15
women [3] - 36:24, 172:4, 181:8
Women's [1] - 75:18
wonder [1] - 274:19
Woo [17] - 5:17, 20:24, 21:2, 174:7, 180:6, 182:19, 184:14, 185:3, 192:23, 197:13, 207:24, 208:7, 208:18, 208:23, 213:19, 257:9, 257:15
WOO [10] - 3:20, 21:3, 21:5, 21:16, 21:23, 23:24, 24:3, 29:18, 29:23, 282:13
Woo's [1] - 182:22
word [9] - 34:2, 44:10, 54:19, 145:1, 159:17, 159:18, 227:6, 240:10, 240:11
words [6] - 23:25, 129:22, 140:23, 221:4, 261:2, 266:9
workers [2] - 55:8, 56:22
workflow [1] - 195:19
workflows [2] - 194:19, 195:4
works [1] - 27:3
world [7] - 38:14, 41:11, 67:21, 150:12, 150:17, 160:9, 197:11
worldwide [2] - 197:1
worry [1] - 140:21
worse [1] - 209:19
worth [4] - 13:15, 98:6, 198:22, 259:2
wow [2] - 42:25, 60:2
wrap [1] - 5:22
write [1] - 202:6
writing [1] - 272:22
written [65] - 22:11, 24:21, 26:5, 28:21, 52:20, 54:10, 78:8, 79:4, 81:13, 81:15, 83:20, 83:21, 83:25, 84:15, 84:21, 84:23, 88:22, 89:22, 90:2, 90:8, 90:14, 92:4, 93:1, 93:3, 93:7, 93:14, 97:15, 97:18, 97:19, 98:2, 98:10, 98:17, 99:23, 100:1, 108:13, 112:1, 112:12, 112:14, 117:10, 122:4, 122:11, 122:15, 132:7, 134:11, 139:22, 156:4, 156:7, 156:10, 157:1, 158:2, 173:8, 197:9, 224:2, 224:8, 224:14, 231:13, 231:21, 231:22, 244:7, 244:17, 244:20, 244:23, 251:3, 274:21, 279:15

wrote [2] - 150:13, 162:10

X

XX [4] - 38:22, 39:3, 39:5
XY [4] - 38:22, 39:2

Y

year [11] - 34:6, 85:2, 93:23, 102:22, 143:18, 143:19, 152:8, 172:24, 173:1
years [14] - 46:1, 47:23, 87:17, 99:12, 152:8, 159:9, 159:11, 162:8, 165:14, 167:11, 169:6, 204:10, 210:13, 220:24
yellow [3] - 68:16, 69:12, 69:21
yes-or-no [1] - 69:4
yes/no [2] - 226:15, 242:25
yield [1] - 104:12
York [2] - 2:15
yourself [3] - 91:20, 147:12, 168:25

Z

zero [2] - 72:22, 105:10
zeros [1] - 105:16
Zhang [2] - 126:20, 127:3
Zimmermann [6] - 70:15, 210:4, 214:13, 214:17, 217:1
Zoom [3] - 93:24, 93:25
zoom [1] - 208:6