

CONFIDENTIAL

Transcript of Kirk S. Schanze

Date: July 21, 2025
Case: Samsung Display Co., Ltd. -v- Pictiva Displays International Ltd. (PTAB)

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UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG DISPLAY CO., LTD. :
Petitioner,, : Case No.
v. : IPR2024-01094
PICTIVA DISPLAYS INTERNATIONAL LTD., :
Patent Owner. :

CONFIDENTIAL
REMOTE STENOGRAPHIC DEPOSITION OF
KIRK SCHANZE
Monday, July 21, 2025
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Deposition of KIRK SCHANZE, held remotely, via videoconference at:

VIA VIDEOCONFERENCE

Pursuant to agreement, before Giselle Mitchell-Margerum, Registered Professional Reporter, Certified Reporting Instructor, Licensed Court Reporter (TN), Certified Court Reporter (GA), Certified Court Reporter (NJ), Certified Court Reporter (WA), Certified Shorthand Reporter (OR), Certified Shorthand Reporter No. 14424 (CA), Alabama Certified Court Reporter (ACCR), Certified Court Reporter (NM).

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PROCEEDINGS

COURT REPORTER: Professor Schanze, please raise your right hand.

Do you swear to tell the truth, the whole truth, and nothing but the truth?

THE WITNESS: Yes, I do.

COURT REPORTER: Okay. We can start.

ATTORNEY HANSEN: Great.

KIRK SCHANZE

having been duly sworn testified as follows:

EXAMINATION BY ATTORNEY HANSEN:

Q. Will you please state your full name for the record?

A. My full name is Kirk Sullivan Schanze.

Q. Do you recognize that you are under oath today, Dr. Schanze?

A. Yes, Ma'am. I recognize that I'm under oath.

Q. Is there anything that might interfere with your ability to testify truthfully and accurately today?

A. Not to my knowledge. For the record, I would like to explain that my office is in a laboratory building and occasionally, there are fire alarms. So if there is one, I would have to leave.

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Q. Understood. And if that happens, please let me know. Have you been deposed before?

A. Yes, Ma'am.

Q. About how many times?

A. About four times, to the best of my recollection.

Q. And what was the subject matter of those four depositions?

A. The first was a patent litigation case regarding conjugated polymers and sensing applications. That was about seven or eight years ago. I'm not recollecting the second or third.

Most recently, I did a deposition on this case, which involved the -- as I understand it, the district case between Samsung and Pictiva. Three patents were involved in that.

Yes. The third -- second deposition -- I'm sorry -- going back in time now, was on an unrelated case involving vapor-deposited films used for extreme UV lithography. And that was a preliminary injunction case between Lam and Impria. And that deposition was earlier this year, I think.

Q. Okay. So if you --

A. Those are the ones I can remember.

Q. Understood. So you have been deposed

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before. And so, you have an understanding about how this works. But let's just go over a few ground rules to make sure that we are on the same page.

So you are here to answer questions that I ask. And if you answer a question, I'm going to assume that you understood the question.

Does that work for you?

A. Yes, Ma'am.

ATTORNEY ZHONG: Objection. Form.

BY ATTORNEY HANSEN:

Q. Now, your attorney may object, as she just did, but you will still have to answer the question. Do you understand that?

A. Yes, Ma'am. To the best of my ability.

Q. Now, we'll take breaks, you know, as appropriate. But if you need a break for whatever reason, we'll try to take one at the next available moment.

Does that work for you?

A. Yes, Ma'am.

Q. What did you do to prepare for your deposition today?

ATTORNEY ZHONG: Dr. Schanze, I caution you not to reveal any attorney/client privileged conversations.

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THE WITNESS: I reviewed materials related to the case between Samsung and Pictiva, including the declaration that I submitted for the IPR case, which I believe is the topic today.

BY ATTORNEY HANSEN:

Q. Did you meet with anyone to prepare for today's deposition?

A. I met with attorney.

Q. What attorney?

A. Attorney Zhong.

Q. Did you meet with anybody else?

A. No.

Q. And about how long did you meet for?

A. Five hours.

Q. Outside of your declaration, did you review any other documents?

A. Yes, I did.

Q. And what documents did you review?

A. Mainly documents that are exhibits in the -- for the declaration.

Q. And when you say "mainly," did you review any documents that weren't exhibits to your declaration?

ATTORNEY ZHONG: Dr. Schanze, I caution you not to reveal any attorney/client privileged

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conversation.

THE WITNESS: In general, I reviewed literature in the field of organic light-emitting devices and materials.

BY ATTORNEY HANSEN:

Q. Are there any documents that you specifically recall reviewing that were not exhibits to your declaration?

ATTORNEY ZHONG: Again, I caution you not to reveal any attorney/client privileged conversation.

THE WITNESS: I can't recall any, in particular.

ATTORNEY HANSEN: Okay.

BY ATTORNEY HANSEN:

Q. But you know that you reviewed additional documents beyond those that are exhibits to your declaration?

A. I don't recall, in particular.

Q. Okay.

ATTORNEY HANSEN: Why don't we make your exhibits available?

Kylan, can you please bring up Exhibit 2001?

TECHNICIAN: Please stand by. And I'm

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sorry, counsel. How would you like that marked?

ATTORNEY HANSEN: Let's mark it as Schanze Exhibit 1.

(Exhibit 1 marked for identification)

BY ATTORNEY HANSEN:

Q. Now, Dr. Schanze, you recognize this document? And if we could go to page 66 or page 70 of the PDF? Sorry. One more up. Sixty-nine, I suppose.

This is a declaration that you signed in October 2024?

A. Yes, Ma'am.

Q. And it relates to the IPR in this case?

A. Yes.

ATTORNEY HANSEN: If we could bring up Exhibit 2041, which we will mark as Schanze 2?

(Exhibit 2 marked for identification)

BY ATTORNEY HANSEN:

Q. And, Dr. Schanze, this is a declaration that you signed, if we can go to PDF page 111. This is a declaration that you signed on May 5th 2025, also for this case?

A. Yes, Ma'am. I see that.

Q. Okay.

Now, for this declaration, Schanze 2, did

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you write this declaration?
A. May I -- before answering, may I download these exhibits?
Q. Sure. They should be in the link that you were provided access to.
A. Please bear with me. So, these exhibits were written by myself, in collaboration with attorney.
Q. Okay.
When you say these exhibits, you are talking about both 2001 -- sorry, Exhibit Schanze 1 and Exhibit Schanze 2?
A. Yes. The exhibits refer to the declarations dated October 2024 and May 2025.
Q. Okay.
Now, focusing on Schanze 2, how long did you spend writing this declaration?
A. I don't recall, exactly. Many hours.
Q. Did you review it carefully for errors?
A. To the best of my ability, I did. But there still may be errors, as in any document that's created.
Q. Are you aware of any specific errors, sitting here today?
A. No, I'm not.

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Q. When were you retained to work on this matter? Specifically the IPR?
A. Sometime last summer, or late in the spring of 2024.
Q. Now, prior to being approached to be an expert in this case, were you familiar with the '223 Patent?
A. No. Not specifically the '223 Patent, I was not aware of.
Q. When you say not specifically the '223 Patent, were you generally aware of the '223 Patent?
A. I was generally aware of the context of organic electronic devices, and electron transport materials, and so forth. But not specifically about the '223 Patent. No, Ma'am.
Q. Okay.
ATTORNEY HANSEN: Let's bring that up. Kylan, could you please bring up Exhibit 1001, which we'll mark as Schanze 3?
(Exhibit 3 marked for identification)
BY ATTORNEY HANSEN:
Q. Dr. Schanze, do you recognize what we have marked as Schanze 3?
A. Yes, Ma'am. This appears to be a copy --

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a PDF copy of the 8,558,223 Patent that you were referring to a few minutes ago.
Q. And this is the '223 Patent that is the subject of your declaration; Schanze 1 and Schanze 2?
A. Yes, Ma'am.
Q. Now, could we please go back to Schanze 1? In particular, I'd like to go to your CV, which I believe starts at PDF page 71.
Now, Dr. Schanze, this is your CV that you attached to your October 2024 declaration?
A. Yes, Ma'am.
Q. And, in general, do you believe that the CV is complete?
A. Yes. To the best of my knowledge, it's complete, at the time.
Q. Any changes that would need to be made in order to bring it up to date today?
A. The most often changes are talks that I've given at meetings. Papers that have been published. Grants that have been received. Students that I've worked with and graduated.
Those are the kind of regular changes that I would make, and may be different currently from the time this CV was created.

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Q. Okay. Now, you are not a librarian. Right, Sir?
A. No. I'm not a librarian.
Q. And you don't have a degree in librarian sciences?
A. No. I do not.
Q. Do you consider yourself an expert in the algorithm used by the Wayback Machine?
A. No.
ATTORNEY ZHONG: Objection to form.
THE WITNESS: I do not.
BY ATTORNEY HANSEN:
Q. And you are not a lawyer?
A. No. I'm not a lawyer.
Q. You are not a patent attorney?
A. No. I'm not a patent attorney.
Q. And you are not admitted to practice before the USPTO?
A. No. I'm not.
Q. Let's turn to Schanze 3. And this is the '223 Patent. If we could take a look at the claims, which start at column 19?
A. I'm going to open that on my local machine, if that's okay.
Q. Fine with me.

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A. Okay. Column 19. Yes, Ma'am.
ATTORNEY HANSEN: And Kylan, if you could go to column 19, please? Great.
BY ATTORNEY HANSEN:
Q. Now, Dr. Schanze, you agree with me that claim one does not call out the compound, BPhen. Correct?
A. I can read claim one, if you would like. And it reads:
"An organic electronic component, comprising a substrate, a first electrode, a second electrode, an electron-conducting layer, which is arranged in such a way that it is electrically conductively connected to at least one of the electrodes, wherein the electron-conducting layer is obtained by joint vaporization of a metal complex, which comprises a central metal atom with an organic compound, wherein the organic compound comprises a heteroaromatic compound, which is conjugated with an aromatic compound via a CC bond."
Q. Now, nowhere in what you just read was the word "BPhen" used. Correct?
A. That would be correct. The word "BPhen" does not appear in the first claim of the '223 Patent.

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Q. Now, claim one, similarly, does not require the use of W2(hpp)4. Correct?
A. Can you state the question again, please, Ma'am.
Q. Sure. Claim one similarly does not require the use of W2(hpp)4. Correct?
A. That would be my understanding. Claim one does not specifically require the use of the compound that you refer to, W2(hpp)4.
Q. Is there any abbreviation or quicker way of saying "W2(hpp)4," that you have used, that you would feel comfortable with?
A. Not to my knowledge.
Q. W2(hpp)4 it is. You agree that W2(hpp)4 is a metal complex with a central metal atom?
A. Yes. I agree that W2(hpp)4 is a metal complex with a central metal atom.
Q. And, in fact, W2(hpp)4 has two central metal atoms. Is that right?
A. W2(hpp)4 contains two tungsten atoms in the compound. I can say that.
Q. Okay.
A. And it contains at least one central metal atom.
Q. Now, BPhen is what's known as an example of a phenanthroline. Is that right?

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A. Phenanthroline, as I understand it, is a compound that contains about 10 carbon -- sorry, I don't know how many carbon atoms, but it contains carbon and nitrogen. It's a heterocycle.
And can you state your question again?
Q. BPhen -- let me ask a different question. BPhen is an analog of phenanthroline. Right?
A. Yes --
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Chemically, it would be considered to be a substituted derivative of phenanthroline.
ATTORNEY HANSEN: Okay.
THE WITNESS: The compound, 110 phenanthroline.
BY ATTORNEY HANSEN:
Q. And BPhen is an organic compound comprised of a heteroaromatic compound, which is conjugated with an aromatic compound, via a CC bond. Correct?
A. I'm reviewing the patent again. Claim one.
Q. I'm just asking a question about BPhen, which as we discussed, is not in claim one.
A. Yes.

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ATTORNEY ZHONG: Objection. Form. Argumentative.
THE WITNESS: Can you state your question again, please?
ATTORNEY HANSEN: Sure.
BY ATTORNEY HANSEN:
Q. BPhen is an organic compound comprised of a heteroaromatic compound, which is conjugated with an aromatic compound, via a CC bond. Correct?
A. Yes. It is.
Q. Do the nitrogens in BPhen have any particular name to a chemist?
A. I'm sorry. That's a very broad question. I don't exactly know what you are asking.
Q. If I were to use the word "pyridinic nitrogens," does that have any meaning to you?
A. Yes, it does. And then in that context, I could say, yes, BPhen contains pyridinic nitrogens.
Q. Okay.
Would BPhen be considered to be an electron-deficient aromatic?
A. Again, that's a very broad concept. It is an aromatic compound. It has, you know, certain HOMO and LUMO values that are known. In the broad context, it's somewhat electron-deficient.

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Q. Would it surprise you to learn that others in the field have described BPhen as an electronic-deficient aromatic?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Again, because of the very general nature of that description, I wouldn't be surprised if some said what you just stated, and others might say something different. It's a fairly broad concept.
BY ATTORNEY HANSEN:
Q. What do you consider to be an electron-deficient aromatic? Or what do you consider to be the definition of an electron-deficient aromatic?
A. It would be a compound that has a tendency to accept electrons under the -- under certain conditions, when mixed with something that can donate electrons.
It also might form charge transfer complexes with other -- other molecular species. That's how I might consider something to be an electron-deficient aromatic.
Q. And under that definition, does BPhen constitute an electron-deficient aromatic?
ATTORNEY ZHONG: Objection. Form.

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THE WITNESS: It's -- again, it's intermediate, I would say. It wouldn't be at the top of my list, I guess I would put it that way, as being an electron-deficient aromatic. It's an aromatic compound. It has pyridinic nitrogens. It has -- it's connected to another aromatic residue via CC bond.
BY ATTORNEY HANSEN:
Q. And BPhen has been used as -- in electron transport layers in OLEDs since at least 2005. Is that right?
A. Yes. To the best of my knowledge, what you said is correct.
Q. And when BPhen is being used in electron transport layer, it is accepting electrons from an electron donating component.
Is that right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: When it's serving as an electron transport layer, it's doing just what it's stated. It's there to transport electrons. The source of the electrons is not defined, as you stated.
BY ATTORNEY HANSEN:
Q. So, for example, when BPhen is doped with

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cesium, BPhen is serving as an electron acceptor?
A. I'm sorry. I don't know the context. If BPhen has been doped with cesium, that doesn't tell me what else is there.
Q. If you have a layer comprising BPhen and cesium, and that's it, in the context of an OLED, is BPhen serving as an electron acceptor?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: I'm sorry. Again, I don't -- in the context of an OLED, I don't -- are you referring to a device with a particular structure?
BY ATTORNEY HANSEN:
Q. Just as an electron transport layer, when BPhen is doped with cesium, is it serving as an electron acceptor?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: I can't -- your description is too vague for me to conclude exactly what the BPhen is doing in the context of what you have just described.
BY ATTORNEY HANSEN:
Q. Are you aware of art that has described electron transport layers comprised of just cesium and BPhen, at least as early as 2005?
A. I believe that I'm generally aware of work

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in which cesium has been used to modify electron transport layers. I don't know that I can point to a particular reference with BPhen and cesium. But I wouldn't be surprised if such existed.
Q. Okay.
Now, the references that would refer to cesium and BPhen, in that context, is BPhen serving as an electron acceptor?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Again, if BPhen is using an OLED, and whether it is or isn't doped with cesium, or mixed with cesium, I would conclude that it's acting as an electron transport layer to transport electrons.
What hasn't been defined is where the electrons are coming from in your description. I would have to conclude that they come from an electrode. And so, in that case, BPhen is acting as -- accepting those electrons and transporting them.
ATTORNEY HANSEN: Okay.
BY ATTORNEY HANSEN:
Q. Now, turning back to Schanze Exhibit 3, and I wanted to look at claim nine.
ATTORNEY HANSEN: Sorry. Go down. It

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should be at the top of column 25.
BY ATTORNEY HANSEN:
Q. Now, claim nine depends on claim one, right?
A. Yes, Ma'am. That's what it states. Claim nine states:
"The organic electronic component according to claim one, which is formed as an organic LED (OLED), which additionally comprises an organic emitting layer."
Q. Now, as we talked about, claim one does not require either BPhen or W2(hpp)4. Right?
A. That's what we discussed earlier. Yes, Ma'am. I agree.
Q. And so, claim nine similarly does not require BPhen or W2(hpp)4. Correct?
A. As I understand the way claim nine is written and dependent on claim one, the answer is affirmative.
Q. Okay.
Now, if we could go to claim two, which is at claim -- on column 19? Now, claim two also depends on claim one. Correct?
A. Yes, Ma'am. If I may, I'll read claim two. For the record, claim two states:

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"The organic electronic component according to claim one, wherein the organic compound coordinates to the metal complex, due to the joint vaporization."
Q. And so, similarly, as we discussed, claim two also does not require BPhen and W2(hpp)4. Is that right?
A. Yes. Similarly, as we describe for claim one, since claim one does not require BPhen or W2(hpp)4, it's not -- it's not explicitly requiring those components.
Q. And let's take a look at claim eight, which is at the bottom of column 24. Now, claim eight also depends on claim one. Correct?
A. I'm sorry. Just a moment, please. Again, I'm following this on my computer with Exhibit 1001.
Q. Which is also known as Schanze 3?
A. Yes.
Q. Okay.
A. Yes. For this deposition. Okay. Claim eight of the '223 Patent, Exhibit 3, reads:
"The organic electronic component, according to claim one, wherein at least parts of the organic compounds bridge two metal complexes together, so that a chain-like structure of the

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metal complexes is formed, and/or at least parts of the organic compounds bridge more than two metal complexes together, so that a network-like structure of the metal complexes is formed."
ATTORNEY HANSEN: I'll strike that as nonresponsive.
BY ATTORNEY HANSEN:
Q. Dr. Schanze, my question was, claim eight also depends on column one. Correct?
A. Yes. Correct. It does state that in claim -- its first line says "claim one."
Q. Okay. Now, let's take a look at claim 10, which is in column 25.
A. Yes, Ma'am.
Q. Now, claim 10 is an independent claim. Right?
A. As I understand, claims -- again, I'm not an attorney, but it doesn't require one of the preceding claims in its statement. So that makes it an independent claim, then the answer is yes.
Q. Okay. Now, claim 10 does not require the use of BPhen. Correct?
A. That would be a correct statement. It does not require the use of BPhen.
Q. Now, claim 10 also doesn't require the use

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of W2(hpp)4. Correct?
A. Claim 10 does not explicit require the use of W2(hpp)4. That is correct.
Q. Now, claim 11, which is at column 26, depends on claim 10. Correct?
A. If I may read it, it helps me understand the question. So your question, again, is does claim 11 depend on claim 10?
Q. Correct.
A. And the first line says:
"The method according to claim 10, wherein during the simultaneous vaporization of the organic compound coordinates in the gas phase to the metal complex."
So, as I read claim 11, it states that it's dependent on claim 10.
Q. Now, looking at claim 12, which is immediately below that, claim 12 also depends on claim 11 -- or claim 10. Correct?
A. Yes, Ma'am. As it states, again -- in the first line of claim 12, it states:
"The method according to claim 10, wherein the electron-conducting layer is deposited as a chain-like or network-like structure."
And so, the answer is yes. It's dependent

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on claim 10, as stated in the first line.
Q. Okay.
Now, claim six specifically claims BPhen. Right?
A. Let me review, please. So we are in column 20. And --
Q. Twenty-two. Well, claim six starts in column 20. Yes.
A. Yes, Ma'am. And claim six reads:
"The organic electronic component according to claim one, wherein the organic compound is selected from a list."
And the list contains chemical formulas of several different structures. And it's my understanding of those 13 or so structures, BPhen would be as compound six, which is -- appears in the top of column 22.
I should also note that not all of the structures are correct. There is an error in compound structure three, as pointed out, I think in my declaration, or one of the declarations.
Q. And that error is the fact that there is a missing double bond in each of the -- I don't want to call them imidazole compounds, but I might be wrong in my nomenclature?

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A. That would be correct. There should be a double bond in each of the three, five-member grain [Phonetic] nitrogen containing heterocycles in compound three.
Q. Okay.
Now, in addition to BPhen at compound -- as compound six, there are two other substituted phenanthroline derivatives provided in claim six. Right?
A. Reviewing the structures, structure five is a -- also a phenanthroline derivative, which is related to BPhen, with the addition of two methyl groups at the two and nine positions.
And scrolling down, I believe compound 10, or 11, which is in column 22, that would be construed as related structurally to BPhen, with the addition of two naphthol units at the two and nine positions of the phenanthroline, in addition to the two phenyl groups that are in the structure referred to as "BPhen compound six."
Q. Okay.
Compound five that you described is more commonly known as the compound, "BCP." Is that right?
A. That's my understanding. Yes, Ma'am.

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Q. And BCP was a compound that was known for use in semiconducting layers as of 2005?
A. Yes, Ma'am. I would agree with that.
Q. Okay.
ATTORNEY HANSEN: Kylan, could we please bring up tab five?
TECHNICIAN: Please stand by. This one is taking a second to load.
ATTORNEY ZHONG: Which exhibit is that? Oh, it's a new exhibit.
TECHNICIAN: I'm sorry, counsel. This one is just stuck on the loading screen right now. I think I was able to get it uploaded to the folder but I'm not able to open it currently. I'll let you know when it loads.
ATTORNEY HANSEN: Okay.
(Exhibit 4 marked for identification)
BY ATTORNEY HANSEN:
Q. Dr. Schanze, do you see tab five in your folder?
A. Bear with me a moment please, counsel.
Q. You may need to refresh the website.
A. Yes. I see tab five. Bear with me for a moment while I download it. Again, the word is tab -- T-A-B -- five. Correct?

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Q. Correct. That's the first line. And then there is some additional description of what the document is.
A. Okay.
ATTORNEY ZHONG: I'm going to object to the -- I'm going to object to the new exhibit as irrelevant.
BY ATTORNEY HANSEN:
Q. Dr. Schanze, please let me know when you have the document open?
A. I have a document that's entitled, "Expert Opinion Provided by Prof. Schanze."
Q. And that's you. Right?
A. That's me.
Q. And this is a declaration that you provided in September 2024? Is that right?
A. It's -- the document that I have is not signed on a specific date. The date that I see -- oh. I'm sorry. The date that I see on page 18 -- physical page 18 -- PDF page 18 -- reads September the 16th of 2024.
Q. And this is a document that you submitted concerning a German patent. Is that right?
A. That would be my understanding.
Q. And at paragraph seven, we see that the

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German patent is DE 10 2008 056 391 B4. And that's in the third line of paragraph 7?

A. Yes, Ma'am.

Q. Now, at the bottom of that paragraph, you say:

"My understanding of the patent-in-suit is based on the parallel U.S. Patent 8,558,223 B2, which is annexed as Exhibit 2."

Do you see that?

A. Yes, Ma'am. I see that statement in paragraph seven at the bottom.

Q. And the '223 -- the patent that you referred to in that line is the same '223 Patent that we have been discussing, that's Schanze 3?

A. It has the same 223 number. Yes. So I guess it -- 8,558,223. So it appears to be correct. Yes.

Q. Did you review the German patent in its original German?

A. To be honest, I don't recall exactly what -- what forms I reviewed. I may have reviewed some of the German and some of the translation. I can't tell you, specifically.

Q. Do you understand German?

A. I'm not a German speaker. I've studied

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German. So I -- but I couldn't do a translation.

Q. Okay. So, but this declaration is based -- at least according to paragraph seven -- on your review of the '223 Patent.

Is that right?

A. So paragraph seven states:

"I've been made aware of the pending lawsuit between Pictiva and Samsung on the basis of the German patent, DE 10 2008 056 391.

I have been provided with the technical documents in these proceedings, in particular, the patent-in-suit, which I assume refers to that German patent, English translations of Pictiva's writ of complaint and Samsung's answer to the complaint..."

And so forth. And then it goes on to say that:

"My understanding of the patent-in-suit is based on the parallel U.S. Patent."

So my recollection is that I would have reviewed the materials that are described in paragraph seven.

Q. Right.

A. But my recollection is vague. It's been almost a year since this was -- work was done. So I'd have to review files and things, to be exact.

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Q. Did you review this declaration in preparation for your deposition today?

A. I have reviewed this declaration at times. I can't be specific exactly when -- when the last time I read it was.

Q. Now, one of the things that you did in this declaration, if you turn to paragraph eight, sub-note three, was to experimentally verify whether Compound 742 coordinates to LiQ when jointly deposited under common co-evaporation conditions.

Do you see that?

A. Yes, Ma'am. So that subparagraph is under paragraph eight. It says, "Reported -- experiments reported here were conducted under my supervision." And three says:

"To experimentally verify whether Compound 742 coordinates to LiQ, when jointly deposited under common co-evaporation conditions."

Q. Now, Compound 742 is the compound that's immediately above paragraph eight, sub-note three?

A. As I understand it, Ma'am, to the best of my knowledge, that is a compound that corresponds in molecular weight to Compound 742. But I cannot testify that that structure is indeed Compound 742.

Q. Understood. The compound that is

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graphically depicted under Figure 1, that's not LiQ, that compound has a number of pyridinic nitrogens?

A. Yes. I would agree that one would qualify those as pyridinic type nitrogens.

Q. Understood. Okay.

Now, let's go take a look at the analysis that you did. If we could turn to paragraph 47, which is on PDF page 11?

A. Okay.

Q. Now, as part of your analysis, you actually looked at the coordination between the compound, BTB and LiQ.

Is that right?

A. The experiments involved the co-evaporation of LiQ and the structure on the left, Figure 2, which you are referring to as "BTB," which is what it states in the caption.

And the aim of the experiment was to determine whether a coordination complex forms when LiQ and 742 are co-evaporated. Excuse me. When LiQ and compound BTB are co-evaporated.

Q. Now, when you say "co-evaporated," is that coextensive with joint vaporization?

A. I'm not sure what the term "coextensive" means. Could you rephrase the question?

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Q. Sure. Does co-evaporated mean the same thing as joint vaporization?
A. Not in my understanding.
Q. What's the difference?
A. Well, co-evaporated is a very broad term. And joint evaporation -- I'm sorry. What was the term that you used?
Q. Joint vaporization.
A. Joint vaporization has certain specific connotations or interpretations, in the context of the patents that we are discussing.
Q. Okay.
Well let's take a look at column -- at paragraph 50, description C, which unfortunately bridges over pages 12 to 13.
A. I'm sorry. Start again, please. I'm on paragraph 50.
Q. Right. And paragraph 50 describes the experimental parameters that you conducted with respect to LiQ plus B2B.
Is that right?
A. Yes, it does.
Q. And, in particular, subsection C describes the co-deposition of B2B plus LiQ. Is that right?
A. Section C is entitled "BTB LiQ

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Co-deposition."
Q. Now, is what's described in this subsection C joint vaporization, as you understand that term?
A. As I -- so the answer would be it isn't specific enough to allow a reader to conclude that it was joint deposition.
Q. What additional detail would be needed?
A. One would have to understand in detail, the evaporator configuration and the substrate configuration during the deposition.
Q. And you, as the person who oversaw this experiment, did you jointly -- jointly vaporize the B2B and the LiQ?
A. To the best of my understanding, yes.
Q. And why is that?
A. The configuration of the chamber allows for the materials to mix in the vapor, as during the deposition, and to be present simultaneously, at or near the substrate, during the deposition.
Q. But we wouldn't be able to understand that from the description that you have provided here?
A. That would be correct. Yes. You would not be able to determine that.
Q. Are you familiar with the concept of

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sequential deposition?
A. In what context, Ma'am?
ATTORNEY ZHONG: Objection to form.
BY ATTORNEY HANSEN:
Q. Sequential deposition of two different materials to create a ETL.
A. I believe I'm familiar with the concept that you have described as "sequential deposition."
Q. Now, if you -- if the BTB LiQ co-deposition layer that you describe in your declaration were created by sequential deposition, would you have added or changed any of the descriptions provided?
ATTORNEY ZHONG: Objection. Form. Vague.
THE WITNESS: As I understand it, sequential deposition would ordinarily be carried out when one wants to create a layered structure. Meaning, first, one material, and then a second material.
And if one did such a, as you describe it, sequential deposition, one would expect that it would affect the structure of the material and the device, if it was used in a device. And so, you would expect it to be stated.
ATTORNEY HANSEN: We have been going for

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about an hour. Would now be a good time for about a 10-minute break?
THE WITNESS: Sure. That sounds great.
ATTORNEY HANSEN: Okay. Let's go back -- let's go off record.
COURT REPORTER: Okay. We are off the record.
(Short break.)
COURT REPORTER: Okay. We are back on the record.
ATTORNEY HANSEN: Kylan, can you please bring up Exhibit 1007?
COURT REPORTER: Kylan, are you there?
TECHNICIAN: Sorry. I didn't catch what you just said.
ATTORNEY HANSEN: Could you please bring up Exhibit 1007?
TECHNICIAN: Please stand by.
Once again, it should be in the folder. I'm not sure. Each time I open an exhibit, it's just taking a little longer to load.
ATTORNEY HANSEN: Okay.
(Exhibit 5 marked for identification)
ATTORNEY HANSEN: Dr. Schanze, do you see Exhibit 1007 in your folder?

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THE WITNESS: Yes, Ma'am. And I've opened it.
ATTORNEY HANSEN: Okay. And we'll mark this as Schanze 4.
BY ATTORNEY HANSEN:
Q. Dr. Schanze, what is Schanze 4?
A. As I look at what was just downloaded as -- was labeled Exhibit 1007, Ma et al., this is a paper published in the Journal, "Synthetic Metals," with the first author's name, Ma.
Q. And this is one of the references that you reviewed in preparing your declarations?
A. Yes, Ma'am. If "reference," you mean a published paper from the literature, yes.
Q. Okay. Now, Ma is an article about developing organic light-emitting diodes. Is that right?
A. The title of Ma reads:
"Organic light-emitting diodes based on new n-doped electron transport layer."
And the abstract, the first line reads:
"Organic light-emitting diodes with 8-hydroxy-quinolinato --"
That's H-Y-D-R-O-X-Y, hyphen, Q-U-I-N-O-L-I-N-A-T-O.

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"-- lithium doped..."
And so on. So I would infer that it is, in part, focused on organic light-emitting diodes.
Q. And 8-hydroxy-quinolinato lithium is otherwise known as "LiQ?"
A. Yes, Ma'am. To the best of my understanding, that's correct.
Q. And 4'7-diphenyl 1, 10 phenanthroline, that's also known as BPhen?
A. The answer would be correct. I should note that the structure is listed in Figure 5 -- excuse me -- Figure 1 of Ma, at the bottom of the first -- second page -- excuse me. At the bottom of the second page.
The name is misspelled in the title. It's written "D-I-P-H-Y-N-E-N-Y-L." It should be P-H-E-N-Y-L. Phenyl.
Q. Now, looking at the abstract, Ma reports that the use of doped ETL HTL layers improves the current efficiency of its exemplar OLEDs by 51 percent.
Is that right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Reading from the abstract, fifth line, the authors state:

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"Compared with the referenced device (without doping), the current efficiency and power efficiency of the p-i-n device are enhanced approximately by 51 and 89 percent, respectively."
That's what it reads.
Q. And so, understanding what "respectively" means, that is saying that the use of doped ETL HTL layers improves the current efficiency of its examplar OLEDs, as compared to undoped materials, by approximately 51 percent.
Is that correct?
A. If what they have written is correctly worded, I would assume that the 51 percent refers to the current efficiency.
Q. Now, Ma talks about these devices and refers to them as a significant improvement in device performance, as compared with the referenced devices. Right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: I'm sorry. Where are you referring to that statement? I don't see the word "significant" in the abstract.
ATTORNEY HANSEN: Sure.
BY ATTORNEY HANSEN:
Q. It's talking -- into the paper, bottom of

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the first page; left-hand column. It talks about a device with a new n-doping layer as an ETL and HTL layer.
Do you see that paragraph?
A. I'm sorry. I am still not following exactly where you are referring.
ATTORNEY HANSEN: Kylan, could you please scroll to the bottom of this first page?
BY ATTORNEY HANSEN:
Q. Do you see the paragraph beginning, "In this paper?"
A. Okay. That's the bottom column to you.
Q. Uh-huh. And they are referring to an ETL which is 33 percent weight LiQ to BPhen. Right?
A. So they made a device with both a P-type electron -- excuse me -- hole transport layer, and they have added LiQ to the electron transport layer. And they state that:
"Using this method, we obtained a significant improvement in the device performance, as compared to the referenced device."
That's what they state.
Q. Okay.
So the 51 percent is the combined improvement from the use of the ETL and the HTL. Is

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that right?
A. I would have to refer exactly to the data to see where these references are. Because the results are presented a bit in a confusing manner in a number of different figure panels, with a number of different device configurations.
So we would have to be more specific for me to conclude exactly where the improvements that they refer to come from.
Q. Okay.
Well why don't we take a look at Figure 3, which is on the bottom of page three?
A. Okay. Figure 3?
Q. Uh-huh.
A. Yeah. Okay. I'm sorry. Do you have a question about Figure 3?
Q. I'm waiting to get to Figure 3.
A. Okay.
ATTORNEY HANSEN: Kylan, could you please scroll down to Figure 3? Great.
BY ATTORNEY HANSEN:
Q. Now, Figure 3 is -- you passed it.
Figure 3 is looking at the current and power efficiencies of doping devices. Do you see that?

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A. Yes, Ma'am. I see Figure 3 reads:
"Power efficiency versus current density characteristics of the complete devices."
And inset shows current efficiency, current density characteristics of the complete devices.
Q. And in each of the devices that they are using, the ETL layer is BPhen with 33 percent by weight LiQ.
Is that right?
A. I'm sorry. I have to read the surrounding text, if you can bear with me for a moment?
Q. Of course.
[Witness reviewed document.]
A. So they are referring to devices B, C, D, and E. So I need to go back to see exactly what those devices are.
Q. Okay.
A. Okay. So on the second page, under paragraph two, "Experiments," they define their devices. So device B is zero doping -- zero percent of the F4TCNQ in the hole transporter, and 33 percent of the LiQ in BPhen. So that's device B.
Q. Yep.
A. Okay. And that's what I told you. This

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is confusing, the way they put it together.
Q. And device C is a device where, again, the ETL doping layer is 33 percent LiQ. Correct?
A. Yes. I'm trying to see what the trends are. And it looks like across this family of devices, B, C, D -- B, C, D and E -- what they are varying is the doping in the hole transporter.
Q. Right.
A. Yeah. So I agree, in these devices, the variable is the amount of TCNQ in the hole transport layer.
Q. Right. So the lines with the square on them are undoped ETL and -- well actually, let's do this a little bit differently.
So the device with the circle is zero percent weight of the HTL doped with the F4TCNQ. Is that right?
A. The circles, as I understand their presentation, which is frankly, Ma'am, unclear, the circles would represent a device that contains -- they are not explicitly stating it in the figure, but I would interpret that as being device B, which would be zero percent of the TCNQ. And it would have the LiQ in the ETL.
But again, there is ambiguity in this

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presentation, because the description is in the text, but it doesn't refer to symbols. So, frankly speaking, one might have trouble concluding exactly what they did here.
Q. Okay. But you agree with me that in the device that is zero weight percent of F4TCNQ, it shows current efficiency, that's about in the middle of the pack.
Is that about right?
A. Yes, Ma'am. Its peak current efficiency appears to be just shy of five candelas per amp, at 50 milliamps per centimeter square. That would be the plot that has the circles on it.
Q. Okay.
Now, the square version is without doping in either the ETL or HTL. Is that right?
A. Again, simply, the authors state in that figure, without doping. And they don't say whether it's A, B, C, or D. So there is some ambiguity.
But one might -- one might guess that that's device A, which they say is an undoped MTDATA HIL and BPhen ETL. So, undoping -- one might construe it's a device that has no additives to either the hole transport or the electron transport.
But again, it's not explicitly stated in

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the figure. So we are extrapolating, based on what information is provided.
Q. Okay.
And the improvement between the -- without doping square line, and the zero percent F4TCNQ circle line is about what percent improvement?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Say again, please?
BY ATTORNEY HANSEN:
Q. The improvement between the without doping square line and the zero percent F4TCNQ circle line is about what percent improvement?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: If I look at the figure, the difference between those two plots, which again, I've stated is ambiguous as to what the device compositions is, but the difference between the circle plot is -- that one's about 4.8 candelas per amp, and the square is about four.
I'm unable, in my head today, to give you a number percent increase on that. I don't do calculations in my brain. But the increase is from around four candelas per amp per square, and about 4.8 candelas per amp circles.
And so, if you want to calculate a

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percentage, you can do so.
Q. Right. So 4.8 minus 4 is about 0.8. Is that right?
A. Yes, Ma'am.
Q. And 0.8 divided by four is about one fifth?
A. Yes, Ma'am.
Q. And one fifth is about 20 percent?
A. Sounds about right. Yes.
Q. So simply moving from an undoped ETL, undoped HTL, to a 33 percent LiQ doped ETL resulted in a 20 percent improvement?
A. Again, if I interpret -- with all the caveats that I've stated, the difference between the square graph and the circle graph, as we discussed, and based on your calculation -- thank you for that calculation -- the difference is about 20 percent more for the circle, relative to the square.
Q. And so, just under half of the 51 percent that they show as being a significantly approved current efficiency may be attributed just to the doped LiQ BPhen layer?
A. Again, as you have taken us through this exercise, as I've stated, we have to make extrapolations to assume that the plots correspond

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to the compositions that we have discussed.
But if that -- those extrapolations were correct, then one would guess that at least in this experiment, the difference between the circle and the square experiments which, as you have stated, may be due to the dope -- the addition of LiQ, is about 20 percent.
Q. And 20 percent is about half of the 51 percent improvement that the authors say shows a significantly improved device?
ATTORNEY ZHONG: Object to form.
THE WITNESS: I would not agree with the characterization of half. Twenty percent is a difference that we have calculated, that's less than half of 50-some odd percent.
BY ATTORNEY HANSEN:
Q. Forty percent. Is that right?
A. If you say so.
Q. Do you agree that two fifths is 40 percent?
A. It's round about. I don't have a calculator in front of me, so...
Q. Okay.
Now, let's take a look at Figure 5, which is immediately next to it. Do you see that?

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A. Yes, Ma'am. I see Figure 5.
Q. Now, you would agree that current density and conductivity are directly related. Is that right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: It depends on the context. I don't think that just in a general way, I can agree with the statement that you made.
BY ATTORNEY HANSEN:
Q. Aren't current density and conductivity related through Ohm's law?
A. If we are speaking specifically about the device that's shown or described in Figure 5, which, as I read the title of that figure in the graph, it says, "electron-only device," then I would agree that current density would be related -- I'm sorry, again, your question is current density is related to what?
Q. Current density and conductivity are directly related.
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: In the context of the device that's shown, the current density and conductivity would be related in a way through Ohm's law. Yeah.
BY ATTORNEY HANSEN:

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Q. And Ohm's law would have them directly related. Is that right? Let me ask a better question.

Ohm's law directly relates conductivity and current density. Correct?

A. So, first, for the record, I'm a chemist. Not an electrical engineer. And as I understand it, Ohm's law relates the resistance current and voltage. And you are asking me to relate through Ohm's law, current density and conductivity, which are different forms.

Q. Okay.

And your unfamiliarity with Ohm's law is because you are a chemist?

A. I'm not used to thinking about the relationship of Ohm's law in terms of conductivity. I'm used to thinking of it in terms of resistance. I'm not saying, I don't understand it.

Q. Okay.

Well let's take a look, if we could, at Figure 5. Now, the bottom line there is an electron-only device where, effectively, it's just passing voltage through undoped BPhen.

Is that right?

A. The bottom line, meaning the one with

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squares? Is that what you are referring to?

Q. The one with squares. Yes. Thank you.

A. Okay. So, as I understand it, that graph represents a plot of current density measured passing through an electron-only device, which would consist of what they are calling "ETL," which I assume is referring to BPhen, with zero percent LiQ added to it.

And they are measuring the current density as a function of the voltage applied across that device.

ATTORNEY HANSEN: Right. I'm going to strike that answer as nonresponsive.

BY ATTORNEY HANSEN:

Q. My question is, the bottom line with the squares refers to the current density passing voltage through undoped BPhen.

Is that right?

A. I don't understand what you mean by the current density passing voltage. That statement is not understandable to me.

Q. Totally fair.

The bottom line reflects the curve acquired by passing voltage through undoped BPhen, resulting in a particular current density at each

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voltage. Is that right?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: So, we do not usually refer to passing voltage. We usually refer to applying voltage. So if you could restate your question in that form, then I could answer it?

ATTORNEY HANSEN: Sure.

BY ATTORNEY HANSEN:

Q. The bottom line reflects the curve acquired by applying voltage to undoped BPhen, resulting in a particular current density at each voltage.

Is that right?

A. Yes. I would agree with that statement.

Q. Okay.

Now, the top line with the upward facing triangles. Do you see that top one?

A. Yes, Ma'am.

Q. And that reflects the curve acquired by applying voltage to an ETL comprised of BPhen plus 33 percent by weight LiQ, resulting in a particular current density at each voltage. Right?

A. Yes. I would agree with that statement.

Q. Now, if we look at current density of the square line, at voltage 12, that has a current

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density of about 125? Would you agree that?

A. It's close. It might be -- it might be 135. It's hard to extrapolate. It's a little higher than 125, but I would say it's about 135 to 140.

Q. Okay.

A. Yes.

Q. Now, the current density of the upward-facing triangle line for the 33 percent LiQ doped line, at 12 voltage, is about a little bit over 350.

Is that right?

A. Yes. It looks to be 370-ish --

Q. Okay.

A. -- milliamps per centimeter square.

Q. And that is about only threefold better? That 33 percent LiQ voltage line is really only about threefold better than the undoped BPhen. Right?

A. I'm sorry. I don't exactly know what you mean by "threefold better." Can you be clear in your statement?

Q. Sure. So 370-ish is three -- is a little bit over three times 145.

ATTORNEY ZHONG: Objection. Form.

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THE WITNESS: I think three times one -- let's call it 140 -- would be 420. So as I see it, the curve with the inverted triangles is less than three times larger. It's more like two times larger.
ATTORNEY HANSEN: Okay.
BY ATTORNEY HANSEN:
Q. And by "inverted triangles," you actually mean the triangles that are upright. Is that right?
A. Oh. I'm sorry. Yes. Yeah. It's a little better than twice, then.
Q. Do you agree that Figure 5 shows that there is an increase in current density, seen with an increase in LiQ doping?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: At a -- I can say that at a given voltage, the data shows that for this electron-only device, the trend shows that at a given voltage, there is an increase in the current density at that given voltage, as a function of added LiQ, up to 33 weight percent, as shown.
There is actually only two data points; 17 and 33. And then at 50, it falls. It's lower.
ATTORNEY HANSEN: Got it. Okay.
BY ATTORNEY HANSEN:

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Q. Do LiQ and BPhen satisfy the requirement that you set out, that the HOMO of LiQ and the LUMO of BPhen are within 0.5EV?
A. Can you ask your question again, please?
Q. Sure. Do LiQ and BPhen satisfy the requirement that the HOMO of LiQ and the LUMO of BPhen are within 0.5 eV?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: I don't have in front of me the information in order to answer that question. So can -- see, I guess in this paper, if I look on page 813, that's the Ma paper, Exhibit 1007. The LUMO of BPhen is -- in this paper, is listed as three electron volts.
That's in the second paragraph on second column of page 813. It lists the -- lists the LUMO of LiQ as 3.1 eV, but the HOMO is not given.
Q. Did you look up the HOMO of LiQ?
A. I don't know -- can you tell me where I would look it up in my materials? Is it in my deposition?
Q. Your declaration? It is not.
A. Declaration. So I'd have to answer, I'm not sure.
Q. Okay. Why didn't you look up the HOMO of LiQ?
A. I didn't see how it was relevant.
Q. And why didn't you think it was relevant?
A. Can you ask your question again?
Q. Why didn't you think it was relevant?
A. Well, in Ma -- this paper that we are referring to -- they attribute the differences to LUMO-LUMO interactions. And if you read down in that paragraph, they state that:
"In a single host device, electrons hop along the LUMO and BPhen, since the LUMO-LUMO difference between BPhen and LiQ is neglectable, subject to their similar LUMO, transport manifolds along with their LUMO are expected to exhibit a certain extent of overlap, after a mixing ratio."
So they are attributing the effect to a LUMO-LUMO interaction. So in that case, the HOMO is not relevant.
Q. So this is a different form of electron charge carrier transport than HOMO-LUMO relationship?
A. I can only state what the authors have concluded in their paper, that they are attributing the effect to LUMO-LUMO interaction in the LiQ BPhen.

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Q. Do you agree that there are more than one way to transport electrons through the ETL, other than a HOMO-LUMO relationship?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Say it again, please?
BY ATTORNEY HANSEN:
Q. Do you agree that there is more than one way to transport electrons through the ETL, other than through a HOMO-LUMO relationship?
A. I --
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Again, in this study, as stated previously, the transport is involving the LUMOs. And I did not really understand your question in that context. So I'm unable to directly answer it.
BY ATTORNEY HANSEN:
Q. If we could turn to your declaration? Which I believe is Schanze 2?
A. Okay. I am closing Exhibit 1007 for now, just for the record.
Q. Okay. If we need to reopen it, we will reopen it.
A. And my exhibit is Exhibit 2041? Is that what you are referring to?

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Q. Correct. Yes. The declaration from May of this year

A. Okay. I'm sorry. I am following along on my computer because it's easier to read. The screen is pretty small on Zoom.

Q. Okay.

If we could turn to paragraph 150 of your declaration, which is on page 71?

A. Yes, Ma'am.

Q. Now, 150, and the structure immediately below there, reflects a screenshot from Web of Science.

Is that right?

A. Yes. Paragraph 150 reads:

"For example, as shown by the screenshot below, the Ma article was not indexed by Web of Science until December of 2008. I personally captured the screenshot from the Web of Science."

And the screenshot below was taken from my computer on or about the date that this declaration was created.

ATTORNEY HANSEN: And if we take a look -- Kylan, if you could scroll down to the image?

BY ATTORNEY HANSEN:

Q. The index date is actually December 1st

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2008. Is that right?

A. That's what it shows. About the sixth line down, it says "Indexed 2008/12/01." So I interpret that to be December 1st 2008.

Q. So you agree that Ma was publicly available, at least as of December 1st 2008?

A. I would agree that Web of Science was able to index the article as of that date. I cannot state, definitively, of its public availability. I can state that Web of Science was able to index it.

I'm not sure how the Web of Science accesses the publisher's information.

Q. As of December 1st 2008, a person interested in finding information about OLED devices n-doped ETLs would be able to find Ma through web of science?

A. I would --

ATTORNEY ZHONG: Objection. Form. Calls for a legal conclusion.

THE WITNESS: I would conclude that a person of skill in the art should -- but I can't say definitively would -- have been able to access the paper from this Web of Science record as of that date.

I can only say that Web of Science is

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reporting that they indexed it on that date. So it should have been available at that time, or after, to a person who was able to access Web of Science, which is not publicly available.

It's available to those that have subscription access, typically through a university library, or some other manner. So, I don't know that that would be construed to be publicly available. That would be a question that's not within my realm.

Q. Okay.

But clearly, since you were able to pull this document, you have access to Web of Science?

A. Yes. I have access to Web of Science through my university's subscription.

Q. And did you have access to Web of Science in 2008?

A. Yes, Ma'am. I did have access to Web of Science in 2008.

Q. Did you have access to Science Direct in 2008?

A. No. I did not.

Q. Did your university not have a subscription to Elsevier Journals?

A. At the time, I was at the University of

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Florida, in Gainesville, Florida. The University of Florida, to the best of my recollection, at that time, was a subscriber to Elsevier Journals, including the one that we are talking about; Synthetic Metals.

But, to my recollection, the University of Florida did not, and actually still does not, subscribe to Science Direct, which is the Elsevier search product.

And, for the record, my current university also does not subscribe to Science Direct either.

Q. Now, if we could turn to paragraph 149? This recites a whole bunch of items that you recite, based on -- to the best of your recollection.

Is that right?

A. So 149, if I may, it helps me in my understanding of the question. It says:

"Additionally, as I recall, in 2008 to 2009, Elsevier Journals often did not promptly index new articles, especially online versions. Thus, it was my recollection that the new articles often could not be located unless one knew the authors' names or the title of the article.

It's also my recollection that in 2008 to 2009, Elsevier search tool had limited search

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capability, as it often failed to identify articles of interest.

Additionally, during the relevant time period, indexing services, such as Clarivate Web of Science, did not index online only articles, making them difficult or impossible to locate."

Q. But if you didn't have access to Science Direct, how would you have any recollection or understanding about their search tools?

A. The search tool that I'm referring to is the search tool in the publisher's subscription. So each publisher includes a search tool inside their journal, or inside their journal family. That's the search tool that I am referring to.

Q. And Elsevier search tool is Science Direct?

A. I cannot answer that. I can only say that the search tool that I'm referring to is the search tool that's within the journal.

As I understand it, at least my understanding in this discussion is that when you say "Science Direct," you are referring to Elsevier's -- they have a search indexing tool that's similar to Web of Science.

That's what I'm referring to when -- what

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I understand you mean by "Science Direct." Maybe I misunderstood.

Q. Got you. Okay.

Now, in paragraph 148, you include a screenshot of the internet archive captures of Elsevier.com/locate/synmet. Is that right?

A. Yes, Ma'am.

Q. Did you look for archived captures of the page linked to this main landing page?

A. To the best of my recollection, no. I did not.

Q. Did you look for Wayback Machine archive pages, outlining the search capabilities of Elsevier search tools in 2008?

A. Can you state your question again, please?

Q. Did you look for Wayback Machine archive pages that captured the websites that outlined the search capabilities of Elsevier's search tools in 2008?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: So, as I understand it, you are asking, did I look for Wayback Machine links to Elsevier's description of their search capability? Is that what you are asking?

ATTORNEY HANSEN: In 2008. That's

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correct.

THE WITNESS: To the best of my recollection, no. I did not. But I also would say I don't know what you are referring to. So...

BY ATTORNEY HANSEN:

Q. Did you look for Wayback Machine archive pages of websites that outlined the indexing protocols for Elsevier search tool in 2008?

A. No. I did not.

Q. You published in Synthetic Metals. Right?

A. Honestly, Ma'am, I can't say for certain. I'd have to review my CV. I don't recall.

Q. Why don't we take --

A. Nearly 400 papers.

Q. Why don't we take a look at your CV, which is in Schanze 1?

A. One minute, please.

Q. And if we turn to PDF page 121? Item 102.

A. Bear with me just a moment. PDF page 121?

Q. Yes.

A. Okay.

Q. This is an article that you published in Synthetic Metals in 2023?

A. Let's see. I see entry number 102. "Schanze, Reynolds, Boncella, Harrison, Foley, et

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al., 'Near-Infrared Organic light-emitting Diodes,'" published in Synthetic Metals, 2003, page -- or volume 137, page 1013.

So I guess I can say affirmatively, I have published in Synthetic Metals.

Q. And why did you choose to publish in Synthetic Metals?

A. Honestly, I can't answer that question clearly, without looking at the article. It may have been connected with a symposium. Often, that's how authors are drawn to publish in certain journals.

My vague recollection is that that might be the case. But if you want me to answer in more detail, I'd have to look the paper up and review it.

Q. Got you. And you've published in other Elsevier Journals in 2009. Is that right?

A. Again, I'm not sure. You'd have to point me to what you are specifically referring to.

Q. Sure. So why don't we take a look at PDF 125?

A. Yes, Ma'am.

Q. Entry number 166.

A. Yes. That reads Ogawa, as the main author, with some other co-authors. And it says:

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"Phosphorescence Quenching of a Platinum Acetylide Polymer by Transition Metal Ions," published in the Journal of Photochemistry and Photobiology, in the year 2009. Issue 207. Page 79.

Q. And the Journal of Photochemistry and Photobiology is a Elsevier journal?

A. I -- to be honest, it's not information that's at the top of my recollection. But if you've looked it up, I will say that I would agree you. It is likely.

Q. Why do you say it is likely?

A. Just some context, please, if I may, for the record, my r sum has approximately 400 papers. Over more than 40 years of career. And I think it's maybe pretty evident that somebody doesn't keep track of every single paper over that time and that number.

So I don't have that level of recollection, unfortunately.

Q. Understood. And that's fine.

ATTORNEY HANSEN: If we could pull up, Kylan, tab three, please?

TECHNICIAN: And, counsel, this is this tech. I just wanted to confirm, I think the last

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one, which was Exhibit 1007, would have been Exhibit 5, and this should be Exhibit 6, I believe.

ATTORNEY HANSEN: Okay. So this is Exhibit 6.

(Exhibit 6 marked for identification)

BY ATTORNEY HANSEN:

Q. Dr. Schanze, do you recognize Schanze Exhibit 6?

A. That's what's on the screen now. I have not downloaded it. What I'm seeing on the screen is a paper that's published in "Journal of Photochemistry and Photobiology A: Chemistry."

It says it's an Elsevier Journal. And the title is, "Phosphorescence Quenching of a Platinum Acetylide Polymer by Transition Metal Ions."

Q. And do you --

A. And, yes. I do recall this paper.

Q. Now, do you see that the article info says that it was available online on May 3rd 2009? Do you see that?

A. Yes, Ma'am.

Q. Do you recall when this article was put into a paper journal?

A. I do not.

Q. Would it surprise you to learn that it was

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September 2009?

A. No. It would not. That seems about the usual difference.

Q. When you say the usual difference, what do you mean?

A. So, many publishers, more back in previous times, around this period of time, would put an article on their website as at what sometimes is called an accepted version.

Now, that would be essentially a PDF of the paper that had been created by the authors without page settings, or was not the final version. And it often would be somewhere on journal's website. Sometimes easy to find. Sometimes not so easy.

And that's -- that's sometimes what "available online" would be referring to.

Q. And I see that there are some listed key words underneath on your article. What are those for?

A. They are -- key words are requested by the journals, from the authors, at time of submission. They are to give a short summary of topics that are in the journal.

I do not know -- or, excuse me. They are

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given to provide a short summary of topics that are in the article. I do not know how the publishers use that information, so I can't construe anything other than what I know as an author.

Q. Do you know if any of your interested colleagues would have been able to identify this article prior to September 2009?

A. Frankly, no. I don't.

Q. Okay.

ATTORNEY HANSEN: Could we please pull tab four, Kylan?

(Exhibit 7 marked for identification)

ATTORNEY HANSEN: We'll mark this as Schanze 7.

THE WITNESS: Sorry. I can't see it. There it is.

ATTORNEY ZHONG: So I'm going to object as to being irrelevant.

BY ATTORNEY HANSEN:

Q. Dr. Schanze, do you see what's been marked as Schanze 7?

A. I see on the screen, a PDF of an article entitled, "The triplet state in platinum acetylide polymers -- oligomers, polymers, and copolymers," with lead author, Silverman. And it appeared in

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Coordination Chemistry Reviews, in the year 2005.
Q. And you are listed as the last author on this paper?
A. That's what it says. Yes.
Q. And you are also listed as the author to whom correspondence should be directed?
A. I believe so. I think that's what the asterisk on my name says. Although I don't see it on the screen, but that's usually the interpretation.
Q. And this is another article that was published in an Elsevier Journal?
A. It appears to. Yes.
Q. And it also says that it was available online on January 20th 2005?
A. That's what it says.
Q. Would it surprise you to learn that this article appeared in a paper journal in July of 2005?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: I don't know what you mean by surprise me. If that's what the published statement is, then that's what it is.
BY ATTORNEY HANSEN:
Q. When you say "published statement," what do you mean?

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A. Must somewhere on this article, have a -- usually, the publishers put a -- an imprint date, or if you looked at the journal in which it appeared in, it would have a date on it.
I can't tell from what you are showing me. I'm sorry.
Q. Okay.
A. And frankly, again, I'm being completely honest. I really don't know -- other than what you are showing me, I have not had the opportunity to review these materials or think about them in many years.
Q. Understood.
ATTORNEY HANSEN: We have been going for about an hour. Would now be a good time to take a break?
THE WITNESS: Sounds good.
ATTORNEY HANSEN: Okay.
COURT REPORTER: Okay. We are off the record.
(Short break.)
COURT REPORTER: We are back on the record.
ATTORNEY HANSEN: Kylan, can you please bring up Exhibit 1005, please, which we'll mark as

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Schanze No. 8?
(Exhibit 8 marked for identification)
ATTORNEY HANSEN: And, Dr. Schanze, please let me know when you've had a chance to download this.
THE WITNESS: I'm working on it.
ATTORNEY HANSEN: Okay.
THE WITNESS: Okay. I have it open. Thank you.
ATTORNEY HANSEN: Great.
BY ATTORNEY HANSEN:
Q. Dr. Schanze, Schanze Exhibit 8 is the English translation of Werner that you reviewed in connection with this IPR. Correct?
A. Yes, Ma'am. It's labeled Exhibit 1005, and I guess it's called Exhibit 8 for this proceeding.
Q. Okay. And if we take a look at the second page? So PDF page two?
A. Yes, Ma'am.
Q. And if we go down to the title? You agree with me that the title of this patent indicates that it's for use of a metal complex as an n-dopant for an organic semiconducting matrix material, organic semiconductor material, and electronic components,

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as well as dopant and ligand and method for producing the same.
Is that right?
A. Yes. That's what the title states. Yes, Ma'am.
Q. And an electronic component is an electronic device?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: I don't know that I would conclude that an electronic component is an electronic device. It's what it states. An electronic component.
ATTORNEY HANSEN: Okay.
BY ATTORNEY HANSEN:
Q. Well why don't we go, then, to PDF page four, where it talks about the invention? And you agree with me that part of the invention relates to the development of an electronic device with an organic semiconducting material, doped with a metal complex as an n-dopant. Right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: So the page that you referred me to, which is PDF page four, document -- page four, the title of it -- the title on that page says:

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"Use of a metal complex as an n-dopant for an organic semiconducting matrix material, organic semiconductor material, and electronic component, as well as dopant and ligand and method for producing the same."

So that, apparently, is the title of the patent application, or patent. And then it goes on in paragraph nine, or the paragraph beginning with line nine, to state that:

"The invention relates to the use of a metal complex as a dopant for doping an organic semiconducting matrix material to modify its electrical properties, wherein the compound acts as an n-dopant with respect to the matrix material."

I don't see anything about an electronic device in that paragraph.

Q. Well, how about the next sentence, which says:

"It also involves an organic semiconducting material containing an organic matrix material and a metal complex as an n-dopant, as well as an electronic device with an organic semiconducting material doped with a metal complex as an n-dopant."

A. Yes. I agree with you that that's what

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line 14 through 16 states.

Q. So you would agree with me that Werner discloses electronic devices comprised of organic semiconducting material doped with a metal complex?

A. I would have to review all the claims to be able to -- if you want me to do that, I will. But the -- it's my understanding that the bulk of this patent is about organic metallic compounds, metal containing compounds, and organic compounds, and not so much about devices.

Q. Okay.

But it's saying here, in this paragraph, that this is an invention about, among other things, electronic devices with an organic semiconducting material doped with a metal complex as an n-dopant. Right?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: Again, I review -- I agree that what you said at line 14 through 16 states what you have stated.

BY ATTORNEY HANSEN:

Q. That was not my question. My question is, you agree that Werner talks about inventions that include, among other things, electronic devices.

Is that right?

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ATTORNEY ZHONG: Objection. Form.

THE WITNESS: Let me take a quick look at the claims, please.

BY ATTORNEY HANSEN:

Q. Why do you need to look at the claims?

A. It's my understanding that the claims describe the scope of the patent.

Q. This is a reference. Why do you need to look at the claims?

ATTORNEY ZHONG: Objection. Argumentative.

THE WITNESS: So if I review claim one, it says:

"Use of a metal complex as a dopant for doping an organic semiconducting matrix material to alter its electrical properties, wherein the metal complex represents an n-dopant with respect to the matrix material, or the use of a metal complex for the production of an electronic device with an electronically functional area containing the metal complex characterized in that the metal complex is a neutral electron-rich metal complex."

So that's what the claim states.

BY ATTORNEY HANSEN:

Q. And what did that mean to you, in terms of

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whether or not this invention relates to an electronic device?

A. My understanding of the patent again is that it's focused primarily on materials chemistry and materials science of organic metallic and metal containing compounds and organic materials.

Q. For the --

A. That's the predominant aspect of this patent.

Q. For the purpose of generating electronic devices?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: Again, my understanding is that it's for the purpose of creating electronic materials.

BY ATTORNEY HANSEN:

Q. And electronic materials are the same as electronic devices?

A. Not in my understanding. Electronic materials may be used in electronic devices, but they are not the same.

Q. You agree, however, that claim one talks about electronic devices?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: Claim one of the patent that

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you provided me with states that:
"Use of a metal complex for the production of an electronic device with an electronic functional area containing the metal complex."
That's what it states.
BY ATTORNEY HANSEN:
Q. And when you say -- this is a reference that you have reviewed in connection with the IPR. Correct?
A. Yes. I have --
Q. Exhibit No. 8? Sorry. Apologies.
A. Yes. I have reviewed this patent, which is referred to in my declaration. I believe it's Werner.
Q. Okay.
Now let's go back, if we could, to the abstract, which is on PDF page two.
A. Yes, Ma'am. I'm there on my version.
Q. Now, you agree with me that one of the bridging ligands called out in the abstract is the ligand, HPP.
Is that right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Let me review the abstract for a moment, please.

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ATTORNEY HANSEN: Of course.
THE WITNESS: Okay. The abstract is listed as, I believe, paragraph -- or line 57. It's got a 57 in front of it, so that's what I'm reading. It says:
"The invention relates to the use of a metal complex as n-dopant for doping an organic semiconducting matrix material for modifying the electrical properties of the same, wherein the compound represents an n-dopant with regard to the matrix material.
The aim of the invention is to provide n-doped organic semiconductors for matrix materials that have little reduction potential while achieving high conductivities.
According to the invention, a neutral electron-rich metal complex having a central atom as the preferably neutral or charged transition metal atom having a valence electron number of at least 16 is used as the dopant compound.
The complex can especially be multinuclear and comprises at least one metal-metal bond. At least one ligand can form a pi-complex with the central atom, or can be a bridging ligand, especially HPP, a borate, carborane, or

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triazacycloalkane or comprise at least one carbanion carbon atom or a bivalent atom selected from the group containing C (carbene), Si (silylene), Ge (germylene), Sn (tin), PB (lead).
The invention also relates to novel dopants and methods for producing them."
So as I've read it, there is a line that does point to HPP, among many other entries.
Q. And HPP is the only species of compound disclosed in that list. Right?
A. I'm sorry. I don't understand your terminology. Can you be clear?
Q. Sure. There is only one HPP. HPP indicates a very specific structure. Right?
A. It implies -- yes, Ma'am. I believe a certain trinitrogen-containing compound. But triazacycloalkane is also rather specific. So it wouldn't be the only specific entry in the abstract.
Q. There is more than one triazacycloalkane than -- there is more than one compound that could be called a triazacycloalkane. Right?
A. Yes, Ma'am.
Q. And there is more than one compound that could be called a borate?
A. Yes, Ma'am.

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Q. And there is more than one compound that could be called a carborane?
A. Yes, Ma'am.
Q. And there is more than one compound that comprises at least one carbanion carbon atom. Correct?
A. Yes.
Q. And there is more than one compound that has a bivalent atom selected from the group consisting of carbene, silylene, germylene, tin or lead.
Is that right?
A. Yes, Ma'am.
Q. Now, looking at this abstract, you also agree that according to the invention, the metal complexes have a central atom? Let me actually strike that.
You agree that the n-dopants, according to the invention, have -- metal complexes have central metal atoms?
A. So in the abstract, it does state according to the invention, a neutral electron-rich metal complex, having a central atom, as a preferably neutral or charged transition metal atom.
So, it does use the term, "central atom."

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Q. Okay.
Do you agree that W2(hpp)4 is one of the metal complexes disclosed in Werner?
A. It's referred to among many, many, many compounds, often appearing in lists of compounds. So, but in that context, it appears among thousands of other, if not literally millions of other compounds.
Q. And you also agree that Werner discloses BPhen as a matrix material?
A. Again, with the same caveats, BPhen is one of many, many, many organic compounds that's described in Werner. Yes.
Q. But BPhen is specifically called out. Right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: One moment, please.
[Witness reviewed document.]
THE WITNESS: BPhen does appear on page 57. But it also appears along with many, many other compounds that are listed and named.
BY ATTORNEY HANSEN:
Q. When you say page 57, you are referring to PDF page 57?
A. Yes, Ma'am. It's labeled SDC

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Exhibit 1005, 57/89.
Q. Got it. Okay. And then it also appears on page 58 of 89 as well. Correct? And let me ask a better question. BPhen also appears on page 58 of 89. Correct?
No. Sorry. Up. We are looking at the numbers on the bottom right.
A. I'm sorry. Which page are we referring to now?
Q. So, internal page 55. The page that has the numbering, 58/89.
A. I'm sorry. I don't see BPhen listed there.
Q. On line five, it says:
"In particular, BPhen can be used as a matrix material."
Do you see that?
A. Yes, Ma'am. I do see that. Starting on line five, the sentence reads:
"In particular, BPhen can be used as a matrix material."
Q. Now, prior to sitting here for this deposition, were you aware that this page specifically called out BPhen?
A. I've read the Werner patent on several occasions, and I've seen these entries.
Q. Now, we talked earlier about how BPhen is a phenanthroline derivative. Right?
A. Yes, Ma'am.
Q. And, in fact, the description calling out BPhen appears in the paragraph which talks about potentially substitute -- aryl-substituted phenanthrolines. Right?
A. I'm sorry. So again, can you draw my attention where you -- I don't have this memorized, obviously. So which paragraph are we specifically pointing to on which page?
Q. Page -- internal page 55. It's the four lines beginning at line three, ending at line six.
A. Sorry. When you say "internal page," do you mean 55/89? Where? Sorry.
Q. No. Internal page is the number at the top of the page.
A. Okay.
Q. And the Bates number is the number at the bottom of the page. It's the same page that we were looking at for the line, "In particular, BPhen can be used as a matrix material."
A. I'm really sorry. I am having some trouble. So again, internal page 55?

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Q. The image of the page where there is a 55 at the top of the page.
A. Yes, Ma'am.
Q. Are you there?
A. Yes.
Q. And do you see that there is a paragraph that begins at line three, that begins "phenanthrolines?" Do you see that?
A. Yes.
Q. It's a four-line paragraph. Is that right?
A. Yes. It reads -- I'm sorry about the navigation problem.
Q. No worries. It's always a difficulty with remote depositions.
A. Okay. So that paragraph, starting on line three of internal page 55 reads:
"Phenanthrolines which can be substituted or unsubstituted, in particular, aryl-substituted, such as phenyl or naphthyl substituted, can also be used as matrix materials. In particular, BPhen can be used as a matrix material."
Q. Now, an aryl substitution is an aromatic group?
A. Aryl substituted, yes, does refer to

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something akin to benzene ring, but it can be naphthyl, phenyl -- excuse me. It can be naphthyl, anthryl, phenanthryl, pyridyl. It can be essentially an infinite number of compounds.

Q. And a phenyl group is an aromatic group?

A. Yes, Ma'am. It's a benzene ring.

Q. And a naphthyl group is an aromatic group?

A. Yes, Ma'am.

Q. And given how phenanthrolines are structured, if the phenanthroline were to be substituted, the substitution would not be on the pyridinic nitrogens. Correct?

A. Can you state the question again, please?

Q. Sure. If the phenanthroline were to be substituted, the substitutions would not be on the pyridinic nitrogens. Correct?

A. No. I don't agree with that. It is possible to make n-substituted aryl derivatives of phenanthroline.

Q. Is that a common structure?

A. I don't know what you mean by "common." It's a compound that can be synthesized.

Q. And that would result is a positively charged nitrogen?

A. Most of the time, yes. If it's an aryl

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substituent, it would be a positively charged derivative.

Q. And have you seen phenanthrolines with n-substitutions used in the development of semiconductor material?

A. Not to my knowledge. But I can't say that it doesn't exist. I would not be able to testify to that.

Q. If the phenanthroline were substituted at any location other than the pyridinic nitrogens, would that constitute an example of a compound that had a heteroaromatic group conjugated to an aromatic group via a CC bond?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: I'm sorry. I need you to repeat that question very slowly so that I can understand. It involves chemistry and, you know, structures that you are describing. So please try again.

BY ATTORNEY HANSEN:

Q. If the phenanthroline were substituted at any location other than the pyridinic nitrogens, would that constitute an example of a compound that had a heteroaromatic group conjugated to an aromatic group via a CC bond?

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ATTORNEY ZHONG: Objection. Form.

THE WITNESS: You said "substituted." I'm not sure if you are specific about what the substitution is.

ATTORNEY HANSEN: That's a good clarification. Let me ask that question.

BY ATTORNEY HANSEN:

Q. If the phenanthroline were substituted at any location other than the pyridinic nitrogens, with a phenyl group, would that constitute an example of a compound that had a heteroaromatic group conjugated to an aromatic group, via a CC bond?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: So it's really difficult to talk chemistry like this with vague terms. So that's the reason for my hesitation. So you are specifically referring to a phenanthroline compound.

Is that correct?

ATTORNEY HANSEN: Correct.

THE WITNESS: In your question. And you have not designated the site of substitution of the phenanthroline.

Is that correct?

BY ATTORNEY HANSEN:

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Q. I've said substituted at any location other than the pyridinic nitrogens.

A. So that then -- just to be clear, that refers to any position, one, two, three, five, seven, nine and 10, I suppose. Correct?

Q. Correct.

A. I -- you know, there are rules of chemical nomenclature. And so, strictly speaking, positions two, three, and four would be the heteroaromatic positions. And I would have to defer my -- to not knowing specifically how to respond, if it was a five or seven position.

Are you waiting for me?

Q. I am not.

Well, let's -- actually, could we go to internal page 54 of the same document, just so we get the numbering correct? And looking at the description of -- the structure of BPhen?

A. Yes, Ma'am.

ATTORNEY HANSEN: And Kylan, if you could scroll down just a little bit? Okay.

BY ATTORNEY HANSEN:

Q. So, in this structure, the one and 10 refer to the pyridinic nitrogens. Correct? Location of the pyridinic nitrogens in the structure

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of BPhen?
A. Yes. That's correct.
Q. And the two phenyl groups are located at the four and seven position?
A. That's correct.
Q. So if you had a substitution at the two, three, four, seven, eight, or nine position, with the phenyl group, that would constitute a heteroaromatic compound conjugated to an aromatic compound, via a CC bond?
A. And you said specifically a phenyl? That's --
Q. I did.
A. Yes. Yes. I would agree with that.
Q. Okay.
Now, with respect to the five and the six position, if you had a phenyl group attached with either of those positions, would that constitute a heteroaromatic group conjugated to an aromatic group, via a CC bond?
A. If we consider the structure, phenanthroline -- 110 phenanthroline as being a heteroaromatic compound taken as a whole, then substitution at the five or seven positions with a phenyl substituent could be considered to be a

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heteroaromatic compound, conjugated to an aromatic compound via a CC bond.
Q. Are you aware of 110 phenanthroline being considered other than a heteroaromatic group?
A. No, I'm --
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: No, I'm not.
BY ATTORNEY HANSEN:
Q. Now, if we could go back to internal page 55? And looking at the paragraph starting at line eight, with the first word, "heteroaromatics?"
Are you there?
A. Yes. That's the start of the next paragraph. The one we've been talking about.
Q. Now, there is a particular example provided below, starting around column -- or line 15. Do you see that?
A. Yes, Ma'am. You are referring to the compound that's named 3-(4-Biphenylyl)-4-phenyl-5-tert-butylphenyl-1,2, 4-triazoles?
Q. I am. Yes. And that compound is colloquially known as "TAZ?"
A. T-A-Z with capital letters?
Q. Yes.

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A. That is my understanding. Yes.
Q. And that was a matrix material that was known for use in semiconducting -- the semiconducting field as of 2000 -- at least as early as 2005?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: It was a material compound that was used in organic electronic devices, in my understanding. I'm not sure about the term, "matrix." So I would just say it's a compound or organic material.
BY ATTORNEY HANSEN:
Q. Werner refers to it as a matrix material. Is that right?
A. In the entry in that paragraph, the term, "matrix" is -- does appear.
Q. Now, the middle of this paragraph discloses that the heteroaromatics are preferably substituted, in particular, aryl-substituted, such as phenyl, or naphthyl-substituted.
Is that right?
A. Yes, Ma'am. The sentence you are referring to reads:
"The heteroaromatics are preferably substituted, in particular, aryl-substituted, such

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as phenyl or naphthyl-substituted."
Q. And by definition, if the heteroaromatic were substituted at a position other than the heteroatom with a phenyl group, that would constitute a heteroaromatic conjugated to an aromatic group via a CC bond.
Is that right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Can you ask the question again, please?
ATTORNEY HANSEN: Sure.
BY ATTORNEY HANSEN:
Q. If the heteroaromatic groups described in the paragraph starting around line eight on internal page 55, were substituted at a position other than the heteroatom, with a phenyl group, that would constitute a heteroaromatic compound, conjugated to an aromatic compound, via a CC bond?
A. So, the paragraph doesn't read how you have asked your question. The question -- the paragraph does not qualify where the substitution is.
But as you phrased it, if it's a -- structure is a heteroaromatic compound that's substituted at a position other than the nitrogen

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with a aromatic ring, such as phenyl, that would constitute the definition of a heteroaromatic compound that's substituted with an aromatic compound, or linked to, via a CC bond.

Q. Okay.

ATTORNEY HANSEN: Could we please pull up Exhibit 2024, please, Kylan?

THE WITNESS: Can I ask a question? Should I put away Werner for now? Or are we coming back to Werner?

ATTORNEY HANSEN: You can put away Werner for now.

This is Schanze No. 9.

(Exhibit 9 marked for identification)

BY ATTORNEY HANSEN:

Q. Dr. Schanze, do you recognize what has now been marked as Schanze No. 9?

A. Sorry. I don't see it on the screen and I'm not sure which one it is that's been uploaded. So could you help me?

Q. Sure. It should be labeled Exhibit 2044.

A. Okay. Let me open it, please.

Q. Of course.

A. Okay. So, again, I'm not seeing it on the screen. Maybe -- oh, I see. I had the wrong view.

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I see it on your Zoom screen also now.

This is a patent labeled "7,972,541, Werner et al."

Q. And this is a reference that you cited in your declaration?

A. I believe so. Yes, Ma'am.

Q. How did you identify this reference?

A. To the best of my recollection, it was brought to my attention by counsel.

Q. In your opinion, does this reference reflect knowledge that a POSA would have had, as of at least May 18th 2007?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: I'm sorry. I don't -- I'm not able to opine on that.

BY ATTORNEY HANSEN:

Q. Why not?

A. The patent is very specific. So, yeah. That's -- it's very specific in terms of its content and description. So I'm not able to say whether it was common lexicon at that time.

Q. Are you familiar with the construct that a person of ordinary skill is aware of all materials available -- publicly available as of the priority date?

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ATTORNEY ZHONG: Objection. Form.

THE WITNESS: I'm sorry. Can you state your question again?

ATTORNEY HANSEN: Sure.

BY ATTORNEY HANSEN:

Q. Are you familiar with the construct that a person of ordinary skill is aware of all materials publicly available, as of the priority date?

A. I'm not specifically aware of that construct. But if you say it's so, then I guess I would agree.

Q. Okay.

And if a POSA were not aware of the contents of this reference, why would you cite it?

ATTORNEY ZHONG: Objection. Form. Argumentative.

THE WITNESS: I honestly can't answer that question. I would say that a POSA that's interested in a specific topic, such as the topic listed here, would do diligence if they were interested in that area, and do searches and find relevant publications or patents.

So that's how it might be come to attention. That's how usually scientific or technical information is discovered.

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BY ATTORNEY HANSEN:

Q. And this patent -- the '541 Patent -- claims priority back to a PCT filed November 10th 2006? Is that right?

A. I'm sorry. Ask your question again, please.

Q. Sure. This patent -- the '541 Patent -- claims priority back to a PCT filed November 10th 2006. Correct?

A. I see at line 22 of the first page, it says "PCT filed November 10th 2006." Again, I'm not --

Q. And --

A. I'm not a patent expert, but I assume that's what you are referring to as the priority date.

Q. And that PCT was published on May 18th 2007?

A. That's what it says on line -- on the line below 87. It says "PCT publication date, May 18th 2007."

Q. Now, let's -- do you have your declaration handy? Schanze 2?

A. That's a document entitled "Exhibit 2041?"

Q. Correct.

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A. If so, yes.
Q. Yes. Do you have that handy?
A. Yes, Ma'am.
Q. Okay. If we could go to paragraph 21, which is on page eight of your declaration?
A. Paragraph 21, that starts with, "Another Novaled patent," and referring to this '541 Patent. Yes.
Q. Okay.
So in paragraph 21 and 22, you talk about the '541 Patent. Correct?
A. Can I refresh my memory by reviewing those materials?
Q. Absolutely.
A. Please allow me a minute.
ATTORNEY HANSEN: And I'd like to take a moment to mark this deposition as confidential.
ATTORNEY ZHONG: Can we take a two-minute break after this one? I just need to take a quick call at 10:00.
ATTORNEY HANSEN: Sure.
[Witness reviewed document.]
ATTORNEY HANSEN: But I need the witness to answer the question first.
THE WITNESS: Oh, I'm sorry. That means I

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should cease doing anything. Is that correct?
ATTORNEY ZHONG: No, no, no.
ATTORNEY HANSEN: No, no. You should answer the question.
ATTORNEY ZHONG: You should answer the question. The pending question.
THE WITNESS: Okay. Well I need to review the material.
ATTORNEY ZHONG: Yeah. Go ahead. Go ahead.
[Witness reviewed document.]
THE WITNESS: Okay. I reviewed paragraph 21. Can you ask your question again, please?
BY ATTORNEY HANSEN:
Q. In paragraphs 21 and 22, you talk about the '541 Patent. Is that correct?
A. Yes.
Q. Okay.
ATTORNEY HANSEN: Why don't we go off the record?
ATTORNEY ZHONG: Okay. Thank you.
(Short break.)
COURT REPORTER: We are back on the record.
BY ATTORNEY HANSEN:

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Q. Okay. Now, in paragraph 23, you provide for the electron affinity of BPhen. Is that right?
A. I'm sorry. So now again, we are referring -- since the break, we are referring to my declaration, which is Exhibit 2041, paragraph 23? Is that correct?
Q. Correct.
ATTORNEY HANSEN: So, Kylan, if we could go back to Schanze 2?
THE WITNESS: So paragraph 23 reads:
"Thus, for example, if the electron affinity of BPhen was known as between 2.4 and 3.0 eV --" and it refers to a specific patent "-- then the ionization potential (or HOMO) of the n-dopant should be no lower than 2.9 to 3.5 eV (that is, the numerical value of the ionization potential should be less than 2.9 to 3.5 eV)."
Q. Okay.
Now, the values that you cite here -- 2.4 to 3.0 eV -- are those values derived from the gas state or the solid state?
A. As cited in reference two, I believe, it states "the gas phase --" I guess that's referring to the tungsten complex. In terms of BPhen, there is a variety of sources.

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If we refer to the aforementioned patent, 129, I'd have to review that to see exactly what -- what measurement they are using. But most often, the measurements, or the numbers, are based on theoretical calculations, or electrochemical measurements, which would be either gas phase, or electrochemistry would be in solution, which is as close to the solid as you can get. But it's not the same.
Q. Okay. Well why don't we take a look at how the '129 Patent defines it?
ATTORNEY HANSEN: Kylan, could we bring up Exhibit 2043, which we'll mark as Exhibit Schanze No. 10?
(Exhibit 10 marked for identification)
BY ATTORNEY HANSEN:
Q. Dr. Schanze, do you see before you what's been marked as Schanze 10?
A. Yes, Ma'am. I'm trying to download it at the same time. But I see it in front of me and I have it open now.
Q. And this is -- Schanze No. 10 is the '129 Patent that you talk about in paragraph 23 of your declaration?
A. Yes.

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Q. Now, the citation in your declaration is to 10 -- column 10, lines 50 through 54. So if we could go there?

A. Yes. I see line 51, it says:

"The well-known matrix material BPhen has, for example, an electron affinity between 3.0eV (estimation from ionization potential and optical band gap) and 2.4 eV (estimation from cyclovoltammetry)."

And then it goes on to say that:

"However, it can be expected that, for materials with an electron affinity smaller than 0.5 eV..."

It's irrelevant. So the first sentence is what's relevant.

Q. Right. And so, which phase -- which value represents the EA of BPhen in the gas phase?

A. So, the measurement on ionization potential, I don't know if that's experimental or theoretical, because it's not stated. And I would interpret that that's gas phase, but there are ways to measure ionization potential of solids. But that's not as common.

So I would interpret the first number to be potentially the gas phase, and the second number,

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cyclovoltammetry, is done with molecules in solution in a liquid phase, dissolved in a solvent. And the number can depend on the solvent, so it's -- can be variable.

Q. Okay. And you agree that there is no defined convention to convert a cyclovoltammetry derived value to either a solid phase or a gas phase electron affinity.

Is that right?

A. Can you state the question again, please?

Q. You agree that there is no defined convention to convert a cyclovoltammetry value to either a solid phase or a gas phase electron affinity.

Is that right?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: You are asking two different questions. The first part is whether there is an accepted convention to convert from solution phase to gas phase, where the solution phase is electrochemistry and the gas phase would be electron affinity.

So I'm assuming that solution phase measurement would be a reduction potential. The answer is, there are many correlations for that

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measurement that vary with solvent, and so forth.

The latter question that you asked about solid state, that, I would say, is less well-defined.

ATTORNEY HANSEN: Okay.

BY ATTORNEY HANSEN:

Q. Now, going back to your declaration -- this is Schanze No. 2 -- at paragraph 24, you cite to the gas phase ionization potential of W2(hpp)4.

Do you see that?

A. Yes, Ma'am.

Q. And the value that you use in a lot of your discussion is the peak value. Is that right? The 3.76?

A. Yes, Ma'am. For example, in Figure 16 -- Figure 1645, which appears on page 10 of the declaration, PDF page 14, shows a graphical representation of that.

Q. Right. And so, for example, at paragraph 67 of your report -- of your declaration -- which is on PDF page 35, internal page 32, you talk about how the HOMO of W2(hpp)4 would be considered to have an energy level of about 3.76 eV.

Is that right?

A. So now, you are referring to paragraph 66

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of my declaration?

Q. Paragraph 67.

A. Sixty-seven. Okay. So the previous paragraph is talking about the ionization potential with a peak value of 3.76 eV. Paragraph 66. And then paragraph 67 goes on to state:

"Thus, its HOMO -- its being W2(hpp)4 -- would be considered to have an energy level of about 3.76 eV."

Q. Right. So my question is, 3.76 eV is the HOMO level that you have used in the course of developing your opinions. Right?

A. That's correct.

Q. Okay.

If we could go back to -- and so -- and actually, this is a good point. So in paragraph 66, you cite as the source for this information, Exhibit 2004. A Cotton textbook.

Is that right?

A. Yes. That is correct.

Q. Okay.

Now, if we could go back to the '541 Patent, which is Schanze 9?

A. Okay.

Q. So if we turn to column four of the

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Schanze patent, at line 15, it provides for:
"The gas phase ionization potential of the dopant having the structure, IVA is 3.6 eV."
Do you see that line?
A. Yes, Ma'am. You are referring now specifically to the so-called '541 Patent, column four, line -- starting with 15, it reads:
"The gas phase ionization potential of the dopant having the structure 4A is 3.6 eV."
And, for the record, compound 4A is labeled as "tungsten WHPP4." I would interpret that to be the compound we have been calling "W2(hpp)4." Because they left out the two.
Q. Yeah. Agreed.
And the second line then says that the IP in the solid state can be estimated, according to this particular article, and is approximately 2.5 eV. Do you see that?
A. Yes. I see that line.
Q. Okay.
Why didn't you cite to the '541 for the values that you proposed for the ionization potential for W2(hpp)4?
A. I'm sorry. Say again? What's your question?

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Q. Why didn't you cite to the '541 Patent for the ionization potential for W2(hpp)4?
A. Well, it's quite close. First off, ionization potentials can be somewhat variable, depending on experimental conditions.
But also, if you do refer to Fu, the article listed J. Am. Chem. Soc., there is some ambiguity in that article, because it states that the solid can be estimated, but Fu refers to electrochemistry in the solution phase. And it's not obvious how the 2.5 is arrived at.
Q. Okay.
Well why don't we talk a little bit about the -- so, I mean, we talked a little bit earlier -- you agree that the POSA would understand that W2(hpp)4 could be used as a dopant for organic materials for OLEDs?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Can you ask your question again?
ATTORNEY HANSEN: Sure.
BY ATTORNEY HANSEN:
Q. You would agree that a POSA would understand that W2(hpp)4 could be used as a dopant for organic material for OLEDs, as of at least the

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date that this patent was filed, which was November 10th 2006?
A. I can't say for certain. Meaning that fields move and jump, oftentimes. The field was aware of the notion of using easily oxidizable materials as dopants.
But I don't know that I could say for certain that a POSA would conclude that W2(hpp)4 could be used as a dopant before these patents. I don't -- can't say that for sure.
Q. And by "these patents," you are referring to the '541 Patent?
A. Well, sure. If you want to use that as an example we are looking at right now.
Q. Okay. Now, in the '541 Patent, if we turn to column three, lines five through 30, this is the material that you've cited in paragraph 21 of your declaration, Schanze No. 2.
Is that right?
A. I'm sorry. So let me catch up with you.
Q. Sure.
A. So we are at column two --
Q. Column three.
A. Column three. Yes, Ma'am. And lines what?

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Q. Five through 30.
A. Okay. And then my declaration?
Q. At paragraph 21.
A. Okay. So paragraph 21 is referring to this patent. And then there is a long paragraph that begins with, "In the case of n-doping."
Q. Uh-huh.
A. Yes, Ma'am.
Q. And that's the material you cited in paragraph 21 of your declaration?
A. Yes.
Q. Okay.
And then if you turn -- and again, this is going back to Schanze No. 9. This is the '541 Patent. If you could turn to column eight, line 19?
A. Sorry. Back to --
Q. You need to keep both your declaration and this patent close by.
A. Yeah. Okay. I'm closing other things to make it easy.
Q. Okay.
A. Okay. '541. Yes, Ma'am.
Q. So if you turn to column eight. Line 19?
A. Okay.

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Q. And this is the material that you cited in paragraph 22 of your declaration. Correct?
A. Yes.
Q. And it's this material that you include in paragraph 22 that provides the basis for your assertion that only dopants, matrix combinations that differ in HOMO and LUMO by no greater than 0.5 eV, would be expected to work in an OLED?
A. I'm sorry. Can you state the question again, please?
Q. Sure. The material that you cited in paragraph 22 of you declaration provides the basis for your assertion that only dopants and matrix combinations, which differ in HOMO and LUMO, by no greater than 0.5, would be expected to work in an OLED?
A. I would say it's one of -- one of several sources. It's not the only source. But it is one of the sources. Yes.
Q. Okay.
Well let's turn back, if we could, to the '541 Patent. This is Schanze No. 9. And let's take a look at --
A. I'm there --
Q. Sorry?

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A. I'm there.
Q. Okay. Let's take a look at table one, which is in column four.
A. Yes.
Q. And here, it provides that the LUMO of BPhen is 2.42. Do you see that?
A. Let's see. I'm looking -- yes. I see in the second column, BPhen is listed as 2.42.
Q. And that value was determined by cyclovoltammetry?
A. That's what it states.
Q. Okay.
Now, why don't we take a look at table two of the '541 Patent, which is at column nine?
A. Okay.
Q. And under example one, it talks about selected phenanthroline derivatives. Do you see that? That's what's reflected in table two?
A. Yes, Ma'am. Compound 1A has phenyls. Well, it shows phenyl at R8 -- R1, 3, 6, and 8.
Q. Right. We'll talk a little bit about that in a second.
The patent describes the examples as being preferred examples of embodiments of this patent. Is that right?

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A. I'm sorry. I don't know what you are -- can you tell me specifically where you are referring to before I answer that question?
Q. Of course. If you take a look at the top of column nine?
A. Okay.
Q. It says:
"Further features and advantages of the invention will become apparent from the following detailed description of preferred examples of embodiments."
With reference to the appended drawings."
Do you see that?
A. Yes, Ma'am. I do. And then it was Figure 1. Figure 2. Figure 3.
Q. Right.
A. And then it goes on to example one.
Q. Right. And so, the compounds in table two are preferred embodiments of the invention of the '541 Patent.
Is that right?
A. They are examples. Above, it says:
"Further features and example -- and advantages will become apparent from the following detailed description of preferred examples of

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embodiments."
So if they are referring below, then I would conclude that example one would be what the inventors called "preferred examples of embodiment." Yes.
Q. Okay.
And table two includes five exemplar phenanthroline derivatives. Is that right?
A. It appears to have five row entries labeled 1A; 1B; 1C; 1D; and 1E. So I interpret that to be five substituted phenanthroline derivatives.
Q. And the table reflects data from doping each of these five matrix materials with a five percent -- five mol percent of W2(hpp)4.
Is that right?
A. Yes, Ma'am. The subscript of the table has an asterisk, and it says:
"Concentration 4A W2(hpp)4: five mol percent."
So that's what I interpret the last column to be, conductivity of those derivatives with five mol percent of W2(hpp)4.
Q. Okay. And the author -- the authors of this patent conclude that the conductivities for these five examples are considerably improved.

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Is that right? That's what it says immediately under the table?

A. It does say:

"Comparison with the conductivity values for the matrix materials ALQ and BPhen, known from the prior art, which is table one, shows considerably improved conductivity values for the phenanthroline derivatives."

So looking back to table one, the conductivity values are in the range of 10 to minus eight, to 10 to minus nine siemens per centimeter, and the entries in table two are increased by -- conductivities are increased by three to four orders of magnitude. That's powers in 10.

Q. Okay. So --

A. That's what they called "considerably improved." It is improved.

Q. Do you not think that they are considerably improved?

A. I really don't want to opine on what the authors thought of the word "considerably." You know, three to four orders of 10 is what they report.

Now, if we take a look at column two, all of the LUMO value -- sorry. My apologies, Kylan.

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Table two. That's what I meant. Let's take a look at table two.

Q. If we take a look at the LUMO values reported for each of these five compounds, they are in the range of about 2.42 to 2.53.

Is that right?

A. Yes, Ma'am. That's what is listed in the table. There is no information provided about where those values come from, however.

Q. So if the ionization potential of W2(hpp)4 is 3.6, which is what one of the values provided in this patent, the '541, the difference between the HOMO and LUMO level with respect to, for example, 1A, would be 1.3 eV.

Is that right?

A. I'm not doing the math, but it's -- it's in that range, I guess.

Q. But that's -- 1.13 eV is considerably more than 0.5 eV. Is that right?

A. 1.3 is greater than 1.5. I'll agree with that.

Q. Now, if you use the 2.5 eV value reported also in the '541 Patent, the delta between the HOMO and LUMO levels of W2(hpp)4 in compound 1A is 0.03.

Is that right?

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A. I'm sorry. I'm getting confused.

Q. Sure.

A. And honestly, I'm sure for you as well, even to a trained person, when we speak about LUMO values in relative to HOMOs, it's very difficult to keep it straight.

So let's start again and try to make sure that I can understand. I might even need to take some notes so I don't say something wrong.

Q. Okay.

So we talked earlier about how the '541 Patent discloses two different values -- sorry. I don't know where you went.

A. I'm getting a pen. That's why I reached over.

Q. Okay.

So we talked earlier about how the '541 Patent discloses two values for the ionization potential for W2(hpp)4. Right?

A. I think we did.

Q. And those two values are 3.6 and 2.5. Right?

A. Yeah.

Q. Okay.

And those two values, I'd like you to keep

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those in mind as we move through this.

A. Wait. I'm sorry. 3.6 and 3.75. Is that correct?

Q. No. 3.06 and 2.5.

A. That's the Fu.

Q. Correct. I can direct your attention back to column four, lines 15 through 19.

A. Yes. Okay. I've jotted those down, just for your -- for the record. I've jotted them on paper here.

Q. Excellent. Let us go back to table two.

A. Okay.

Q. So looking at column 1A, column 1A has a LUMO level reported here in this -- in the same paper of 2.47. Right?

A. Yes. It does.

Q. Now, if we use as the HOMO level of W2(hpp)4, the 3.6 value that was reported in the '541, the delta between HOMO and LUMO, between W2(hpp)4 and compound 1A, is 1.13 eV.

Is that right?

A. Yes. Approximately, that's correct. Yeah.

Q. And that delta is greater than 0.5 eV. Right?

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A. Yes.
Q. In contrast, if you use the 2.5 eV value reported in this paper, the HOMO-LUMO, delta between W2(hpp)4 and compound 1A is 0.03 eV.
Is that right?
A. So when you say "in this paper," what you mean is the value that's referred to on -- in column 4, the second entry in paragraph starting on line 15, which comes from reference Fu of 2.5 eV? And then the answer is yes. That the difference is considerably smaller.
Q. Okay. Now, let's look at compound IB. Compound IB is reported as having a LUMO of 2.42. Right?
A. I'm sorry. Compound IB now? What is -- which compound are we talking about?
Q. Compound IB. Do you see compound IB?
A. Which --
Q. On table two.
A. Table two. Okay. Okay. Compound -- I would call that 2B.
Q. It doesn't say "2B." It says "IB."
A. Okay. Greek. Sorry. Greek. 1B. Right?
Q. We can call it "1B."
A. Yes.

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Q. And that compound is listed as having a LUMO level of 2.42. Correct?
A. Yes.
Q. Now, again, keeping in mind the two values of W2(hpp)4 that we talked about, that are reported in the '541 Patent, the delta between the HOMO and LUMO of W2(hpp)4 and compound 1B, if you use the 3.6IP value reported, is 1.18 eV. Right?
A. Yes.
Q. And that's greater than 0.5 eV. Correct?
A. Yes.
Q. Now, if you use the value of 2.5 eV reported in this paper, the delta between the HOMO and LUMO, between W2(hpp)4 and compound 1B, is 0.08. Correct?
A. Yes.
Q. And that is below the 0.5 eV delta. Correct?
A. Yes.
Q. Now, let's take a look at compound 1C. Do you see compound 1C?
A. Yes, Ma'am. That's the compound with phenyl at R6, and naphthyl at R8. Sorry. R3 and R6 phenyl. R1 and R8's naphthyl.
Q. Right. Now that compound is listed as

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having a LUMO value of 2.5. Right?
A. Yes. It is.
Q. Now again, keeping in mind the two values reported in the 541 for ionization potential or the HOMO level for W2(hpp)4, if we use the 3.6 value, the delta between HOMO and LUMO, between W2(hpp)4 and compound 1C, is 1.1 eV.
Is that right?
A. Yes.
Q. And that is greater than 0.5 eV, for the delta between the HOMO and LUMO level. Is that right?
A. Yes.
Q. Now, if we use the 2.5 value, the delta between the HOMO and LUMO level between W2(hpp)4 and compound 1C is zero. Correct?
A. Yes.
Q. And that is less than a 0.5 eV delta. Correct?
A. Yes, it is.
Q. Now, let's take a look at compound 1D. Do you see compound 1D?
A. Yes, Ma'am. That's the derivative with R3 and R6 phenyl; and R1 and R8, biphenyl.
Q. Now, that compound -- compound 1D -- is

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listed as having a LUMO level of 2.53. Do you see that?
A. Yes. I do.
Q. And if we use, again, the two values of W2(hpp)4, that were reported in this paper, if you use the 3.6 value reported for W2(hpp)4, the delta between the HOMO and LUMO levels of W2(hpp)4 and compound 1D, the delta is 1.07 eV. Correct?
A. Sounds right.
Q. And that is, again, greater than 0.5 eV. Correct?
A. Yes -- yes, Ma'am. One is greater than 0.5. Yes.
Q. And if you use the 2.5IP -- well, let me back up.
If you use the 2.5 eV HOMO level reported for W2(hpp)4 in this paper, the delta between the HOMO and LUMO levels of W2(hpp)4 and compound ID is 0.03. Is that right?
A. Yes. But in that case, it's -- is it negative or positive? Its absolute value is 0.03. Yes.
Q. You're right. Its absolute value is 0.03. Is that right?
A. Yes, Ma'am.

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Q. Okay. Let's take a look at compound 1E.
A. Okay. And that's the last entry. R3, R6 is phenyl. And R1 and R8 is phenanthryl.
Q. Now, if you take a look at the LUMO reported for compound 1E, it's 2.51. Correct?
A. Yes, Ma'am.
Q. And again, keeping in mind the two values for the HOMO level reported for W2(hpp)4, if you use the 3.6 value, the delta between the HOMO and LUMO of W2(hpp)4 and compound 1E is 1.09. Correct?
A. Yes, Ma'am.
Q. And that is greater than 0.5 eV. Correct?
A. Yes.
Q. But if you use the value of 2.5 as the HOMO level for W2(hpp)4, the absolute value of the difference between the HOMO and LUMO level between W2(hpp)4 and 1E, is 0.1. Correct?
A. Yes. The absolute value is 0.01.
Q. And, in fact, if you use the 3.6 eV value as the HOMO level of W2(hpp)4, there is no combination of W2(hpp)4 and any of matrix materials 1A through 1E, that would fall within the 0.5 eV delta, between the matrix LUMO, and doping HOMO, described as preferential in the '541 Patent. Right?

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A. Can you state that question again, please?
Q. Sure. If you use the 3.6 eV value as the HOMO level of W2(hpp)4, there is no combination of W2(hpp)4 and any of matrix materials 1A through 1E that would fall within the 0.5 eV delta between matrix LUMO and doping HOMO, described as preferential in the '541 Patent. Correct?
A. I would just say that the -- as we have discussed together through this table, there is no -- no entry in that table where the difference between the 3.6 listed value of HPP4's HOMO and the LUMO listed in this table is less than 0.5. I'll agree with that.
Q. Okay. Let's turn to table one, if we could. Now, in table one, the LUMO for BPhen is reported as being 2.42.
Do you see that?
A. Yes, Ma'am. I do.
Q. Now, if the HOMO of 3.6 for W2(hpp)4 is used, the delta between the HOMO of W2(hpp)4 and the LUMO of BPhen provides for a delta of 1.18.
Is that right?
A. That sounds correct. Yes; 3.6 is the -- we are taking as the HOMO of W2(hpp)4. And 2.42, we are taking as the LUMO of BPhen. The difference is

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1.8 -- 1.08. Is that right? 1.18.
Q. 1.18.
A. Yeah.
Q. But if the 2.5 eV value reported in the '541 Patent is used for the HOMO of W2(hpp)4, the delta between the HOMO of W2(hpp)4 and the LUMO of BPhen is 0.09 eV.
Is that right?
A. The absolute value is 0.08, I think. Right?
Q. I'm sorry; 0.08. Good correction. I apparently can't do math. And 0.08 is within the 0.5 eV delta, expressed as preferential by the Werner '541?
A. I believe so. Yes.
Q. Okay.
Now, why don't we go back, if we could, to table two? Now, table two, in compound 1A, differs from the structure of BPhen, only in that there is a phenyl group at positions R1 and R8.
Is that right?
A. The structure of 1A is a phenanthroline compound that has phenyl groups -- four phenyl groups, substituted one at R8; one at R6; one at R3; and one at R1.

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So it does share a structural similarity with BPhen, with having phenyls at R6 and R3. But this compound contains two additional phenyls at R1 and R8.
Q. Would you agree that the pyridinic nitrogens of compound 1A and BPhen would have similar steric hindrance to each other, vis- -vis a compound like W2(hpp)4?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Can you state your question again, please?
ATTORNEY HANSEN: Sure.
BY ATTORNEY HANSEN:
Q. Would you agree that the pyridinic nitrogens of compound 1A and BPhen would have similar steric hindrance to each other -- as compared to each other, vis- -vis a compound like W2(hpp)4?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: So, I don't know, in the context of chemistry, and materials chemistry, and organic chemistry, we do not use the term, "vis- -vis." So I'd have to ask you to rephrase the question for me to be able to answer it.
ATTORNEY HANSEN: Sure.

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BY ATTORNEY HANSEN:
Q. Are the pyridinic nitrogens of compound 1A more or less sterically hindered, as compared to the pyridinic nitrogens of BPhen?
A. Again, it would depend on the context. It would not be possible to just blanket say that one is more than the other, because steric hindrance depends on the context of what is being described. What -- yeah.
Q. Do you think that the steric hindrance of the pyridinic nitrogens of BPhen would be the same as the steric hindrance of the pyridinic nitrogens of compound 1A?
A. I can say that again, it depends on the context. In some cases, the answer would be yes. And some, the answer would be no. It depends on what we are talking about in terms of hindrance, with respect to what.
Q. Can you describe a scenario in which the pyridinic nitrogens of compound 1A would be less sterically hindered than the pyridinic nitrogens of BPhen?
A. I'm sorry. Say again? Ask your question again, please.
Q. Sure. Can you describe a scenario in

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which the pyridinic nitrogens of compound 1A would be less sterically hindered than the pyridinic nitrogens of BPhen?
A. I can't say there would be a situation where it would be less, but I can foresee a situation of where it would -- could be the same.
Q. Okay.
A. And not greater.
Q. Now, we talked a little bit about this earlier, but BCP is structurally similar to BPhen, except that BCP has methyl groups at the carbons immediately adjacent to the pyridinic nitrogens.
Is that right?
A. If I recall correctly, we talked about the structure of BCP, which appears in the '223 Patent. And if I'm recalling correctly, that structure is a phenanthroline derivative that has phenyl substituents at R3 and R6. And it has metal substituents at R1 and R8.
Is that correct?
Q. Yes.
A. Okay. So that's BCP. And could you ask your question again?
Q. You answered my question.
A. Okay.

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Q. Would you expect that the electron affinity of BCP would be around 2.4 to 2.5 eV, if tested using the same conditions set forth here in example one?
A. First off, for the record, the testing conditions that are described in table two are not provided, to my understanding. It's just a list of values. So we don't really know how they were obtained.
So, again, which one do you want me to compare to -- do you want compound 1A compared to BCP?
Q. We can do this differently. Why don't we go to table one? Now, table one shows that the EA of -- or the LUMO of BPhen is 2.42. Right?
A. Yes, Ma'am.
Q. Determined via CB, using ion?
A. Ferrocene; ferrocene.
Q. Oh, sorry. Ferrocene. As the internal standard?
A. Yes.
Q. And you would expect that BCP would have a similar LUMO, if determined using the same -- or same standard?
A. I can't say for certain. I would have to

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study the structures a bit. Substituents can have substantial effect on the LUMO values or the reduction potentials, depending on where they are placed.
And so, there could be a difference -- substantial difference, as much as a half an eV, or they could be very similar, depending on the LUMO structure and where the density is.
So that's my answer. It's a little hard without studying a little more carefully, what the effect would be.
Q. Okay.
Now, if we could go back to table one -- or sorry, table two, and take a look again at compound 1A?
A. Yes, Ma'am. I'm looking at it.
Q. Yes. Okay. Great.
Now, the difference -- as we talked earlier, the difference between BPhen and compound 1A is the presence of two phenyl groups at R1 and R8. Right?
A. Yes, Ma'am.
Q. And that compound has an eV of 2.47. Right?
A. It has a LUMO that's listed as 2.47,

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without any qualification as to how that number is arrived at. So it does make it a little more difficult to compare to other values that appear, for example, in table one, where they do explicitly state how they -- how it was measured.

Q. Okay. But it's in the same range as -- 2.47 is in the same general vicinity as the LUMO reported for BPhen.

Is that right?

A. The value that's listed in the table, again, that is unqualified in terms of how it's measured, is numerically about the same. But my conclusion about whether it is actually the same, I withhold that. Because I can't conclude, because I don't know how these values were determined.

Q. Okay.

Now, compound 1A in table one, would be a compound wherein the organic compound comprises a heteroaromatic compound, which is conjugated with an aromatic compound, via a CC bond?

A. Correct.

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: Can you ask your question again, please?

ATTORNEY HANSEN: Sure.

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BY ATTORNEY HANSEN:

Q. Compound 1A is a compound wherein -- or comprising a heteroaromatic compound which is conjugated with an aromatic compound via a CC bond.

Is that right?

A. It's a heteroaromatic compound that's conjugated with multiple aromatic compounds via CC bonds. I can state that. It's not singular or -- it's plural.

And I'm not sure how the "and" connotation is in your world. But it has multiple aryl substituents. Four of them, to be exact.

Q. Okay.

Would you agree that compound 1A comprises a heteroaromatic compound which is conjugated with an aromatic compound, via a cc bond?

A. I --

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: Yeah. I need you to help me with the legal definition of the word, "comprises."

BY ATTORNEY HANSEN:

Q. "Comprises" is generally understood to mean "includes at least."

A. So I would say that compound 1A includes at least one aromatic ring that's attached to a heteroaromatic structure by a CC bond.

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Q. Okay.

Now, in compound 1B, would you agree that compound 1B includes at least one aromatic ring that's attached to a heteroaromatic structure, by a carbon-carbon bond?

A. Yes. I would.

Q. And would you agree that compound 1C is a compound that includes at least one aromatic ring that's attached to a heteroaromatic structure, by a carbon-carbon bond?

A. Compound 1C is the one with the naphthyls at R1 and R8, and phenyls at R3 and R6. Ask your question again, please.

Q. Compound 1C is a compound that includes at least one aromatic -- oh, sorry -- that includes at least one aromatic ring that's attached to a heteroaromatic structure by a carbon-carbon bond?

A. Yes. Compound 1C would fit that designation.

Q. And compound 1D is a compound that includes at least one aromatic ring that's attached to a heteroaromatic structure by a carbon-carbon bond?

A. Yes.

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Q. And compound 1E would include at least one aromatic ring that's attached to a heteroaromatic structure by a carbon-carbon bond?

A. Yes.

Q. Now, do you have handy your copy of the '223 Patent, which would be Schanze 3?

A. One moment, please. I have to pull it up again.

Q. And you'll need both the '541 and the '223, side-by-side.

A. Okay. What is the exhibit number of '223 please?

Q. Schanze --

A. Oh, that's --

Q. It's Schanze 3.

A. Oh; 1001. Yeah. The exhibits, as downloaded, don't have the new designations on them. So...

Q. Oh. I see. Sorry. Yes. Exhibit 1001.

A. Okay. I've got it.

Q. Great. Could you turn in the '223 Patent to take a look at compound seven? I'm sorry. Compound 11.

A. Compound 11.

Q. Which is a -- there's a couple places you

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can take a look at it. And why don't we look at column 22?

A. Oh. I see it on column eight.

Q. That works too. We can look at it there.

A. Okay. Compound 11, which is phenanthroline substituted with two naphthyl groups at the two and nine positions, and phenyls at the five and seven positions. Yes.

Q. Compound 11 is the same compound as compound 1C of the '541 Patent. Correct?

A. I believe the answer to that is yes. One -- compound 1C.

Q. Correct.

A. Yes.

Q. Are they the same compound?

A. To the best of my knowledge, yes.

Q. Okay.

A. Oh, wait. I'm sorry. I'm sorry. Excuse me. Compound 1C is ambiguous. It says R1 and R8 equals naphthyl. Specifically, as I stated, the compound in the '223 patent is -- let me get back to that -- it's structure 11.

Naphthyl can be substituted at either the one or the two position. And the structure that's drawn as compound 11 is substituted with the

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naphthyl in the two position.

And from the description in table two of the '541 Patent, we cannot conclude which compound they are referring to.

Q. I'm sorry. I don't understand -- so compound 1C says that positions two, four, and five, and seven are hydrogens. Correct?

A. Yes, Ma'am.

Q. And that positions three and six are phenyl?

A. That's correct.

Q. And positions one and eight are naphthyl?

A. That's correct.

Q. So, I --

A. However. Yes. Okay. So I'll teach you some organic chemistry.

If you look at the structure in 11 -- if you look at the naphthalene -- focus on the naphthalene, naphthalene can be attached to the phenanthroline via either the one position carbon or the two position carbon. That is, they are two different isomers that you could draw.

And the table in the 223 -- excuse me -- the '541 Patent, table two, entry 1C, does not specifically denote which naphthyl is substituted.

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So we cannot conclude whether the compound 1C is the same as compound 11, or it might be different. Because there are two isomers that the name that's listed in table two could refer to.

Q. Got you.

A. There are actually --

Q. Understood.

A. There are actually three isomers. It could be one naphthyl, one naphthyl; it could be one naphthyl, two naphthyl; or it could be two naphthyl, two naphthyl. And that's the structure that's listed as compound 11. It's the two, two, version.

Q. Understood. So -- I see. So 1C could represent three compounds. One of which is compound 11?

A. That's correct.

Q. Okay.

Why don't we turn to -- back to the '541 Patent? So this is Schanze No. 9?

A. Yes, Ma'am. The '541 Patent.

Q. And I'd like to take a look at comparative example two, which is at column 10.

A. Column 10. Comparative example two. Yes.

Q. Now, comparative example two is a -- talks about creating a layer similar to example two, but

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using BPhen instead of the matrix material, 1E.

Do you see that?

A. Yes, Ma'am. I do.

Q. And in example two, the dopant used is W2(hpp)4. Correct?

A. I would interpret that's correct. Because that's what they say example one and two are doped with, W2(hpp)4.

Q. And that's using a 4 mol percent of W2(hpp)4?

A. I think it's five; is it not? Five mol percent?

Q. In example two, it says "four percent."

A. Okay. I'll take what you say. Yes. It does say four.

Q. Okay.

Now, it's reported that the resulting conductivity of this layer -- so the BPhen doped with a matrix material -- BPhen, sorry, doped with W2(hpp)4, is four times 10 to the negative seven, S per CM.

Do you see that?

A. Yes, Ma'am.

Q. Okay. And this is reported as differing by a factor of five from example two. Right?

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A. Okay. Let's read example two. Sorry. That is dopant 4A. Sorry. That's 4A as the tungsten complex. 1E. That's the phenanthryl. And they claim that that has a conductivity of two times 10 to minus six siemens percent meter. And then in comparative example, they use BPhen, and arrived at four times 10 to minus seven siemens per centimeter. And you said how many difference?

Q. A factor --

A. To me, that's --

Q. A factor of five.

A. A factor of five. Yes. I'll agree with that. The BPhen is a factor of five lower conductivity. Which is less than one order. Yes.

Q. Right.

A. Are you waiting for me?

Q. I am not.

A. Okay.

Q. I was waiting to cough.

ATTORNEY ZHONG: If it's a good breaking point, can we take a break?

ATTORNEY HANSEN: It is not just yet, unless Dr. Schanze desperately needs a break.

THE WITNESS: I'm not desperate but, you

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know, in the next 10 minutes or so would be nice.

ATTORNEY HANSEN: We can do that.

BY ATTORNEY HANSEN:

Q. So let's keep -- keeping in mind the four times 10 to the negative seven S per CM value that's reported in example two, I'd like to go and take a look at table one.

A. Yes.

Q. So table one reports, again, the doping of BPhen with W2(hpp)4. Right?

A. In this case, they claimed five more percent.

Q. But there is a difference in value reported here. Here, it says it's four times 10 to the negative nine. Right?

A. Yes, Ma'am. That's what I read as well.

Q. Okay.

Now, four times 10 to the negative nine is at least a forty-fold improvement over undoped BPhen. Right?

A. So, the -- in the table one, it lists undoped pristine, as we call it, BPhen, as having a conductivity of less than 10 to minus 10 siemens per centimeter. And then with the doping, the five more

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percent, they claim four times 10 to minus nine. That would be at least -- at least great -- forty times greater in numerical value than the pristine BPhen. Yes.

Q. And if we use the value of four times 10 to the negative seven, that would be a value that's at least four thousand-fold over the pristine BPhen. Correct?

A. That would be correct, I believe. Yes. Four times 10 to minus seven is four thousand larger than one times 10 to minus 10.

Q. Would you view a four thousand-fold improvement in conductivity to be a good development when developing an electronic device?

ATTORNEY ZHONG: Objection. Form.

THE WITNESS: I would say that I would view it as an increase in conductivity. I think the complete characterization as an improvement in electronic device, it would depend on the context. There is more than just conductivity that comes into play.

ATTORNEY HANSEN: Okay.

We can take a break now. Should we go off the record?

ATTORNEY ZHONG: Yes.

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THE WITNESS: Yes.

(Luncheon break.)

COURT REPORTER: We are back on the record.

ATTORNEY HANSEN: Kylan, could you please bring up Schanze Exhibit 9, please?

BY ATTORNEY HANSEN:

Q. And, Dr. Schanze, this is the '541 Patent that we were discussing prior to lunch.

A. Okay.

Q. Exhibit 2044, I think is another way that it might have been written.

A. Exhibit 2044. Okay. Yes. I have that. Okay.

Q. Great. And then if we could go to column nine. Example one.

A. Okay.

Q. Now, the films or the doped matrix materials that were created in example one, were those doped matrix materials made by using methylene chloride as a solvent?

A. Let me review.

[Witness reviewed document.]

A. Well, example one does not -- you know, the text above table two doesn't say anything about

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how the films were constructed.
I'm not sure if you can direct me to somewhere else in the paper where that -- there is some general discussion. Like in column eight, it says, preferably, that matrix material has an evaporation temperature.
Q. And what does that mean, having -- specifying an evaporation temperature?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Well, one would interpret that -- again, "evaporation" is not a definitive term, but it would imply that heating a compound to 200 degrees centigrade or above, it says, at least, would cause it to go into the vapor phase, sublime, basically, that a temperature above 200 degrees C, presumably in a vacuum. But that's not stated.
BY ATTORNEY HANSEN:
Q. Got you. So --
A. But again -- sorry. Go ahead.
Q. No. Please go ahead.
A. Well, in your earlier question -- I'm not sure that I can include how the samples were prepared.
Q. If they were -- the sample doped matrices of example one, if they were made in methylene

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chloride, the methylene chloride was not degrading W2(hpp)4 past the point of usability. Right?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Can you state your question again, please?
ATTORNEY HANSEN: Sure.
BY ATTORNEY HANSEN:
Q. If the sample doped matrices of example one were made using methylene chloride, the methylene chloride was not degrading W2(hpp)4 past the point of usability. Right?
A. Well, I'm sorry. I don't know that I can really -- again, if you could direct me to a place in the patent that -- where they describe making solutions in methylene chloride, then -- but otherwise, I don't know that I can provide an answer to that question, because it's very speculative.
Q. Is methylene chloride a common solvent for you -- common solvent used to make semiconducting materials?
ATTORNEY ZHONG: Objection. Form.
THE WITNESS: Methylene chloride is a common solvent in organic chemistry. It can be used to make, you know, films of any kind of organic compound. But it's not -- it's not commonly used,

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for various reasons.
BY ATTORNEY HANSEN:
Q. When you say it's not commonly used, you mean it's not commonly used in making semiconducting materials?
A. When you say "semiconducting materials," can you be more specific? I don't know what you mean. You mean synthesis of semiconducting materials?
Q. Sure. Like making a doped ETL.
A. Can you ask that question again?
Q. Is using methylene chloride commonly used for making a doped ETL?
A. To my knowledge, no. It's not.
Q. Okay.
ATTORNEY HANSEN: I have no further questions at this time, but reserve the right to ask further questions, should your counsel choose to redirect.
ATTORNEY ZHONG: Okay. Give me 20 to 30 minutes.
ATTORNEY HANSEN: Okay.
ATTORNEY ZHONG: Let's go off the record, I guess.
ATTORNEY HANSEN: Okay.

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COURT REPORTER: Okay. We are off the record.
(Off the record.)
COURT REPORTER: Okay. We are back on the record.
EXAMINATION BY ATTORNEY ZHONG:
Q. Welcome back, Dr. Schanze. Can you please pull up Exhibit 2044, which I believe is Schanze Exhibit No. 9? The '541 Patent.
A. Yes. I have that up --
Q. Okay.
A. -- counsel.
Q. Can you please go to column four; lines 15 through 19?
A. Okay. That's the reference to the gas phase ionization potential of the structure 4A.
Q. Yes. Correct. Do you recall discussion with counsel regarding the ionization potential for the tungsten to HPP4 -- sorry -- for the tungsten -- let me just restart.
Do you recall discussion with counsel regarding the ionization potential for tungsten 2HPP4?
A. Yes. I do.
Q. Okay.

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Do you know what is the source of the 3.6 eV that's reported for the gas phase here?
A. To the best of my knowledge, no.
Q. Okay.
Do you know what is the source for the 3.76 that you have cited in your declaration?
A. Yes. It comes from the Cotton textbook, is my recollection, which is cited in the declaration.
Q. Okay. And --
A. And --
Q. Go ahead. Are you done?
A. Yeah. There is also a science article that has a corresponding result. A Cotton science article.
Q. And is that -- does that happen to be Exhibit 2009?
A. One minute, please. Yes. Yes. It is Exhibit 2009 from the declaration.
Q. And the 2.5 eV is in reference to the Fu paper in JACS 2005, pages 7227 to 7234. Is that correct?
A. Well, that's what the patent says. Yes.
Q. Okay.
ATTORNEY ZHONG: So I have posted the Fu

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paper as Exhibit 2105 in the chat.
(Exhibit 11 marked for identification)
(Exhibit 12 marked for identification)
ATTORNEY ZHONG: Can you please download and open it?
THE WITNESS: One minute, please. Okay. I have that article open.
ATTORNEY ZHONG: Okay.
BY ATTORNEY ZHONG:
Q. Can you please verify this is the article that's cited in column four of the '541 Patent?
A. Okay. So the first author is Fu. That corresponds. And the reference is -- we call it JACS --
Q. Yes.
A. -- Journal of American Chemical Society, 2005. Page -- volume 137. Page 7227 to 7234.
Q. So that is the --
A. And I --
Q. Sorry.
A. I believe that corresponds with what's in the patent.
Q. Okay. And you have reviewed this paper before. Correct?
A. Yes, counsel. I have reviewed it.

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Q. Does this paper reference the tungsten HPP4 compound anywhere?
A. No. It does not.
Q. And does it discuss conversion of the solution phase results to solid phase IP potential, anywhere in the paper?
A. It does not.
Q. And the compounds that's referenced here are pure organic compounds in the Fu paper. Is that correct?
A. Yes. That is my understanding. It's a variety of different organic compounds, and organic ions, and free radicals.
Q. Would a person of ordinary skill in the art extrapolate the results in this paper to ditungsten HPP4 if they wanted to determine the ionization potential of the ditungsten HPP4?
A. No.
Q. And do you have any idea how Werner derived the 2.5 eV number from this paper?
A. No. I do not.
Q. Would you consider that 2.5 eV number based on the side of the Fu paper, to be a reliable number?
A. I have no basis that -- to expect it to be

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reliable. So I would say it's not reliable.
Q. Now, in the '541 Patent, Werner actually doped BPhen with ditungsten HPP4. Correct?
A. Yes.
Q. And --
A. That's one --
Q. And it also reported the electrical conductivity of the resulting film. Correct?
ATTORNEY HANSEN: Objection. Leading.
THE WITNESS: The '541 Patent -- let me just make sure I'm on the right page here. It does appear to report -- ask your question again, counsel.
ATTORNEY ZHONG: Okay.
BY ATTORNEY ZHONG:
Q. So why don't we first look at table one?
A. Okay.
Q. The second entry in table one reports the conductivity of BPhen doped with five mol percent of ditungsten two -- ditungsten HPP4. Correct?
A. Yes. If you accept what's written here, yes. Conductivity is reported as four times 10 to minus nine siemens per centimeter.
Q. Okay.
Would a person of ordinary skill in the

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art consider the resulting film to be electron -- to be electron-conducting, given the report of conductivity?

A. No. It's very low conductivity.

Q. And let's go to column 10. Comparative example number two.

A. Yes.

Q. And do you see that in this comparative example, it also reported a conductivity of four times 10 to the minus seven siemens per centimeter, for a film made with BPhen and the ditungsten HPP4?

Do you see that?

A. Yes. I do.

Q. And would a person of ordinary skill in the art consider a film with a reported conductivity, electron conducting?

A. Again, it's relatively poor conductivity, that value.

Q. Okay. And, in fact, Werner states that the resulting film is too low for use -- strike that.

Werner considers that the conductivity of the resulting film is too low for use in organic light-emitting diodes.

Is that correct?

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ATTORNEY HANSEN: Objection. Leading.

THE WITNESS: If I read the paragraph starting with line 15, from column 10, it says that:

"By comparing Figures 1 and 2, it can be seen that the conductivity of a semiconductor material consisting of 4A, which is the tungsten HPP complex, and BPhen, is too low for use in organic light-emitting diodes."

BY ATTORNEY HANSEN:

Q. Now, given this disclosure, would a person of ordinary skill in the art be motivated to use BPhen doped with W2(hpp)4 as an electron-conducting layer for use in OLED?

A. No.

Q. Can you please take a look at comparative example number three?

A. Yes. Same column.

Q. Yes.

A. Okay.

Q. Werner made an OLED device using BPhen doped with ditungsten HPP4. Correct?

A. Yes --

ATTORNEY HANSEN: Objection. Beyond the scope. And leading.

Dr. Schanze, you just have to let me get

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my objections in.

THE WITNESS: I'm sorry.

Go ahead, please.

BY ATTORNEY ZHONG:

Q. Let me just repeat the question. In comparative example number three, Werner made an OLED device that includes BPhen doped with ditungsten HPP4.

Is that correct?

ATTORNEY HANSEN: Objection. Leading. And beyond the scope.

THE WITNESS: If I read the comparative example that you have directed me to, it's my understanding that there is an OLED that was prepared, as described in example three, but using BPhen instead of the other heterocycle 1D.

So that would be my understanding, that the OLED included BPhen doped with the tungsten HPP complex, as the electron transport layer.

BY ATTORNEY ZHONG:

Q. What is a driving or operating voltage for this OLED device?

ATTORNEY HANSEN: Objection. Beyond the scope.

THE WITNESS: The driving voltage is

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unknown.

ATTORNEY ZHONG: Okay.

BY ATTORNEY ZHONG:

Q. So it could be driven at an atypically high voltage for an OLED device. Correct?

ATTORNEY HANSEN: Objection. Calls for speculation. Beyond the scope. And leading.

THE WITNESS: We have no way of knowing what the voltage was, so it could be high. Yes.

ATTORNEY ZHONG: Okay.

BY ATTORNEY ZHONG:

Q. And what is the reported brightness over time?

ATTORNEY HANSEN: Objection. Beyond the scope.

THE WITNESS: So according to line 52, in one hour, the brightness decreased from 4,800 candelas per meter to lower than 1,000 candelas per meter.

BY ATTORNEY ZHONG:

Q. Would a POSITA consider such brightness change to be suitable or acceptable for an OLED device?

ATTORNEY HANSEN: Objection. Beyond the scope.

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THE WITNESS: No. Typically, that degree of loss and brightness in that short a period of time would not be an acceptable device performance statistic.
BY ATTORNEY ZHONG:
Q. So would a POSITA consider the OLED device that's reported in comparative example number three to be a suitable device for use as an OLED?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: No.
BY ATTORNEY ZHONG:
Q. Can you take a look at example number three?
A. So that's example three in column 10 of the same document?
Q. Correct.
A. Yes. Okay.
Q. Does example three report the driving voltage for the resulting OLED?
ATTORNEY HANSEN: Objection. Beyond the scope. Leading.
Counsel, how does this relate to the testimony that I elicited on direct?
ATTORNEY ZHONG: You can object to that

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but I'm going to ask the questions.
ATTORNEY HANSEN: Counsel, you can --
ATTORNEY ZHONG: No. You --
ATTORNEY HANSEN: -- we're going to stop the deposition and go to the PTAB.
ATTORNEY ZHONG: Okay. You discussed about the '541 at length, including the performance of the 1A through 1E with BPhen. So I think that you opened the door for us to take a fulsome look at the performance of the resulting devices.
BY ATTORNEY ZHONG:
Q. So, Dr. Schanze?
A. Yes.
Q. Do you want me to repeat the question?
A. Yes, please. Repeat the question, counsel.
Q. Okay.
So for Exhibit No. 3, the OLED device, does it report the driving voltage for the OLED device?
ATTORNEY HANSEN: Objection. Beyond the scope. And leading.
THE WITNESS: To the best of my understanding, it does not report the operating voltage.

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BY ATTORNEY HANSEN:
Q. And what is the change in the brightness over time, in example number three?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: It reports that after 10 hours, the OLED that's described in this example, decreased in luminance from 5,000 candelas per meter square, to 3,300 candelas per meter square.
BY ATTORNEY HANSEN:
Q. Would a person of ordinary skill in the art consider this drop in brightness to be acceptable for an OLED?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: It's still rather low performance, to be honest.
BY ATTORNEY ZHONG:
Q. So would a person of ordinary skill in the art consider the resulting device to be an acceptable OLED, or suitable -- strike that.
Would a person of ordinary skill in the art consider the resulting device to be suitable for use as an OLED?
ATTORNEY HANSEN: Objection. Beyond the

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scope.
THE WITNESS: Likely not for an OLED for commercial application. No.
BY ATTORNEY ZHONG:
Q. Do you recall discussion with counsel regarding the steric -- the comparative steric effect of compounds 1A -- strike that.
Do you recall discussion with counsel regarding the steric effects of compounds 1A through 1E?
A. I remember a discussion of the steric effects. Yes.
Q. Okay.
For -- for interaction with ditungsten HPP4, is 1A more or less sterically hindered, compared to BPhen?
ATTORNEY HANSEN: Objection to form.
THE WITNESS: For interaction with the ditungsten complex, it notes that one might consider to involve -- yes, interaction. I would consider 1A to be more sterically hindered than BPhen.
BY ATTORNEY ZHONG:
Q. What about for 1B through 1E? For reactions or interactions with ditungsten HPP4, through the -- by pyridine -- strike that.

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So for interaction with ditungsten HPP4, especially -- especially at the nitrogen atoms, would you consider compounds 1B, 1C, 1D, and 1E, to be more or less sterically hindered than BPhen?
ATTORNEY HANSEN: Objection to form.
THE WITNESS: I would consider each of those compounds with respect to the interaction with tungsten, as you described, to be more hindered.
ATTORNEY ZHONG: Can you pull up Exhibit 2055, which is the claim construction order in the district court?
ATTORNEY HANSEN: I'm going to object to this as being beyond the scope, and that I did not raise this document at all. And I would welcome, counsel, your assertion as to why this relates to the testimony that I elicited under direct.
Counsel, how does this relate to the testimony that I elicited under direct?
ATTORNEY ZHONG: Because you are talking about interactions, I think it bears to see how the Court has construed the term, "coordinate."
ATTORNEY HANSEN: It does not, actually. I did not ask about "coordinate."
ATTORNEY ZHONG: Well, we think that --
ATTORNEY HANSEN: I asked about steric

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hindrance --
ATTORNEY ZHONG: Yeah. And that bears on whether there is coordination now. So you opened the door.
ATTORNEY HANSEN: I did not.
ATTORNEY ZHONG: Well, it's a difference of opinion.
ATTORNEY HANSEN: We are going to move to strike this whole line of testimony if you continue down this road.
ATTORNEY ZHONG: Okay. You can move. And I doubt the board is going to agree with you.
ATTORNEY HANSEN: Well then, should we stop the deposition now so that we can get a ruling in advance?
ATTORNEY ZHONG: I'm pretty sure the board is going to ask us to continue.
ATTORNEY HANSEN: Well, we can find out.
ATTORNEY ZHONG: Let's continue.
BY ATTORNEY ZHONG:
Q. Dr. Schanze, can you please go to PDF page 51? And do you see the Court has provided the construction for the term, "coordinate?"
A. PDF page 51 --
Q. Sorry. PDF page 50.

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A. Okay.
Q. Coordinate.
A. Yes. I see the definition that's -- the right column is what the Court has accepted. Is that correct?
Q. Yes.
A. Yeah. So the document states that "coordinates" is interpreted as:
"Forms a chemical bond between two atoms in which a shared pair has been supplied by one of the two atoms."
Q. Okay. What is another name for this definition for a chemist?
ATTORNEY HANSEN: Objection to form.
THE WITNESS: I believe "data bonding" might be a term.
ATTORNEY ZHONG: Okay.
BY ATTORNEY ZHONG:
Q. So as between a phenanthroline and a ditungsten HPP4, how could you form a data bond?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: I'm sorry. Can you repeat the question, counsel?
ATTORNEY ZHONG: Yeah. Sorry. Strike

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that. It's not good.
BY ATTORNEY ZHONG:
Q. For a mixture of phenanthroline and ditungsten HPP4, if a data bond is formed, it would be between which two atoms?
A. So, again, the question involves the bonding between a ditungsten complex and a phenanthroline-type ligand.
Is that correct?
Q. Correct.
A. The most frequent or common mode of bonding of phenanthroline type ligands to any type of metal center involves the two nitrogens forming a complex with the metal center.
Q. Okay.
But in the specific case of ditungsten HPP4 and phenanthroline, would a person of ordinary skill in the art expect phenanthroline to bind to the metal center through the two nitrogens?
A. No. Because the tungsten doesn't have any vacant coordination cites. They are all occupied.
Q. Can we please pull up Exhibit 1005?
A. Is that one of the ones that was recently --
Q. Yeah. It's a Werner --

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A. Okay.
Q. It's a Werner translation.
A. Oh. Okay. Okay.
Q. Do you have it?
A. Yes. Yes, counsel.
Q. Can you please go to PDF page number two?
A. Yes.
Q. Do you recall discussion with counsel about the abstract on this page?
A. Yes, I do.
Q. Okay.
Do you recall counsel's questioning to you whether HPP is the only -- the only express species recited as a ligand candidate in this abstract?
A. Yes, I do.
Q. Okay.
Does this abstract state anywhere, how the HPP compares to pi-complex, or borate carborane, or triazacycloalkane, as candidate ligands?
ATTORNEY HANSEN: Objection to form.
THE WITNESS: I'm sorry. Can you repeat the question, counsel?
ATTORNEY ZHONG: Sure.
BY ATTORNEY ZHONG:
Q. Do you see at the end of the abstract, it

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states:
"At least one ligand can form a pi-complex with a central atom, or can be a bridging ligand, especially a HPP, a borate, carborane, or triazacycloalkane, or comprises at least one carbanion carbon atom of a bivalent atom selected from the group, including C (carbene), Si (silylene), Ge (germylene), tin and lead."
Do you see that?
A. Yes. I see that sentence.
Q. Okay.
Does this sentence state that HPP is more preferred than the borate, carborane, triazacycloalkane, or the carbanion carbon atom or a bivalent atom, selected from the group, including carbene, silylene, germylene, tin or led?
ATTORNEY HANSEN: Objection to the form.
THE WITNESS: The way I read that is it's listing especially a whole list of different structures that include HPP, a borate, a carborane, triazacycloalkane, octane, et cetera.
So it doesn't appear as written to call any individual one out over another.
ATTORNEY HANSEN: Okay.
BY ATTORNEY ZHONG:

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Q. How many species are there under the general groups of borate, carborane, triazacycloalkane, et cetera?
A. Honestly, an infinite number of possibilities.
Q. So at least thousands, if not millions at least?
A. Yes.
Q. Of compound?
A. Yes.
Q. Can we please pull up Exhibit -- not Exhibit -- tab five, which I believe is your -- one of your declarations in the German action?
A. One minute. I'm -- okay. It's the document entitled "Expert Opinion Provided by Prof. Schanze?"
Q. Correct. Can you please go to page 12? The bottom of page 12, and top of page 13?
A. Is that PDF or --
Q. Yeah. It's the same.
A. Okay. Okay. Bottom of 12.
Q. Yes.
A. Top of 13. Yes.
Q. Do you see that the paragraph is discussing "BTB, lithium Q co-deposition?"

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A. Yes.
Q. Is co-deposition the same or different than joint vaporization?
A. In my understanding, co-deposition is a broader -- a broader term than joint vaporization, as used in the context of the '223 Patent. Joint vaporization is more specific.
Q. And have you seen testimony from Samsung's expert that confirms this understanding of yours?
ATTORNEY HANSEN: Objection to form. Beyond the scope.
THE WITNESS: Yes. I have seen testimony. I believe it was Kymissis, if I'm not mistaken. And that discussion gave a -- essentially specified that there were -- one had to really understand the conditions used, the evaporator configuration, and so forth, in order to understand whether joint vaporization had taken place or was being used.
ATTORNEY ZHONG: Okay.
(Exhibit 13 marked for identification)
ATTORNEY HANSEN: So Dr. Kymissis' deposition transcript is Exhibit 2106. And this one should be under seal. Non-public. Let me know when you have it.
THE WITNESS: Okay. I'm sorry. Can you

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repeat the exhibit number?
ATTORNEY ZHONG: 2106. I put it in the chat.
THE WITNESS: Oh. Okay.
COURT REPORTER: Mr. Zhong, are any of these new exhibits being marked?
ATTORNEY ZHONG: It's Exhibit 2106.
THE WITNESS: I don't see it in my chat but I see it on the screen.
ATTORNEY ZHONG: I can put it in there again. If you check the chat again, it should be there.
THE WITNESS: Yes. I see it. Thank you.
ATTORNEY ZHONG: Okay. Let me know when you have it.
THE WITNESS: Okay. I have it.
BY ATTORNEY ZHONG:
Q. Can you please go to transcript page 78?
A. Yes. I'm on that page.
Q. Seventy-eight.
A. Seventy-eight?
Q. Yeah. Can you please take a look at lines 20 through 25?
A. Yes.
Q. Okay.

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Do you see that Dr. Kymissis was asked whether he has ever performed joint vaporization in the chamber?
A. Yes. I see that question.
Q. And what was -- what was his answer?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: The answer, starting on line 22, is:
"So I have done co-deposition of materials but I'm not certain that that would necessarily qualify as joint vaporization because of the types of systems that I was using."
BY ATTORNEY ZHONG:
Q. And can you please go to the next page, which is 79?
A. Yes.
Q. And can you review lines 11 through 16?
A. So, line 11 is from the witness. And it says:
"So the '223 Patent describes the benefits of the patent as obtained by joint vaporization, and so, it is -- basically is describing the process where there is substantial mixing and coordination that occurs as part of that joint vaporization process."
Q. Okay. So this is Dr. Kymissis' view of what the joint vaporization is in the context of the '223 Patent.
Is that correct?
ATTORNEY HANSEN: Objection to form. Beyond the scope.
THE WITNESS: That's my understanding, as stated by this witness. I would say I agree with this characterization.
ATTORNEY HANSEN: Objection. Move to strike that last answer as beyond the question.
BY ATTORNEY ZHONG:
Q. And can you please go to paragraph 81? To page 81?
A. Yes.
Q. Starting from line 22 through next page -- the first three lines of the next page.
A. I'm sorry. Starting on line 22?
Q. So, page 81.
A. Yes.
Q. Eighty-one, line 22, through 82, lines three.
A. Okay.
ATTORNEY HANSEN: Objection. Beyond the

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scope.
THE WITNESS: So the transcript reads:
"If you evaporate something at the same time, is that -- will that result in joint vaporization."
And answer:
"Not necessarily."
And then follow-up answer:
"It really depends on the details of the deposition, the pressure, the reactivity of the two materials, the degree of intermixing."
BY ATTORNEY ZHONG:
Q. Is that consistent with your understanding of whether co-deposition necessarily results in joint vaporization?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: Yes.
BY ATTORNEY ZHONG:
Q. And can you please take a looking at page 82, starting -- page 82, line 20, through page 83, line 17?
A. Eighty-two, line 22?
Q. Line 20 -- line 20.
A. Okay. Down to the next page, line 17?

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Q. Correct. So let me ask you, what is a common and ordinary meaning of joint vaporization to Dr. Kymissis?

ATTORNEY HANSEN: Objection. Beyond the scope.

THE WITNESS: So the witness' response is:

"So again, in my -- I -- in my report, I describe if you go to paragraph 52 in my non-infringement report, I provide that, you know, at least a POSITA would understand that joint vaporization required that the metal compound and the organic compound could be co-evaporated so they are present together in the vapor phase.

And so, again, it also depends on the pressure, because that determines how much interaction the two materials will have in the vapor phase.

If the pressure is very low, then the mean free path is long. If the pressure is high, they have more opportunity to interact. But it also depends on the structure of the evaporation sources and whether the plumes are allowed to interact in a way that permits the reaction to occur in the vapor phase.

So it is not a simple understanding but

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that is generally what a person of ordinary skill in the art would recognize as joint vaporization."

ATTORNEY ZHONG: Okay.

BY ATTORNEY ZHONG:

Q. You reviewed Exhibit 1007, which is the Ma reference. Correct?

A. Yes.

Q. Does the Ma reference provide the details mentioned by Dr. Kymissis, that is needed to determine whether there is joint vaporization or not?

ATTORNEY HANSEN: Objection. Beyond the scope.

THE WITNESS: To my understanding, no, Ma does not provide sufficient information to define joint vaporization, as it's been described by Kymissis in his deposition.

ATTORNEY ZHONG: Okay.

BY ATTORNEY ZHONG:

Q. And let's go back to tab number five, which is your German declaration.

A. I'm there.

Q. Do you recall discussion with counsel about the BTB and compound 72?

A. I'm sorry. And compound 742?

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Q. Compound 742.

A. Yes. I believe that's Figure 2 on page 11?

Q. Correct.

A. Of 12.

Q. Do you recall counsel asking you whether those two compounds also include pyridinic nitrogen atoms?

A. Yes. I do.

Q. The heteroaromatics in these two compounds -- the BTB and the Compound 742 -- are triazine compounds. Correct?

A. Yes, they are.

Q. They are not phenanthrolines. Correct?

A. They are not phenanthrolines. That's correct.

Q. How -- do triazine -- strike that.

The triazines and the phenanthrolines have different steric effects and electronic effects. Correct?

A. Yes. They are different structures and have different sterics, and different electronics. That would be correct.

Q. Okay.

So the phenanthrolines would have fused

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heteroaromatics. Is that correct?

A. I'm sorry. Your question dropped out. Could you repeat it, please.

Q. Okay.

So, in the phenanthrolines, the two pardine rings are fused together. Is that correct?

A. Yes. I think the term is "benzo fused." So there is a benzene ring that freezes them together. Blocks --

Q. Sorry.

What about for the BTB and the Compound 742? Are those heteroaromatic rings fused? Or they can freely rotate?

ATTORNEY HANSEN: Objection. Beyond the scope.

THE WITNESS: They are not fused. And there is free rotation among all of the linkages from the heterocycle to the aromatic units.

ATTORNEY ZHONG: Okay.

BY ATTORNEY ZHONG:

Q. What about the electron transport properties of triazines versus phenanthrolines? Which one is a better electron transporter?

ATTORNEY HANSEN: Objection. Beyond the scope.

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THE WITNESS: It's my understanding that the triazines, as a class, have better transport characteristics than the phenanthrolines.
BY ATTORNEY ZHONG:
Q. Do you recall discussion with counsel regarding the conditions under which tungsten 2HPP4 and phenanthroline films are formed?
A. Yes. I remember a discussion.
Q. Does the '541 Patent describe how the films are formed?
A. Without reviewing every line, I can say I do not believe that it does describe the conditions that were used to make the films that are studied.
Q. Okay.
Is there anything in the '541 Patent that suggests that the films were formed through joint vaporization?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: Not to my knowledge. No.
ATTORNEY ZHONG: Okay.
BY ATTORNEY ZHONG:
Q. And beyond methylene chloride, are there other common -- common -- strike that.
Beyond methylene chloride, are there other

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solvent that's typically used for solution-based OLED?
ATTORNEY HANSEN: Objection. Mischaracterizes his testimony.
THE WITNESS: Yes. There are other solvents that are used to make films for organic solution processed -- organic or electronic materials.
ATTORNEY ZHONG: Okay.
BY ATTORNEY ZHONG:
Q. And would a person of ordinary skill in the art know which -- what those solvents are?
A. Yes.
Q. And when you do vaporization, besides joint vaporization, can there also be layered vaporization?
A. Yes. Vaporization can be done in many ways, including layered deposition.
Q. So in Ma, could there be layered deposition?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: As we discussed, Ma does not describe the conditions for deposition. But it is possible that it's a layer deposition.

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BY ATTORNEY ZHONG:
Q. So even though the two materials may be heated together, that could still be layered deposition?
ATTORNEY HANSEN: Objection. Beyond the scope.
THE WITNESS: Yes. I believe that's described in the declaration -- my declaration -- conditions where you could have two sources heated, but it results in layered or separate -- separated deposition.
ATTORNEY ZHONG: I'll pass the witness.
ATTORNEY HANSEN: Why don't we take a brief break and I can figure out if I have any additional questions?
ATTORNEY ZHONG: Okay.
ATTORNEY HANSEN: Let's go off the record.
COURT REPORTER: Okay. We are off the record.
(Short break.)
RE-EXAMINATION BY ATTORNEY HANSEN:
Q. Dr. Schanze, did you speak with counsel to prepare for the questions that she just asked you?
A. We spoke generally. And -- but not specifically.

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Q. And about how long did you speak for?
A. Five minutes.
Q. And when did you review the article, Fu?
A. Over the weekend.
Q. And prior to over the weekend, had you reviewed Fu beforehand?
A. Not to my knowledge.
ATTORNEY HANSEN: I have no further questions. Thank you so much for your time.
ATTORNEY ZHONG: Okay. Thank you.
THE WITNESS: Thank you.
ATTORNEY ZHONG: Court reporter, do you need anything from us? Any spelling before we let Dr. Schanze go?
COURT REPORTER: Can I get the orders for the transcript, please.
ATTORNEY ZHONG: I need the rough.
COURT REPORTER: Okay. And the final transcript, I guess.
ATTORNEY ZHONG: I don't need the final transcript because I believe the opposing counsel is supposed to serve on us.
COURT REPORTER: I know normally when you order the rough, you are supposed to order the final.

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ATTORNEY ZHONG: I don't know what the rules are, but I do prefer -- well, you know what? Okay.

COURT REPORTER: Yes. That's how it is done.

ATTORNEY ZHONG: Okay. Hold on a minute. Give me a second. Anything else you need from us?

COURT REPORTER: No. That's it. Thank you.

(Whereupon, the deposition adjourned at 4:43 p.m.)

REPORTER'S CERTIFICATE

I, GISELLE MITCHELL-MARGERUM, the undersigned, a Registered Professional Reporter, Certified Reporting Instructor, Licensed Court Reporter, and Certified Court Reporter, do hereby certify:

That the witness, KIRK SCHANZE, before examination was remotely duly sworn to testify to the truth, the whole truth, and nothing but the truth.

That the foregoing deposition was taken remotely stenographically by me on Monday, July 21, 2025, and thereafter was transcribed by me, and that the deposition is a full, true, and complete transcript of the testimony, including questions and answers, and objections, motions and exceptions made by counsel.

That reading and signing was not requested; and that I am neither attorney nor counsel for, nor related to or employed by, any of the parties to the action in which this deposition was taken; and that I have no interest, financial or otherwise, in this case.

IN WITNESS WHEREOF, I have hereunto set my hand this 1st day of August, 2025.



GISELLE MITCHELL-MARGERUM, RPR, CRI, CCR, LCR, ACCR, CSR
CALIFORNIA CSR 14424

CERTIFICATE OF DEPONENT

I, KIRK SCHANZE, hereby certify that I have read the foregoing pages, numbered 1 through 181, of my deposition of testimony taken in these proceedings on Monday, July 21, 2025 and, with the exception of the changes listed on the next page and/or corrections, if any, find them to be a true and accurate transcription thereof.

Signed: .....
Name: KIRK SCHANZE
Date: .....

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Quantum-Chemical Predictions of Absolute Standard Redox Potentials of Diverse Organic Molecules and Free Radicals in Acetonitrile

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Abstract: A calibrated B3LYP/6-311++G(2df,2p)//B3LYP/6-31+G(d) method was found to be able to predict the gas-phase adiabatic ionization potentials of 160 structurally unrelated organic molecules with a precision of 0.14 eV. A PCM solvation model was benchmarked that could predict the pK_a's of 15 organic acids in acetonitrile with a precision of 1.0 pK_a unit. Combining the above two methods, we developed a generally applicable protocol that could successfully predict the standard redox potentials of 270 structurally unrelated organic molecules in acetonitrile. The standard deviation of the predictions was 0.17 V. The study demonstrated that computational electrochemistry could become a powerful tool for the organic chemical community. It also confirmed that the continuum solvation theory could correctly predict the solvation energies of organic radicals. Finally, with the help of the newly developed protocol we were able to establish a scale of standard redox potentials for diverse types of organic free radicals for the first time. Knowledge about these redox potentials should be of great value for understanding the numerous electron-transfer reactions in organic and bioorganic chemistry.

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1. Introduction

The propensity of an organic molecule to donate or accept an electron in solution is measured by its (one-electron) standard redox potential ($E°$).[1] A sound knowledge about standard redox potentials is fundamental to understanding the innumerable chemical and biological electron-transfer reactions. Thus chemists have developed, and are still developing, a variety of experimental methods to obtain the $E°$ data. At present, the most popular experimental method for measuring $E°$ is cyclic voltammetry.[2] The error of this method is usually as low as 0.01−0.02 V when the redox process is reversible. However, for nonreversible redox reactions the experimental situation is complicated, and accurate $E°$ values are available only via some sophisticated techniques such as pulse radiolysis.[2] Therefore, it is not always easy to obtain reliable experimental $E°$ data. Furthermore, for the species that are highly unstable (e.g., organic radicals), it can be very difficult to measure their standard redox potentials experimentally.

Recognizing the limitations of the experimental methods, some research groups recently tried to develop theoretical approaches to predict the standard redox potentials in solution. A general idea in these studies is to employ a certain theoretical method (i.e., AM1,[3] PM3,[4] DFT[5−9]) to compute the gas-phase ionization energies and then add the solvation energy terms calculated using either an explicit[6] or implicit[3−9] solvation model. The results from these pioneering studies are usually in reasonable agreement with the experiments. However, each of the above studies only considered the redox potentials of a fairly small group of closely related compounds. In some occasions, only the relative $E°$ values between a few structurally related compounds were obtained instead of the absolute values.[8] Thus, it still remains unclear whether one could develop a generally applicable protocol to accurately predict the absolute $E°$ values for a large number of structurally unrelated molecules.

(1) The standard redox potential refers to standard conditions (i.e., all reactants are 1.0 M or 1 atm pressure, 298 K). Also, in the present study we only considered the single-electron transfer redox potentials. Furthermore, people have defined both the oxidation potentials and reduction potentials by using different orders of half reactions. In the present study, we only considered the redox potential that corresponded to the oxidation of a species. For the reduction of a species, one just needs to consider the oxidation of the corresponding reduced form.

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We recently launched a program to systematically investigate how to utilize the modern quantum-chemical methods to gain useful, quantitative data for realistic, solution-phase organic chemistry. In the first step, we benchmarked a generally applicable protocol to calculate the pK_a values of diverse organic acids in dimethyl sulfoxide with a precision of 1.7−1.8 pK_a units.[10] Herein we wished to develop a first-principle protocol that could be used to predict the absolute standard redox potentials of diverse types of organic molecules. The significance of the study is twofold: (1) to benchmark a generally applicable theoretical tool that could predict the standard redox potentials with reasonable accuracy and (2) to comprehensively test the efficacy of quantum-chemical methods for electrochemistry, which represents one of the few remaining areas of chemistry that has not been successfully modeled by modern ab initio computations.

The focus of the present study was to establish a coherent, simple, and well-defined method to predict the standard redox potentials of diverse organic molecules of substantial size in organic solution. To accomplish this goal, we carefully calibrated the theoretical method for the gas-phase calculations and parametrized the solvation model for the solution-phase calculations. As to the solvent we chose acetonitrile, because acetonitrile is one of the most popular organic solvents for the measurement of redox potentials. To demonstrate that our protocol can be used for diverse types of organic molecules, we extensively searched the literature and compiled more than 270 experimental standard redox potentials.[11] By comparing the theoretical results with the experimental data, we would be able to confidently assess the performance of the theoretical protocol for the redox potential predictions.

Armed with the carefully benchmarked theoretical method, we next tried to establish a scale of standard redox potentials for various organic free radicals. Such a scale of data has been highly desirable for many years in organic and bioorganic chemistry,[12−22] because organic free radicals have been found to participate in a plethora of electron-transfer reactions. Information about the electrochemical properties of these radical reactants or intermediates in solution is of tremendous importance to understanding the reaction mechanisms and kinetics. Unfortunately, as free radicals are usually transient species, their redox potentials are very difficult to measure experimentally. Up to now the $E°$ values of only a few free radicals have been reported,[12−22] and not all of these data are free of flaws. It is truly valuable to have an extensive tabulation of the $E°$ values for organic free radicals. By supplying trustworthy and useful data that are difficult to obtain via the experiments, we also hoped to better demonstrate the value of computational electrochemistry.[6,9]

2. Developing a Reliable Protocol To Calculate Standard Redox Potentials

2.1. Calibrating the Gas-Phase Ionization Potentials. Before computing the standard redox potentials, it is indispensable to calculate the gas-phase adiabatic ionization potentials (IPs), defined as the enthalpy changes of the following reactions in the gas phase at 298 K, 1 atm.

$$\text{Reduced form (g)} \rightarrow \text{Oxidized form (g)} + e^- \text{(g)} \quad (1)$$

Although high-level theoretical methods such as G3 and CBS-Q can provide very accurate IPs, these methods are too demanding for general applications. The HF and MP2 methods are known to be inappropriate for the IP calculations.[23] Thus, the only choice is to use the density functional theory (DFT) methods to calculate the IPs.

Herein the popular B3LYP density functional was selected to calculate the gas-phase adiabatic ionization potentials. The standard 6-31+G(d) basis set was used for the geometry optimizations and frequency calculations, while the single-point energy calculations were performed with the 6-311++G(2df,2p) basis set. For the molecules that have more than one possible conformation, the conformation with the lowest electronic energy was singled out and used in the ensuing calculations. Each final optimized geometry was confirmed by the B3LYP/6-31+G(d) frequency calculation to be a real minimum on the potential energy surface without any imaginary frequencies. The enthalpy of each species was calculated using the B3LYP/6-311++G(2df,2p) electronic energy and the zero-point vibrational energy and thermal corrections (0 → 298 K) obtained at the B3LYP/6-31+G(d) level (unscaled).

The adiabatic IPs calculated using the above approach are compiled in the Supporting Information. Comparing these theoretical IPs with the available experimental data, we found that the B3LYP/6-311++G(2df,2p)//B3LYP/6-31+G(d) method systematically underestimated the adiabatic IPs (Figure 1. Pay attention to the $y = x$ line.). Similar underestimation behavior of the DFT methods in the IP calculations was noted previously by Jursic in his study on alkanes[23] and by Kollman et al. in their study on toluene derivatives.[24]

Despite the underestimation problem, it is found that the B3LYP IPs correlate well with the experimental data, that is:

$$\text{IP (Exptl)} = \text{IP (B3LYP)} + 0.28 \text{ eV} \quad (2)$$

For 160 structurally unrelated molecules, the correlation coefficient (r) of eq 2 is 0.989 and the standard deviation (sd)

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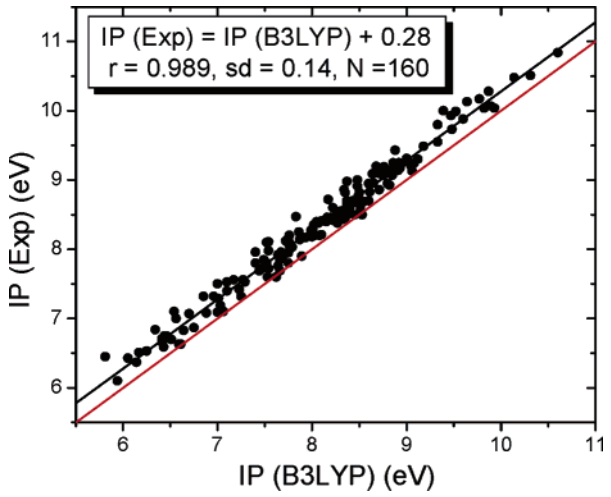


Figure 1. Correlation between the theoretical and experimental adiabatic IPs.

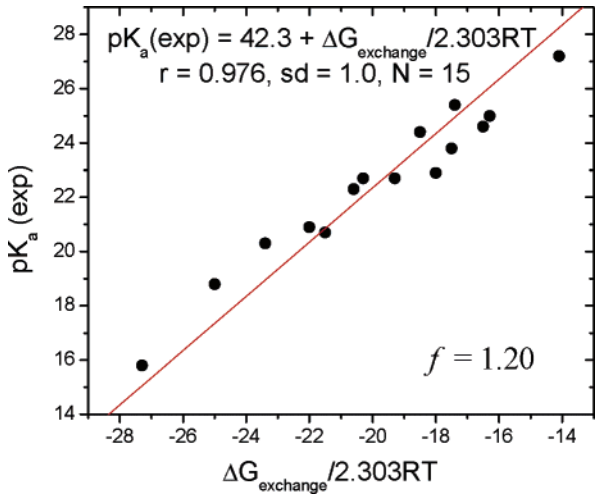


Figure 2. Correlation between the theoretical and experimental pK_a's in acetonitrile.

equals 0.14 eV (ca. 3 kcal/mol). It is worth noting that the experimental error for adiabatic IPs is usually 0.05−0.1 eV (i.e., 1−2 kcal/mol). Therefore, by adding 0.28 eV to the B3LYP results one can predict the adiabatic IPs reasonably well.

2.2. Calibrating the Solvation Model. With reliable theoretical gas-phase adiabatic IPs in hand, the next crucial step for the redox potential calculation is the computation of solvation free energies. In the present study, we used the polarized continuum model (PCM) developed by Tomasi and co-workers[25] to calculate the solvation free energies in acetonitrile.

A central idea in the PCM model is the construction of a solvent-inaccessible cavity in which the solute molecule resides.[26,27] In practice, this solvent-inaccessible cavity is built as a union of overlapping spheres centered on the nuclei of atoms or chemical groups. The sphere radii are usually proportional to the atomic radii with a scale factor (*f*). For aqueous solution, the *f* value was optimized to be 1.2,[25] while for dimethyl sulfoxide solution *f* was optimized to be 1.35.[10,28] Nonetheless, for many other solutions including acetonitrile, rigorous optimization of the *f* value has not been done because of the lack of experimental solvation free energies.

Without a careful optimization (or assessment) of the solvation model for acetonitrile, we were reluctant to blindly apply it to the redox potential calculations. Unfortunately, there are not enough experimental solvation free energies for us to evaluate the PCM model for acetonitrile.[29] At this point, we decided to use the experimental pK_a's of 15 organic acids in acetonitrile to assess the solvation model and to optimize the *f* value.[30] These 15 experimental pK_a values vary significantly from 15.8 to 27.2 (see the Supporting Information). Thus, it is sensible for us to assess and optimize the solvation model by attempting to calculate these pK_a's theoretically.

To calculate the pK_a's in acetonitrile, we considered the following proton-exchange reaction

$$AH + {}^{-}CH_2CN \rightarrow A^{-} + CH_3CN \qquad (3)$$

If the free energy change of the above reaction is defined as $\Delta G_{exchange}$, the pK_a of the acid AH can be calculated by eq 4.[10]

$$pK_a(HA) = pK_a(CH_3CN) + \frac{\Delta G_{exchange}}{2.303 \times RT} \qquad (4)$$

It is known from the previous studies that the gas-phase free energy change of eq 3 can be fairly accurately calculated.[10] Thus, whether the theory can reproduce the experimental pK_a's mainly relies on the quality of the solvation energy calculations.

Using the Bondi scale of radii,[31−32] we examined different *f* values ($f = 1.10, 1.15, 1.20, 1.25, 1.30, 1.35$. See the Supporting Information for details) for the PCM model in the calculation of pK_a's in acetonitrile. Because the pK_a value of CH_3CN in acetonitrile has not been accurately determined (pK_a(CH_3CN) > 33.3[33]), we could only plot the experimental pK_a's against the theoretical results for ($\Delta G_{exchange}$/2.303*RT*) at different *f* values. By fixing the regression slope at 1.00, we found that $f = 1.20$ gave the best fit with the highest correlation coefficient ($r = 0.976$) and lowest standard deviation (sd = 1.0 pK_a unit) (Figure 2). It is worth mentioning that the correlation results also suggest that pK_a(CH_3CN) = 42.3.

2.3. Computing Standard Redox Potentials in Acetonitrile. At this point we have established a theoretical protocol that can predict the gas-phase adiabatic IPs with an accuracy of 0.14 eV (ca. 3 kcal/mol). We have also optimized a solvation model that can predict the solution-phase pK_a's with an accuracy of

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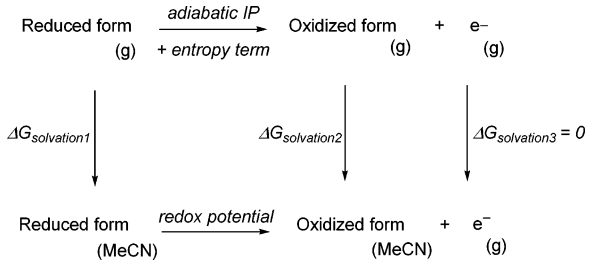


Figure 3. Free energy cycle for the redox reaction in acetonitrile.

1.0 pK_a unit (ca. 1.4 kcal/mol). Now it is time to see whether these theoretical methods can be combined to calculate the standard redox potentials in acetonitrile accurately.

It should be noted that by convention the standard redox potential is defined for half reactions written in the order:

$$E°: \quad \text{Reduced form} \rightarrow \text{Oxidized form} + e^- (g) \qquad (5)$$

The value of $E°$ is usually measured relative to a reference electrode, for instance, the normal hydrogen electrode (NHE). The NHE half reaction is $H^+(aq) + e^- (g) \rightarrow {}^1/_2H_2(g)$. Thus, the $E°$ value is connected to the standard free energy change of the reaction

$$\Delta G°: \quad \text{Reduced form} + H^+(aq) \rightarrow \text{Oxidized form} + {}^1/_2H_2(g) \qquad (6)$$

in the form of eq 7.

$$E° = \Delta G°/F \qquad (7)$$

where F is the Faraday constant equal to 23.06 kcal/mol·V.

From a free energy cycle as shown in Figure 3, one can relate the redox potentials with the gas-phase adiabatic IPs and solvation energies using the following equation:

$$E° \text{ (versus NHE)} = \text{IP} + \frac{1}{23.06}(-T\Delta S + \Delta G_{\text{solvation2}} - \Delta G_{\text{solvation1}}) - 4.44 \qquad (8)$$

In eq 8, IP is the gas-phase adiabatic ionization potential (unit: eV), which equals the gas-phase enthalpy change from the reduced form to the oxidized form plus e^- at 298 K. The second term, $-T\Delta S$ (unit: kcal/mol) is the gas-phase entropy term from the reduced form to the oxidized form plus e^- at 298 K.[33] The next terms, $\Delta G_{\text{solvation1}}$ and $\Delta G_{\text{solvation2}}$ (unit: kcal/mol), correspond to the solvation free energies of the reduced and oxidized forms. The last term, −4.44 (unit: eV), is the free energy change associated with the reference NHE half-reaction (i.e., $H^+(aq) + e^- (g) \rightarrow {}^1/_2H_2(g)$).[34]

Using eq 8 it is straightforward to compute the standard redox potential of any organic molecule in acetonitrile from the aforementioned theoretical gas-phase IP (corrected by adding 0.28 eV) and solvation energies (f = 1.20). To assess the performance of this protocol, we compiled all the literature experimental standard redox potentials for organic molecules containing no more than 12 non-hydrogen atoms (see the Supporting Information). This compilation provided more than 270 structurally unrelated compounds that included alkanes, alkenes, alkynes, aromatics, alcohols, amines, aldehydes, ketones, ethers, esters, nitro compounds, halogenated compounds, amides, thiols, sulfides, heterocycles, hydrazines, azoalkanes, silanes, and tetrazenes.[35]

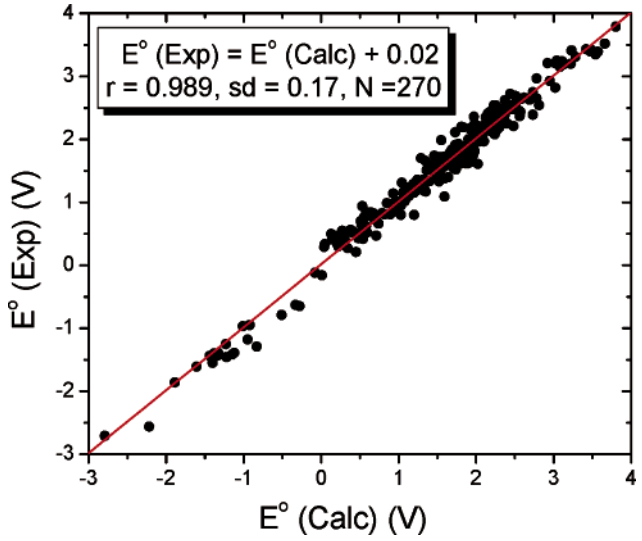


Figure 4. Correlation between the theoretical and experimental standard redox potentials in acetonitrile.

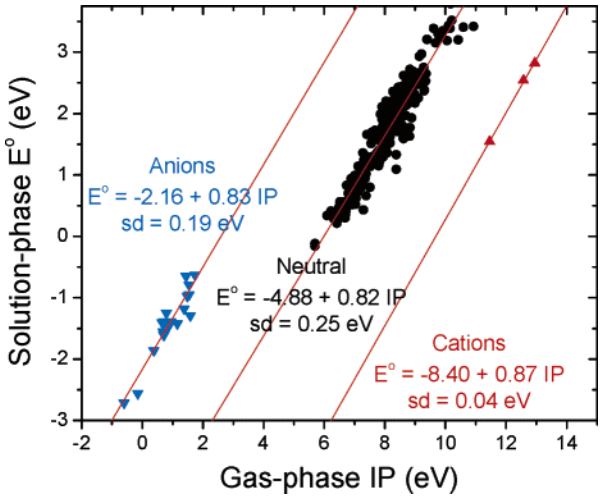


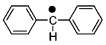
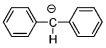
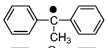
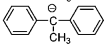
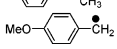
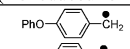
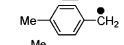
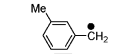
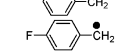
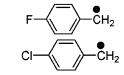
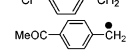
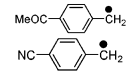
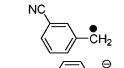
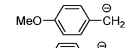
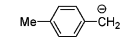
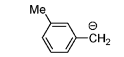
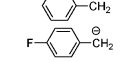
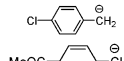
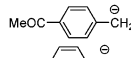
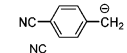
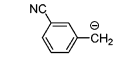
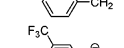
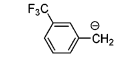
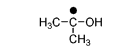
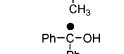
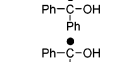
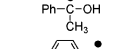
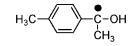
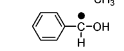
Figure 5. Correlation between the gas-phase adiabatic ionization potentials (theoretical values) and experimental standard redox potentials in acetonitrile.

The correlation between the experimental and theoretical standard redox potentials is shown in Figure 4. From Figure 4 it can be seen that the slope and intercept of the correlation are 1.00 and 0.02 V, respectively, indicating that there is almost no systematic error in the predictions. The correlation coefficient (r) is 0.989. The standard deviation between the experimental and theoretical standard redox potentials is 0.17 V (e.g., 4 kcal/mol) for 270 structurally unrelated compounds. Although this standard deviation is higher than the reported experimental error (0.01−0.02 V) of cyclic voltammetry, it is worth noting that not all of the experimental redox potentials were measured under rigorously reversible reaction conditions. In fact, for most cases the experimental errors are reported to be around 0.1 V.

(34) Trasatti, S. *Pure Appl. Chem.* **1986**, *58*, 955.
(35) Not all the redox potentials are reported relative to NHE. Nevertheless, it is not hard to convert one scale of redox potentials to the other by using the relative potentials of different electrodes. For instance, SCE versus NHE = +0.24 V and $Ag|Ag^+$ (0.1 M) versus NHE = +0.57 V.

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Table 1. Experimental and Theoretical Adiabatic Ionization Potentials (IPs, eV) and Standard Redox Potentials (E°, V) in Acetonitrile for Organic Free Radicals

Species (As reduced form)	IP (exp.)	IP (calc)[a]	E^0(exp) *vs.* NHE	E^0(calc) *vs.* NHE	Ref.
	7.24 ± 0.01	7.48	0.97	0.96	14a
	6.6	6.71	0.40	0.48	14c
	0.91 ± 0.01	1.16	-1.21	-1.31	14a
	0.79 ± 0.11	1.00	-1.49	-1.57	14c
	7.3 ± 0.1	6.74	0.59	0.63	14a
	1.36 ± 0.10	1.71	-0.90	-0.88	14a
	5.7	5.91	-0.79	-0.85	14b
	-	0.00	-1.76	-1.82	14c
	-	5.21	-0.88	-1.24	14b
	6.9	6.99	0.61	0.58	14c
	0.81 ± 0.13	1.05	-1.34	-1.31	14c
	-	6.49	0.47	0.43	14c
	-	1.51	-1.10	-1.16	14c
	6.70 ± 0.03	7.03	0.35	0.17	14c
	-	0.2	-1.76	-1.88	14c
	6.94	7.38	0.00	0.35	14c
	-0.02 ± 0.10	0.18	-1.06	-1.48	14c
	7.07	7.16	1.00	1.01	14c
	1.87 ± 0.01	2.07	-0.52	-0.48	14c
	-	6.45	-0.21	-0.23	14c
	-	6.53	-0.11	-0.25	14c
	-	6.74	0.16	-0.04	14c
	-	6.21	0.55	(-0.62)	14c
	-	7.10	-0.10	0.17	14c
	-	6.38	0.44	(-0.66)	14c
	-	5.95	-0.61	-0.46	14c
	-	0.50	-1.79	-1.71	14c
	6.8 ± 0.1	6.72	0.50	0.50	14e
	-	6.69	0.69	0.80	14e
	6.96 ± 0.02	7.13	0.75	0.85	14e
	7.12 ± 0.02	7.31	0.94	0.98	14e
	-	7.43	0.97	0.92	14e
	-	7.43	1.04	0.97	14e
	-	7.70	1.14	1.22	14e
	-	8.02	1.32	1.36	14e
	-	8.03	1.35	1.28	14e
	-	0.99	-1.51	-1.50	14d
	0.84 ± 0.14	1.07	-1.38	-1.42	14d
	0.88 ± 0.14	1.15	-1.26	-1.30	14d
	0.94 ± 0.01	1.19	-1.26	-1.34	14d
	-	1.42	-1.16	-1.29	14d
	-	2.03	-0.47	-0.75	14d
	-	2.11	-0.53	-0.78	14d
	-	1.82	-0.87	-1.05	14d
	-	1.64	-0.96	-0.92	17
	-	6.47	-0.37	-0.46	19b
	-	6.22	-0.01	0.10	19b
	-	6.34	0.00	0.01	19b
	-	6.13	-0.22	-0.13	19b
	-	6.65	-0.06	0.17	19b
	-	7.21	0.55	0.79	19b
	-	6.61	0.62	0.46	19b
	-	6.07	0.15	-0.20	19b
	1.10 ± 0.01	1.33	-0.29	-0.60	21

[a] Calculated by the B3LYP/6-311++G(2df,2p)//B3LYP/6-31+G(d) method and corrected by adding 0.28 eV to the DFT results. Experimental gas-phase adiabatic ionization potentials are taken from NIST Standard Reference Database 69, March 1998 Release: *NIST Chemistry WebBook* (data compiled by J. E. Bartmess).

Therefore, the theoretical protocol is modestly successful for predicting the standard redox potentials.

At this point, we need to mention that not all of the theoretical predictions are in reasonable agreement with the experiment. For propene, 2-methyl-propene, 1-butene, 2-butene, 1-pentene, 1-octene, and 2-octene, the experimental standard redox potentials[36] (versus NHE) are 3.21, 3.16, 3.17, 2.72, 3.25, 3.21, and 2.74 V, but the theoretical values are 2.73, 2.33, 2.82, 2.32, 2.81, 2.61, and 2.24 V, respectively. The deviation between the experiment and the theory is about 0.5−0.8 V (i.e., 11−18 kcal/mol). Furthermore, for propane-1-thiol and butane-1-thiol the experimental standard redox potentials are 1.71 and 1.91 V versus NHE,[37] but the theoretical predictions are 2.37 and 2.48 V, respectively. The cause of these dramatic deviations remains to be clarified.

2.4. Correlation between Ionization Potentials and Redox Potentials. No one has compiled as many standard redox potentials in acetonitrile previously. Therefore, we have a unique opportunity to reliably reinvestigate one important subject related to the redox potentials, i.e., the correlation between gas-phase ionization potentials and solution-phase standard redox potentials. This correlation has been proposed and used by many authors in either explaining the experimental data or predicting unknown redox potentials.[38,39] We were interested in this

(36) (a) Fleischmann, M.; Pletcher, D. *Tetrahedron Lett.* **1968**, *60*, 6255. (b) Clark, D. B.; Fleischmann, M.; Pletcher, D. *J. Electroanal. Chem. Interfacial Electrochem.* **1973**, *42*, 133.

(37) Loveland, J. W.; Dimeler, G. R. *Anal. Chem.* **1961**, *33*, 1196.

(38) Miller, L. L.; Nordblom, G. D.; Mayeda, E. A. *J. Org. Chem.* **1972**, *37*, 916.

(39) Recent examples: (a) Dhiman, A.; Becker, J. Y.; Minge, O.; Schmidbaur, H.; Muller, T. *Organometallics* **2004**, *23*, 1636. (b) Ue, M.; Murakami, A.; Nakamura, S. *J. Am. Chem. Soc.* **2002**, *149*, 1572.

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correlation because it could reveal some important information about the solvation effect on redox potentials. Thus we plotted the theoretical gas-phase adiabatic IPs against the experimental redox potentials in Figure 5.

From Figure 5 it is clear that the gas-phase IPs cannot have a unified correlation with the solution-phase redox potentials for all of the compounds. Nevertheless, after we separated the compounds into three groups, i.e., anions (20 members), neutral compounds (247 members), and cations (3 members), we obtained three nice correlation lines. Surprisingly, the slopes of these three lines (0.83, 0.82, and 0.87) are fairly close to each other, although their intercepts (−2.16, −4.88, and −8.40 V) are dramatically different. Therefore, in each group the standard redox potentials are correlated with the IPs, but molecules with different total charges cannot be put together for such a correlation.

It is obvious that the different intercepts (i.e., −2.16, −4.88, and −8.40 V) are caused by the different solvation effects experienced by the anions, neutral molecules, and cations in acetonitrile. Furthermore, the slopes (ca. 0.85) of the correlations indicate that about 15% of the gas-phase ionization potentials are offset by the solvation in the solution-phase redox processes. Both of the above two effects are nicely reproduced by the PCM solvation model. Thus the redox potentials of anions, neutral molecules, and cations can be successfully predicted by a single quantum-chemical method.

At this instant we should mention that, although the continuum solvation model has been shown to be successful for various types of closed-shell molecules, it has never been extensively tested for open-shell species (e.g., radicals) against solid experimental data in the past. Since the redox potential calculations require accurate computation of the solvation energies of the open-shell species, the results from the present study should represent one of the first confirmations for the validity of the continuum solvation model for open-shell species. Such a confirmation is important, because we expect steady growth in the application of computational methods to studies of the solution-phase chemistry of various open-shell speices.

3. Standard Redox Potentials of Organic Free Radicals in Acetonitrile

To test the usefulness of the above theoretical protocol, we utilized it to study the standard redox potentials of organic free radicals in acetonitrile.[40] These redox potential data are of particular importance in mechanistic organic chemistry because free radicals are the intermediates of a plethora of electron-transfer reactions. Although considerable efforts have been devoted to the determination of the redox potentials of free radicals, up to now chemists have only measured the standard redox potentials of a few relatively stable free radicals (e.g., benzyl radicals).[12−22]

3.1. Comparing the Predictions with Available Experimental Data. Before predicting the unknown redox potentials, we first utilized the theoretical protocol developed in section 2 to calculate the standard redox potentials of free radicals that had been experimentally measured. The results are summarized in Table 1. It is worth noting that both the oxidation from carbon anions to carbon radicals and the oxidation from carbon radicals to carbon cations were considered in the present work.

(40) Only the carbon-centered free radicals are considered in the present study.

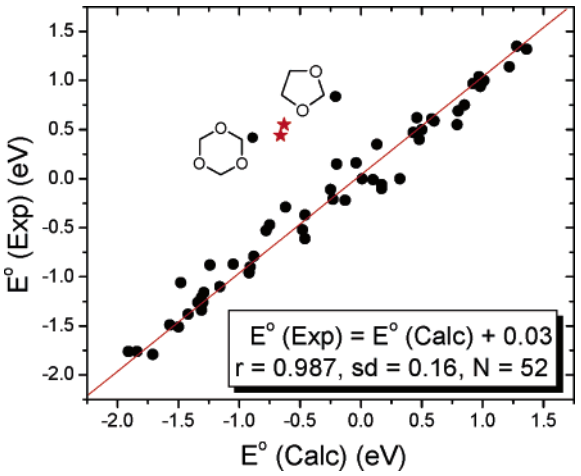


Figure 6. Correlation between the theoretical and experimental redox potentials in acetonitrile for organic free radicals.

Plotting the theoretical redox potentials against the experimental data, we obtained a nice correlation (Figure 6). The slope and intercept of the correlations are 1.00 and 0.03 V, respectively, indicating that there is almost no systematic error for the predictions. The correlation coefficient (r) is as high as 0.987, and the standard deviation for 52 redox couples is as low as 0.16 V. Thus the theoretical protocol is satisfactory for the calculation of standard redox potentials of organic free radicals. Nevertheless, there are two cases for which the theory does not agree with the experiment. They correspond to the oxidations of 1,3-dioxolane and 1,3,5-trioxane radicals to the corresponding cations (Figure 6).[14]

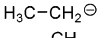
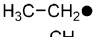
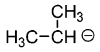
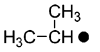
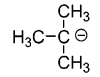
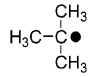
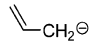
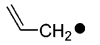
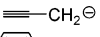
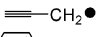
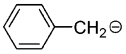
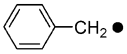
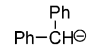
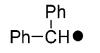
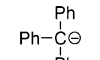
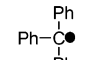
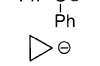
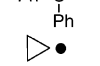
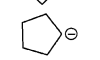
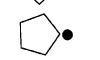
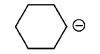
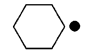
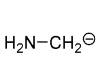
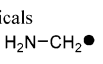
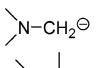
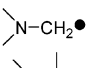
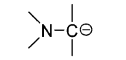
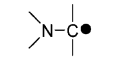
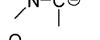
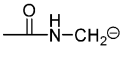
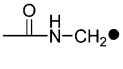
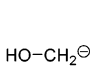
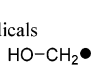
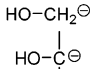
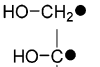
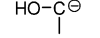
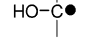
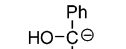
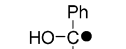
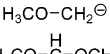
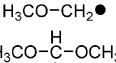
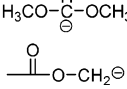
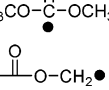
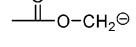
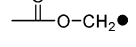
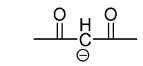
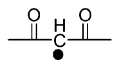
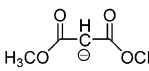
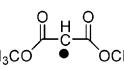
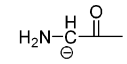
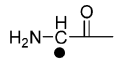
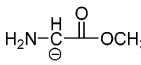
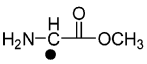
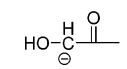
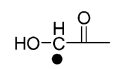
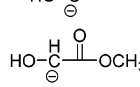
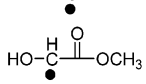
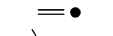
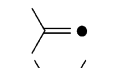
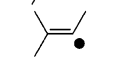
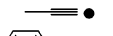
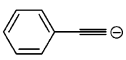
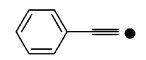
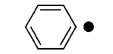
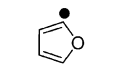
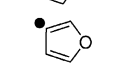
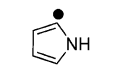
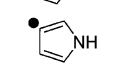
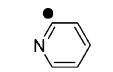
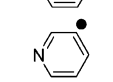
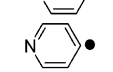
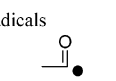
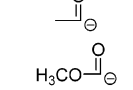
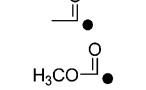
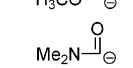
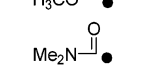
3.2. A Scale of Standard Redox Potentials for Organic Free Radicals. Having confirmed the reliability of the theoretical method for a number of free radicals, we next utilized the same method to calculate the standard redox potentials of various types of organic free radicals. These include the alkyl radicals, α-amino radicals, α-alkoxyl radicals, α-carbonyl radicals, captodative radicals, alkenyl radicals, alkynyl radicals, aromatic radicals, and carbonyl radicals. For each type, we selected a few representative examples. Both the oxidation of free radicals to carbon cations and the oxidation of carbon anions to free radicals were considered. The results are shown in Table 2.

To better illustrate the calculation results, we showed the predicted standard redox potentials graphically in Figure 7. From Figure 7 it can be seen that the aromatic carbon radicals have the highest standard redox potentials, around ∼+1.5 to +3.0 V (versus NHE). They are followed by alkynyl (ca. +2.4 V), alkyl (∼+0.5 to +2.5 V), and α-carbonyl radicals (∼+1.2 to +2.3 V). The standard redox potentials of alkenyl and captodative radicals are about 1.0 V. The standard redox potentials of carbonyl radicals are about 0.6 V. The standard redox potentials of α-alkoxyl radicals are about ∼−0.5 to +0.8 eV. The standard redox potentials of α-amino radicals are about ∼−1.5 to +0.5 V. Thus, depending on the substituents, the standard redox potentials of carbon-centered free radicals range from −1.5 to +3.0 V.

Compared to the radicals, the standard redox potentials for the carbon anions follow a different trend. The highest standard redox potentials are observed for the alkynyl anions (ca. +1.4

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Table 2. Adiabatic Ionization Potentials (IP, eV) and Standard Redox Potentials (E°, V) of Organic Free Radicals in Acetonitrile Predicted by the Method Developed in the Present Study

Species (As reduced form)	IP	E^0 *vs.* NHE	Species (As reduced form)	IP	E^0 *vs.* NHE
Alkyl radicals					
	0.36	-0.98		10.23	2.54
	0.06	-1.55		8.49	1.23
	0.06	-1.81		7.65	0.65
	0.22	-1.88		7.03	0.17
	0.79	-1.11		8.42	1.42
	1.23	-0.64		9.00	2.00
	1.16	-1.31		7.48	0.96
	1.71	-0.88		6.74	0.63
	1.77	-0.99		6.32	0.45
	0.62	-1.05		7.05	0.05
	0.20	-1.69		7.78	0.83
	0.11	-1.84		7.41	0.57
	0.32	-1.76		7.30	0.63
α-Amino radicals					
	-0.26	-1.80		6.69	-0.66
	0.00	-1.82		5.91	-0.85
	0.18	-1.86		5.10	-1.47
	1.00	-1.53		5.40	-0.82
	0.75	-1.45		7.26	0.36
α-Alkoxyl radicals					
	0.07	-1.55		7.97	0.49
	0.13	-1.81		6.50	-0.42
	0.87	-1.59		6.45	0.02
	0.18	-1.48		7.38	0.35
	0.40	-1.37		6.07	-0.64
	0.86	-1.21		7.55	0.85
α-Carbonyl radicals					
	2.04	0.04		8.70	1.94
	1.59	-0.58		8.00	1.49
	1.96	0.01		8.87	2.09
	1.79	-0.34		7.55	1.17
α-Carbonyl radicals					
	3.09	0.76		8.84	2.18
	3.16	0.83		8.65	2.23
Captodative radicals					
	1.19	-0.98		7.44	0.54
	1.12	-1.02		7.23	0.37
	1.54	-0.50		8.47	1.46
	1.36	-0.71		8.27	1.37
Alkenyl radicals					
	0.96	-0.61		8.97	1.63
	1.01	-0.77		7.31	0.46
	0.79	-1.15		7.22	0.55
Alkynyl radicals					
	3.04	1.35		9.04	1.98
	3.34	1.38		9.33	2.60
Aromatic radicals					
	1.33	-0.60		8.51	1.80
	2.13	0.33		9.79	2.85
	1.91	0.08		9.90	2.99
	1.86	0.01		9.04	2.18
	1.40	-0.29		9.10	2.28
	1.07	-0.75		8.07	1.41
	1.68	-0.32		8.59	1.92
	1.71	-0.35		8.74	1.97
Carbonyl radicals					
	0.74	-1.07		7.41	0.24
	1.66	-0.26		7.79	0.79
	0.93	-0.93		7.03	0.29

V). They are followed by α-carbonyl (∼−0.6 to +0.7 V) and aromatic (∼−0.8 to +0.2 V) anions. Carbonyl anions and captodative anions have similar standard redox potentials (∼−1.0 to −0.5 V). The standard redox potentials of alkenyl anions are around −1.0 V. The standard redox potentials of α-alkoxyl and α-amino anions are about ∼−2.0 to −1.5 V. The standard redox potentials of alkyl anions range from −2.0 to −0.7 V.

4. Summary

The ability to accurately predict the standard redox potential for a given molecule in the solution phase is highly desirable.

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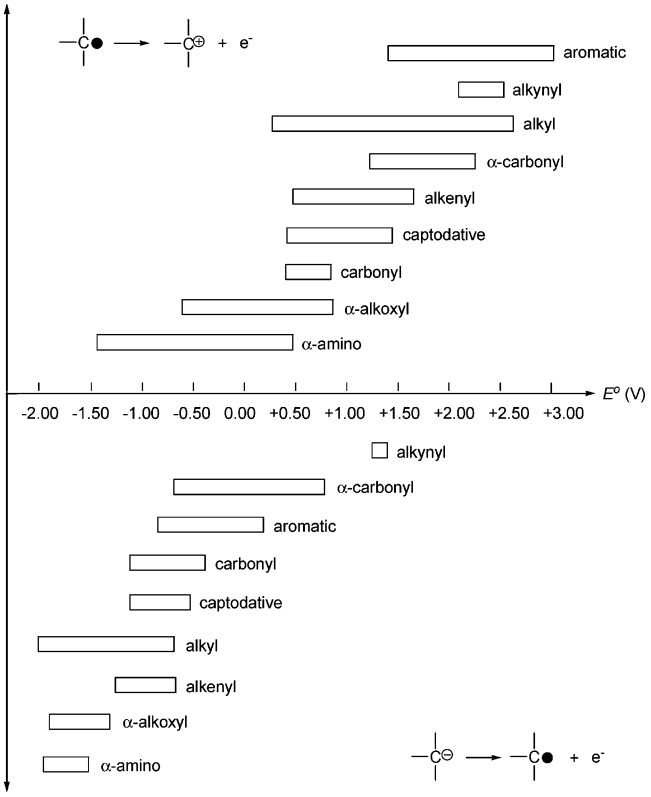


Figure 7. Standard redox potentials of various types of organic free radicals in acetonitrile.

Identifying key electronic features that dictate the redox potential on a molecular level is of substantial importance and might facilitate the derivation of rational strategies for tuning the redox properties of catalysts and provide a unique pathway to discovering novel redox-active systems with desired chemical behavior. In the present study, we carefully benchmarked a generally applicable theoretical protocol for the prediction of standard redox potentials in acetonitrile. This protocol was utilized to calculate the standard redox potentials of 270 structurally unrelated organic molecules, and it was demonstrated to have a precision of 0.17 V.

The primary value of the study is that it provides the chemical community a calibrated protocol for the prediction of standard redox potentials. Second, the study demonstrates that it is time for computational electrochemistry[6,9] to become a powerful tool for organic chemistry research. Furthermore, the study comprehensively tests the validity of the continuum solvation theory for the organic radical species. It demonstrates that this great theoretical model can successfully predict the solvation energies of organic radicals. Finally, with the help of the newly developed protocol we are able to establish a scale of standard redox potentials for diverse types of organic free radicals for the first time. Knowledge about these redox potentials is of great value for understanding the numerous electron-transfer reactions in organic and bioorganic chemistry.

5. Computational Methodology

All of the theoretical calculations were conducted using the Gaussian 98 and 03 programs.[41,42] The gas-phase calculations were conducted using the standard B3LYP/6-311++G(2df,2p)//B3LYP/6-31+G(d) method. The PCM solvation model was used in its original dielectric formulation (D-PCM) developed by Tomasi and co-workers[25,26] to calculate the solvation free energies in acetonitrile. The gas-phase geometry was utilized for all the solution-phase calculations, as it was demonstrated that the change of geometry by the solvation effect was usually not significant.[27] All the PCM calculations were performed at B3LYP/6-31+G(d,p) level (version = MATRIX INVERSION, cavity = PENTAKISDODECAHEDRA, Icomp = 4, TSNUM = 60, TSARE = 0.4, radii = bondi, alpha = ∼1.10−1.35).

Acknowledgment. This study was supported by the National Natural Science Foundation of China (No. 20332020 and No. 20472079). We also thank the USTC Supercomputer Center.

Supporting Information Available: Experimental and theoretical adiabatic ionization potentials and standard redox potentials for more than 270 compounds. Experimental and theoretical pK_a values for 15 organic acids. Complete citations for refs 41 and 42. This material is available free of charge via the Internet at http://pubs.acs.org.

JA0421856

(41) Frisch, M. J. et al. *Gaussian 98*, revision A.7; Gaussian, Inc.: Pittsburgh, PA, 1998.
(42) Frisch, M. J. et al. *Gaussian 03*, revision B.04; Gaussian, Inc.: Pittsburgh, PA, 2003.

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UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

PICTIVA DISPLAYS INTERNATIONAL LTD., ET AL.,	)	
Plaintiffs,	)	Civil Action Nos. 2:23-cv-00945-JRG
vs.	)	2:24-cv-00532-JRG
SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS AMERICA, INC.,	)	
Defendants.	)	

** CONFIDENTIAL **
** ATTORNEYS' EYES ONLY PURSUANT TO PROTECTIVE ORDER **

REMOTE VIDEOTAPED DEPOSITION
OF
IOANNIS KYMISSIS, Ph.D.
Saturday, June 14, 2025
San Francisco, California

Reported by: B. Suzanne Hull, CSR No. 13495

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Exhibit #
Schanze 13
07/21/25
exhibitsticker.com

APPEARANCES

For Plaintiffs:	Irell & Manella LLP By MR. JASON G. SHEASBY Attorney at Law 1800 Avenue of the Stars Suite 900 Los Angeles, California 90067 (310) 203-7096 jsheasby@irell.com
For Defendants:	Quinn Emanuel Urquhart & Sullivan LLP By MR. GAVIN K. SNYDER Attorney at Law 1109 1st Avenue Suite 210 Seattle, Washington 98101 (206) 905-7000 gavinsnyder@quinnemanuel.com - and - By MS. MELISSA J. BAILY Attorney at Law 50 California Street Twenty-second Floor San Francisco, California 94111 (415) 875-6600 melissabaily@quinnemanuel.com
The Videographer:	Kim Smith

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E X H I B I T S

EXHIBIT	DESCRIPTION	PAGE
Exhibit 1	OLED document, September 22, 2022, Bates Stamp Numbers SDC_00071260 through SDC_00071284, twenty-five pages	23
Exhibit 3	PM Manual, October 11, 2023, Bates Stamp Numbers SDC_00070979 through SDC_00070995, seventeen pages	25
Exhibit 2	Transcript of Jihyung Seo, dated January 21, 2025, eighty-four pages	26
Exhibit A1	OLED, Bate Stamp Number SDC_00071266, one page	54

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Exhibit A2	Microcacvity, Bates Stamp Number SDC_00071265, one page	54
Exhibit 7	Exhibit A to Humphrey's report, three hundred twenty-three pages	65
Exhibit 13	United States Patent, Schmid, et al., Patent Number US 8,558,223 B2, date of patent October 15, 2013, twenty-one pages	81
Exhibit 12	Transcript of Yonghun Jo, March 12, 2025, twenty-two pages	90
Exhibit 14	Novateq tear-down report, TOF-SIMS analysis - Stage III Samsung Galaxy S24 ultra red pixel, February 8, 2025, Bates Stamp Numbers PICTIVA00042502 through PICTIVA00042546, forty-five pages	108

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EXHIBIT NO.	DESCRIPTION	PAGE
Exhibit 16	Chemical Physics Letters, "Unraveling the complexation effect of electron transporting materials with Liq on the charge transport properties: A theoretical perspective," Sunwoo Kang, Sang Ho Jeon, Taekyung Kim, Bates Stamp Numbers PICTIVA00030235 through PICTIVA00030242, eight pages	113
Exhibit 18	iRiver Clix2 OLED characterization project report, Job Number V1QWL906, one hundred seventeen pages	120
Exhibit 19	synthetic Metals, "Organic light-emitting diodes based on new n-doped electron transport layer," J.W. Ma, Wei Xu, X.Y. Jiang, Z.L. Zhang, five pages	120

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EXHIBITS (Continued)

EXHIBIT NO.	DESCRIPTION	PAGE
Exhibit 20	International application published under the Patent Cooperation Act (PCT), September 15, 2005, International Publication Number WO 2005/086251 A2, Bates Stamp Numbers PICTSAMSUNGEDTX013791 through PICTSAMSUNGEDTX013878, eighty-nine pages	120
Exhibit 21	PowerPoint slide deck, December 12, 2013, Bates Stamp Numbers SDC_00076984 through SDC_00077057, seventy-four pages	129
Exhibit 22	Excel spreadsheet, Bates Stamp Number SDC_00074321	137
Exhibit 26	August 5, 2014, Bates Stamp Numbers SDC_00074415 through SDC_00074452, thirty-eight pages	138

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Exhibit 23	Samsung SDI, Dreamus, Bates Stamp Numbers DREAMUS_00000001 through DREAMUS_00000039, thirty-nine pages	154
Exhibit 24	Excel spreadsheet, Bates Stamp Number DREAMUS_00000040	155
Exhibit 25	ReignCom Limited, Bates Stamp Numbers DREAMUS_00000042 through DREAMUS_00000302, two hundred sixty-one pages	155
Exhibit 27	United States Patent, Schmid, et al., Patent Number US 8,723,164 B2, date of patent May 13, 2014, thirteen pages	159
Exhibit 4	Excel spreadsheet, Bates Stamp Number SDC_00045424	177

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Exhibit 5	United States Patent, Schmid, et al., Patent Number US 8,723,174 B2, date of patent May 13, 2014, Bates Stamp Numbers PICTIVA00000160 through PICTIVA00000171, twelve pages	177
Exhibit 6	[redacted] Bates Stamp Numbers SDC_00072475 through SDC_00072537, sixty-three pages	177
Exhibit 8	Excel spreadsheet, LUMO_HOMO	177
Exhibit 9	Expert report of Ioannis Kymissis, Ph.D., regarding the validity of U.S. Patent Numbers 8,558,223 and 8,723,164, five hundred fifty-six pages	178

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EXHIBIT NO.	DESCRIPTION	PAGE
Exhibit 10	Expert report of Ioannis Kymissis, Ph.D., regarding the noninfringement of U.S. Patent Numbers 8,558,223 and 8,723,164, four hundred eighteen pages	178
Exhibit 15	Curriculum vitae of Kirk S. Schanze, Bates Stamp Numbers PICTIVA00041241 through PICTIVA00041487, two hundred forty-seven pages	178
Exhibit 17	E-mail, To: Michael Kim, From: EBay - cmoredeals4u, dated December 20, 2024, Re: Order #235648 from iRiver America shipped on October 3, 2007, Bates Stamp Numbers PICTSAMSUNGEDTX487530 through PICKSAMSUNGEDTX487532, three pages	178

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QUESTIONS INSTRUCTED NOT TO ANSWER:

Page 115 Line 25
Page 142 Line 19
Page 163 Line 20

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San Francisco, California

Saturday, June 14, 2025; 8:05 a.m.

THE VIDEOGRAPHER: Good morning.

We are going on the record on June 14, 2025, at 8:05 a.m. 08:05:50 08:05:56

Please note that this deposition is being conducted virtually. 08:05:58

Quality of recording depends on the quality of camera and Internet connection of participants.

What is seen from the witness and heard on screen is what will be recorded.

Audio and video recording will continue to take place unless all parties agree to go off the record. 08:06:12

This is media unit one of the video-recorded deposition of Dr. Ioannis Kymissis, taken by counsel for the plaintiffs in the matter of Pictiva Displays International, et al., versus Samsung Electronics Company, et al., filed in the United States District Court, for the Eastern District of Texas, Marshall Division, Case Number 2:24-cv-00532-JRG. 08:06:12 08:06:23 08:06:27 08:06:27 08:06:36 08:06:36 08:06:42

My name is Kim Smith, representing Veritext Legal Solutions, and I am the videographer. 08:06:46 08:06:50

I am not related to any party in this 08:06:53

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action, nor am I financially interested in the outcome. 08:06:55 08:06:58

If there are any objections to proceeding, please state them at the time of your appearance. 08:06:58 08:07:01

Counsel will now state their appearances and affiliations for the record, beginning with the noticing attorney, and then the court reporter will introduce herself and the witness will be sworn. 08:07:03 08:07:06 08:07:09 08:07:12

MR. SHEASBY: Jason Sheasby, for plaintiffs. 08:07:15

MR. SNYDER: Gavin Snyder, with Quinn Emanuel, on behalf of the defendants. 08:07:17 08:07:19

And then also with me is Melissa Baily, from Quinn Emanuel. 08:07:21 08:07:25

THE REPORTER: My name is Suzanne Hull. I am a certified shorthand reporter representing Veritext Legal Services. My CSR number is 13495. 08:07:25 08:07:25 08:07:37

Raise your right hand, please, Dr. Kymissis. 08:07:37

Do you solemnly swear or affirm that the testimony you shall give shall be the truth, the whole truth, and nothing but the truth. 08:07:43 08:07:43 08:07:45

THE WITNESS: I do. 08:07:47

IOANNIS KYMISSIS, Ph.D.,

called as an expert witness by counsel for Plaintiffs, being first duly sworn, testified as

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follows:

THE REPORTER: Thank you.

Mr. Sheasby.

EXAMINATION

BY MR. SHEASBY:

Q. Good morning, sir.

Can you state your full name for the record.

A. Good morning.

My name is Ioannis Kymissis.

Q. You have been retained by Samsung in this matter; is that correct?

A. That is correct.

Q. As an expert; is that correct?

A. That is correct.

Q. You have a preexisting relationship with Samsung; is that correct?

A. That is correct.

Q. You consult for Samsung; is that correct?

A. I have not had any consulting relationship with Samsung, but Samsung has sponsored research within my group through the university.

Q. How much -- since when has Samsung sponsored your work?

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A. So I have had two projects with Samsung, and one of those projects was about five years ago, and another project started about a year ago. 08:08:34 08:08:38 08:08:43

Q. And you -- so you have an ongoing project with them? 08:08:45 08:08:50

A. There is a current project in my group which is with Samsung Electronics, yes. 08:08:51 08:08:54

Q. What was the value of the project that was five years ago? 08:08:56 08:08:58

A. That project was [redacted]. 08:08:59 08:09:05

Q. And the project that is ongoing right now? 08:09:07

A. That project is [redacted] 08:09:10 08:09:14

Q. For how -- and how long will that continue? 08:09:15

A. That project is -- [redacted]. 08:09:18 08:09:22

Q. And what is the total amount of grant funding your laboratory receives? 08:09:26 08:09:29

A. So at my time at Columbia I have raised about [redacted], and so those projects represent about [redacted] of the funding in my group. 08:09:31 08:09:34 08:09:38

Q. Not the question I asked. 08:09:41

On a yearly basis, what is the funding at your -- in your laboratory? 08:09:42 08:09:46

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MR. SNYDER: Objection to form. 08:09:47
THE WITNESS: Yeah. 08:09:48
So I have seven Ph.D. students and one post doc right now; so, roughly speaking, you know, my group is somewhere around [redacted] of funding and expenditure. 08:09:48 08:09:53 08:09:57 08:10:02
BY MR. SHEASBY: 08:10:04
Q. Great. 08:10:05
Does Samsung contribute other funds to the school that you are a part of? I know that you are -- you -- you have a -- a deanship that relates in the engineering school. 08:10:05 08:10:12 08:10:14 08:10:23
MR. SNYDER: Objection to form. 08:10:24
THE WITNESS: I am not aware of any other -- I'm sorry. 08:10:25 08:10:27
Are you -- are you asking about research contributions or any unrestricted contributions or -- 08:10:28 08:10:30
BY MR. SHEASBY: 08:10:34
Q. Anything. Any money, any sort of income benefit provided to your laboratory by Samsung or to your school by Samsung? 08:10:34 08:10:39 08:10:43
MR. SNYDER: Objection to form. 08:10:44
THE WITNESS: Yeah. 08:10:45
So I am not sure I have a lot of visibility into the other research groups in my school or at the 08:10:45 08:10:48

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university. Samsung supports research across all areas, and so there are certainly other faculty that have research projects with Samsung; so I'm not sure that I can answer that with specificity. But I'm not aware of any other either in kind or financial support that Samsung provides to the school separate from -- from research funding. 08:10:52 08:10:58 08:11:02 08:11:05 08:11:07 08:11:11 08:11:14

BY MR. SHEASBY: 08:11:16

Q. To the faculty? 08:11:16

A. To the -- I'm sorry. 08:11:18

Can you be clearer about that question? 08:11:21

Q. Research funding to the faculty. 08:11:23

A. Again, research funding flows first to the school, and then it is expended by the school; so that is not funding that comes directly to the faculty, if that makes sense. 08:11:26 08:11:28 08:11:32 08:11:35

Q. It does make sense. 08:11:37

In addition to -- do you have any business relationship with Samsung? 08:11:38 08:11:41

A. No. 08:11:42

I do not. 08:11:43

Q. Do you work for a company that was acquired by Samsung? 08:11:44 08:11:46

A. So I was the first employee at a company called QD Vision, and I worked there as a full-time 08:11:47 08:11:51

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employee for one year and then as a consultant for a few years. And about twelve years after I left, that company was acquired by Samsung Electronics. 08:11:55 08:11:59 08:12:02

Q. And did you have any stock interest or obtain any economic advantage from that? 08:12:04 08:12:09

A. No. 08:12:11

I did not. My -- I had [redacted] 08:12:12

[redacted] 08:12:16

[redacted] 08:12:20

[redacted] 08:12:23

[redacted] 08:12:28

[redacted] 08:12:32

[redacted] 08:12:36

Q. That acquisition, was the company a commercial success? 08:12:38 08:12:43

A. That's a difficult question to answer. I'm sorry. If you could be more specific, I can try to answer it. 08:12:46 08:12:51 08:12:54

Q. Sure. 08:12:54

Was this company that Samsung acquired able to launch a commercial product? 08:12:54 08:12:57

MR. SNYDER: Objection to form. 08:13:00

THE WITNESS: The company did have several commercial products. They were able to release the first QD-enabled television in a collaboration with 08:13:00 08:13:03 08:13:08

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Sony. There were also other products that were introduced by the company, and -- and the company's technology is the basis for what Samsung today and other companies as well call QD LED. 08:13:12 08:13:16 08:13:19 08:13:22

And so with respect to whether a commercial product was launched, yes. QD Vision did launch several commercial products both in the television space, and there were also several products in the lighting space. There was a high CRI -- light color-rendering index -- lamp that QD Vision developed, and that was also commercially sold. 08:13:26 08:13:31 08:13:34 08:13:37 08:13:39 08:13:42 08:13:48

BY MR. SHEASBY: 08:13:50

Q. And what was the acquisition price for QD Vision? 08:13:50 08:13:52

MR. SNYDER: Objection to form. 08:13:54

THE WITNESS: So my understanding is that the acquisition was for about $70 million. 08:13:54 08:13:58

BY MR. SHEASBY: 08:14:02

Q. And you said that this technology from QD Vision is the foundation for the quantum dot technology that is used by Samsung; is that correct? 08:14:06 08:14:11 08:14:15

MR. SNYDER: Object to the form. 08:14:18

THE WITNESS: So there are a number of quantum dot technologies that Samsung is pursuing; so I would not characterize my statement that way. I'm 08:14:19 08:14:23 08:14:28

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sorry. 08:14:32

If you could ask the question again, I could try to answer more precisely. 08:14:32 08:14:35

BY MR. SHEASBY: 08:14:37

Q. Sure. 08:14:37

Are you the named inventor on any QD Vision patents? 08:14:38 08:14:42

A. Yes. 08:14:42

I am the named inventor on several patents that were issued to QD Vision. 08:14:42 08:14:46

Q. Have you done an element-by-element analysis to determine if Samsung's accused products in this case use any of those patents? 08:14:48 08:14:49 08:14:50

A. So I have not offered any opinion on whether any of my patents were involved in any of the accused products. 08:14:54 08:14:59 08:15:02

Q. Sure. 08:15:03

Have you identified -- have you done an element-by-element analysis to identify any third-party patent or Samsung patent that is used by any of the accused products? 08:15:03 08:15:06 08:15:09 08:15:13

A. So I have not offered an opinion on any patents, other than the patents that are at issue in this case. 08:15:14 08:15:18 08:15:20

Q. Okay. How many hours have you spent on this 08:15:20

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project? 08:15:25

A. So if we count the background research 08:15:25
collection of references, writing the report, editing 08:15:32
the report, reviewing the report, and other 08:15:36
preparation, it is several hundred hours. 08:15:39

Q. You wrote the report yourself? 08:15:41

A. So the report contains my opinions. 08:15:44

Q. Did you write the report yourself? 08:15:47

A. So I generally don't do the typing for my 08:15:49
writing. You know, I produce about twenty papers 08:15:54
a year, for example, in my research; so I provided my 08:15:58
opinions and the structure that I recommended, but 08:16:02
I asked for assistance in the typing from the legal 08:16:06
team. 08:16:09

I, however, then also -- some of those were 08:16:10
delivered in writing, some in discussion, and then 08:16:14
I also reviewed and approved and edited the final 08:16:16
report document. But the actual typing I asked for 08:16:22
assistance with. 08:16:25

Q. What portion of the report did you actually 08:16:26
write yourself? 08:16:28

A. I can't say. I was involved in all of the 08:16:28
parts of the report, but it is difficult for me to 08:16:32
come up with specific sections or numbering. 08:16:35

Q. Did you write more than 5 percent of the 08:16:37

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report yourself? 08:16:39

A. Again, I can't say specifically exactly what 08:16:40
percentage. 08:16:44

Q. How about more than 3 percent? 08:16:44

A. Again, I can't offer an opinion on the exact 08:16:47
percentage. 08:16:50

Q. Okay. So I have added a number of 08:16:50
documents. 08:16:55

By the way, do you have your reports in 08:16:55
front of you? 08:16:59

A. I have a paper copy, but it would be very 08:17:00
helpful if you could introduce the electronic reports 08:17:03
into the exhibits so I can do searches, which may 08:17:06
speed up some of our discussion. 08:17:08

Q. I am happy to do that. 08:17:09

Have you ever designed a commercial OLED? 08:18:26

A. So I was involved in designing a number of 08:18:49
organic light-emitting diodes while I was at 08:18:55
QD Vision, but I -- none of those went into 08:19:01
commercial production without further modifications. 08:19:04

Q. And since you have left -- so the answer 08:19:06
is -- have you ever designed a commercial OLED? 08:19:09

A. So I have not designed any unmodified 08:19:13
commercial organic light-emitting diodes. 08:19:17

Q. And since you have been a faculty member, 08:19:20

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have you published any papers -- peer-reviewed papers on OLED design? 08:19:23 08:19:29

A. So I -- give me a second to think about it. I have published about 150 peer-reviewed papers, and so I -- I can't say whether I published any specifically out of OLED design. I have published a number on organic light-emitting diodes and particularly a number of transport and charge injection issues, but some of that is in the context of organic affordable tank devices, which have some similar and some different issues; so I'm not sure exactly how to answer that question. 08:19:31 08:19:37 08:19:42 08:19:50 08:19:53 08:19:58 08:20:01 08:20:05 08:20:10 08:20:14

Q. All right. I will -- let me try to be crisp. 08:20:15 08:20:19

Have you published any paper on an OLED design? 08:20:19 08:20:23

MR. SNYDER: Object to the form. 08:20:23

THE WITNESS: So I have not published any papers exclusively on the design of organic light-emitting diodes. 08:20:24 08:20:29 08:20:33

BY MR. SHEASBY: 08:20:34

Q. Okay. Why don't we -- I have now uploaded Exhibit 1 through 9 to the Exhibit Share. Just for the sake of good order and efficiency, why don't you go ahead and download all of those. 08:20:34 08:20:37 08:20:40 08:20:43

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A. Okay. Great. 08:20:46
Q. One through ten, actually. 08:20:47
A. All right. I see ten now. It is 08:20:49
alphabetically. 08:20:52
Okay. I think I have them all downloaded. 08:20:54
Q. Great. 08:21:32
Let's turn to Exhibit -- Exhibit 1. 08:21:39
(Deposition Exhibit Number 1 08:21:39
was marked for identification.) 08:21:39
THE WITNESS: (Witness complies.) 08:22:00
BY MR. SHEASBY: 08:22:00
Q. Let's go ahead and open that up. 08:22:00
A. Okay. I'm at Exhibit 1 now. 08:22:11
Q. I'll put it on the screen, actually, and 08:22:13
we'll do this -- I will make a PowerPoint so we can 08:22:28
annotate it. 08:22:38
Great. 08:23:02
So I have marked a page from Exhibit A1, 08:23:02
just so we can work with it on the screen, but you 08:23:07
have the full .pdf of it. 08:23:09
Do you recognize this document? 08:23:12
A. Yes. 08:23:13
I recognize at least the figures in the 08:23:13
document. 08:23:15
Q. Uh-huh. 08:23:16

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A. There were a lot of documents. I don't remember the structure exactly. 08:23:17 08:23:19

Q. And did you analyze this document before preparing your opinion? 08:23:22 08:23:25

A. I do remember seeing this document and so, yes. I offered some analysis based on the device stacks and this figure as well. 08:23:26 08:23:29 08:23:33

Q. And you see the reference to G EML and G prime? 08:23:35 08:23:45

A. Yes, I do. 08:23:47

Q. And the reference between R EML and R prime? 08:23:49

A. Yes, I do. 08:23:55

Q. What are those layers? 08:23:56

A. So the -- the G EML is the emissive layer or the green subpixel; so that is the region in which the holes are injected on one side, the electrodes are injected on the other. Those carriers then form an exciton, which gets transferred to the green lumiphore, and then that is the region that generates the light which is emitted. 08:23:58 08:24:05 08:24:09 08:24:13 08:24:17 08:24:22 08:24:24

Q. And do you see the Korean characters in red that are on the surface of the R EML, B EML, and G EML layer? 08:24:26 08:24:30 08:24:36

A. I do, but sorry. If I can just complete my explanation before of what the prime layer is. 08:24:37 08:24:42

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Oh, sorry. You had asked what the EML and the prime layers are. 08:24:45 08:24:48

Q. Okay. Well, we'll get back to that. 08:24:50

Do you see the -- what box? 08:24:53

A. I do, yes. 08:24:59

Q. That is a Korean character; correct? 08:25:01

A. That is. 08:25:03

Q. Have you had that Korean character translated for you? 08:25:03 08:25:06

MR. SNYDER: Objection to form. 08:25:07

THE WITNESS: Yes, I have. 08:25:10

BY MR. SHEASBY: 08:25:11

Q. Who translated it for you? 08:25:13

A. I believe this came up in a discussion with Mr. Jo, in an interview with him. 08:25:15 08:25:21

Q. All right. Does Mr. Jo speak English? 08:25:24

A. That conversation was through a translator. 08:25:27

Q. The -- if you go to Exhibit 3, which is the Seo transcript. 08:25:32 08:25:46

(Deposition Exhibit Number 3 was marked for identification.) 08:25:46 08:25:51

THE WITNESS: Sorry. I think Exhibit 3 -- oh, sorry. 08:25:53 08:25:56

MR. SHEASBY: It is -- the Seo transcript will be Exhibit 2. 08:25:56 08:25:59

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(Deposition Exhibit Number 2 was marked for identification.) 08:25:59 08:26:11

THE WITNESS: Okay. I have it open now. 08:26:11

BY MR. SHEASBY: 08:26:13

Q. And if you turn to 163-20 to 164-3. 08:26:15

A. (Witness complies.) 08:26:28

Okay. I see that section. 08:26:44

Q. And if we actually turn to 162-20 to 160- -- 162-22 to 163-1, you'll see that Mr. Seo, Samsung's corporate representative, testified that those three Korean characters transmit as light-emitting surface; correct? 08:26:46 08:26:59 08:27:11 08:27:14 08:27:16

MR. SNYDER: Objection to form. 08:27:17

THE WITNESS: I see that statement in the transcript. 08:27:20 08:27:22

BY MR. SHEASBY: 08:27:22

Q. And did you speak to Mr. Seo in preparing your opinions? 08:27:22 08:27:26

A. I actually can't remember if I interviewed Mr. Seo. I spoke with a number of Samsung employees, and I believe I did. Give me one second to just check because I made a list in my report. 08:27:26 08:27:35 08:27:39 08:27:43

I believe that I did. 08:28:08

Q. Did you access any experimental data that contradicts that [redacted] 08:28:11 08:28:27

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[redacted] 08:28:30

MR. SNYDER: Objection to form. 08:28:34

THE WITNESS: So sorry. I'm not exactly 08:28:38
sure what you are asking. 08:28:41

BY MR. SHEASBY: 08:28:43

Q. Well, if you are not sure what I am asking, 08:28:44
you should just say I am not sure what you are 08:28:46
asking, and I will reask the question. 08:28:49

A. Yeah. 08:28:50

I am not sure what you are asking. 08:28:51

Q. Okay. Did you look at any Samsung 08:28:52
experimental data that contradicts the statements on 08:28:54
this page of the document that [redacted] 08:29:08

MR. SNYDER: Objection to form. 08:29:08

THE WITNESS: So there are a number of 08:29:08
reasons -- and I discuss some of these in my 08:29:12
report -- [redacted] 08:29:37

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[redacted] 08:29:39

MR. SHEASBY: Objection to form. 08:29:41

BY MR. SHEASBY: 08:29:43

Q. I am asking you, did you see any 08:29:44

experimental data that contradicts [redacted] 08:29:51

MR. SNYDER: Objection to form. 08:29:54

THE WITNESS: So, again, the -- whether we 08:29:55

describe this as an experiment or not, you see the 08:29:58

spectrum of the light that is emitted from the 08:30:01

organic light-emitting diodes, and the spectrum of 08:30:05

that light is consistent with the emission of the 08:30:08

light only occurring within the emissive layer. 08:30:10

MR. SHEASBY: Objection to form. 08:30:16

BY MR. SHEASBY: 08:30:16

Q. I'm asking you can you identify any 08:30:17

experimental data generated at Samsung that [redacted] 08:30:25

MR. SNYDER: Objection to form. 08:30:27

THE WITNESS: So, again, the -- 08:30:28

BY MR. SHEASBY: 08:30:29

Q. Give me the name of the document. Give me 08:30:32

its Bates number. That is what I'm looking for. 08:30:33

MR. SNYDER: Objection to form. 08:30:36

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THE WITNESS: If you give me a minute, we can look at the spectrum as an example of the emitted light from the organic light-emitting diode. I'll see if, for example, this exhibit has that spectrum. Just give me one moment. 08:30:37 08:30:42 08:30:44 08:30:47 08:30:52

So if we look, for example, on the page after this one in the document, you know, it has a spectrum of the -- of one of the emitted -- one -- one of the organic light-emitting diodes. 08:31:52 08:31:55 08:31:57 08:32:06

And, again, one of the pieces of evidence [redacted]. Now, in an organic light-emitting diode, the exciton, when it recombines, emits light corresponding to the energy of that HOMO-LUMO gap. And so if light was being emitted from the prime layers, we would see light escaping from the OLED with a shorter wavelength than the wavelength of the lumiphore, which is present in the EML. 08:32:10 08:32:24 08:32:27 08:32:32 08:32:35 08:32:39 08:32:42 08:32:48 08:32:51

And so although it is not an explicit experiment in which we attempt to create some different structure, [redacted] 08:32:52 08:32:57 08:33:03

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[redacted] 08:33:14

MR. SHEASBY: Objection. Form. 08:33:18

BY MR. SHEASBY: 08:33:19

Q. I'm actually asking you if there has been any -- would -- have you run any experiments that 08:33:19 08:33:22

contradict the assertion that [redacted] 08:33:29

MR. SNYDER: Objection to form. 08:33:33

THE WITNESS: So, again, [redacted] 08:33:40

MR. SHEASBY: Objection. 08:33:44

THE WITNESS: -- which is the emissive layer. 08:33:45 08:33:46

MR. SHEASBY: Objection to form. 08:33:47

BY MR. SHEASBY: 08:33:48

Q. I asked you if you have run any experiments to determine [redacted] 08:33:48 08:33:59

MR. SNYDER: Objection to form. 08:34:00

THE WITNESS: So, again, in every OLED the wavelength of light being emitted is measured. And that next page, actually in this very document, shows 08:34:02 08:34:07 08:34:10

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the spectrum, for example, of one of the red OLEDs. 08:34:13

[redacted] 08:34:31

MR. SHEASBY: So objection. Form. 08:34:39

BY MR. SHEASBY: 08:34:40

Q. I asked you if you had run any experiments. 08:34:40

Did you or did you not? It is a yes-or-no 08:34:44

question. 08:34:47

MR. SNYDER: Objection to form. 08:34:47

THE WITNESS: I'm sorry. 08:34:50

Is your question whether I personally 08:34:51

conducted any experiments -- 08:34:53

BY MR. SHEASBY: 08:34:55

Q. That's correct. 08:34:56

A. -- or that I was viewing data? 08:34:56

Q. That's correct. 08:34:58

I asked you if you had run any experiments. 08:34:59

MR. SNYDER: Objection to form. 08:35:02

THE WITNESS: So to answer your question, 08:35:03

I am reviewing the data, which is provided by 08:35:05

Samsung, and I did not personally make any of the 08:35:08

devices or measure the graphs which are there; 08:35:12

however, your exhibit -- again, on the very next 08:35:16

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page, if you would like to look at the spectrum, we can walk through its shape -- 08:35:19 08:35:22

MR. SHEASBY: Objection. Form. 08:35:24

THE WITNESS: -- and provide the evidence that I am using to answer your question. 08:35:26 08:35:27

MR. SHEASBY: Objection. Form. 08:35:29

BY MR. SHEASBY: 08:35:30

Q. I asked you if you had run any experiments, and the answer is either a yes or a no. 08:35:30 08:35:33

A. I don't -- 08:35:36

MR. SNYDER: Objection to form. 08:35:36

THE WITNESS: I did not personally make any of the devices which are described in that document. 08:35:37 08:35:39

BY MR. SHEASBY: 08:35:39

Q. Did you perform any simulations for any of the devices that are at issue in this case? 08:35:43 08:35:47

MR. SNYDER: Objection to form. 08:35:50

THE WITNESS: I did not personally simulate any of the devices that are at issue in this case. 08:35:51 08:35:54

BY MR. SHEASBY: 08:36:09

Q. Okay. Now -- so what is the -- so if we turn to the second page of the document we were looking at, which is Exhibit 1, you are referring to the bottom left-hand graph; is that correct? 08:36:09 08:36:38 08:36:41 08:36:45

A. I'm sorry. 08:36:52

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Just so that we are clear, are you speaking about the page after this page or the second page of the document in its totality? 08:36:54 08:36:57 08:37:00

Q. The page after this page, which is SDC_00 -- 00007-1267. 08:37:02 08:37:08

A. That is correct. 08:37:13

So that would be then, just to be clear, that -- this page. 08:37:14 08:37:18

Q. And you believe that that bottom left-hand graph corresponds to the devices on the previous page? 08:37:19 08:37:23 08:37:27

A. [redacted] 08:37:36

Q. And you believe this corresponds to the red pixel that was from the previous page? 08:37:37 08:37:42

A. Yes. 08:37:46

That is -- that is my understanding. 08:37:47

Q. And did you get the document translated to have confidence in that? 08:37:49 08:37:52

A. The -- I did not have a certified translation of the document. 08:37:54 08:38:00

Q. Okay. Let me ask you this. 08:38:02

Does this generally reflect the design of the blue -- if we turn to this page of Exhibit 1, 08:38:04 08:38:07

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does this generally reflect the design of the blue, green, and red pixels that are used in the accused devices? 08:38:10 08:38:13 08:38:17

MR. SNYDER: Objection to form. 08:38:18

THE WITNESS: This is the general design of the organic light-emitting diodes that are used by Samsung. 08:38:18 08:38:21 08:38:25

BY MR. SHEASBY: 08:38:26

Q. Okay. Let me ask you the next question, which is now if we go down, this is a shift from red to -- red to green in the -- what you think is the red pixel; is that correct? 08:38:26 08:38:28 08:38:33 08:38:40

A. So the red pixel is involved in that change that this is showing a difference in the spectrum as a function of the viewing angle. 08:38:42 08:38:47 08:38:50

Q. Okay. And now I want to dig into your -- you had some logic, and now that we have gotten it cleaned up, the red EML -- what is the wavelength of the red EML? 08:38:52 08:38:56 08:38:59 08:39:03

A. I'll have to check. If you just give me a second, there is additional documentation of the red peak wavelength. Sorry. I would have to check on that to give you an exact answer. 08:39:05 08:39:11 08:39:14 08:40:24

Q. Okay. Well -- 08:40:26

A. Is that -- yeah. 08:40:28

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Q. So.... 08:40:29
A. There is possible weights of pixel, so.... 08:40:30
Q. I'm sorry. 08:40:34
Go ahead. Say that again. 08:40:34
A. No. 08:40:35
I'm sorry. Go ahead. 08:40:35
Q. Okay. So you -- what is your logical basis 08:40:36
for why the interface between EML and HTL is not 08:40:40
a light-emitting surface? 08:40:45
MR. SNYDER: Objection to form. 08:40:50
THE WITNESS: So if we look specifically at 08:40:51
a red pixel on -- or a green pixel, again, the 08:40:53
exciton is confined within the emissive layer. And 08:40:58
the light that we see from those subpixels is only 08:41:02
the light which is from the -- the lumiphores, which 08:41:05
are within the emissive layer. 08:41:10
BY MR. SHEASBY: 08:41:11
Q. Yes. 08:41:11
I understand you said that. 08:41:12
What is the experimental evidence that shows 08:41:13
that? 08:41:15
MR. SNYDER: Objection to form. 08:41:17
THE WITNESS: I didn't conduct any 08:41:19
experiments in order to determine that personally. 08:41:21
And, you know, we would need to review, again, the -- 08:41:24

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the color quality and the wavelength of light coming out. That is only one of several pieces of evidence, however. 08:41:28 08:41:33 08:41:36

BY MR. SHEASBY: 08:41:36

Q. Okay. So let's dig into that one. 08:41:36

So what is the -- what is the experimental data that you can point to right now that supports the assertion you just made? 08:41:39 08:41:41 08:41:44

MR. SNYDER: I would just like to remind the witness, you can finish your answer. 08:41:46 08:41:49

THE WITNESS: Great. 08:41:51

There is other evidence as well in addition to experimental data. And, again, right now, at this moment, I don't have it in this exhibit. This document also contains other information. But if we have a little bit of time, I can look at other more detailed documents examining that since you were asking for a specific -- for a specific reference. 08:41:52 08:41:54 08:41:58 08:42:01 08:42:06 08:42:09 08:42:12

But in addition to the -- the spectrum of the light that is emitted from the single-color pixels, additional information that we can use is a simulation, which, again, I did not personally conduct but has been conducted by many others. 08:42:19 08:42:24 08:42:28 08:42:30 08:42:35

And it is also something that is well known from the -- a person of ordinary skill in the art, 08:42:39 08:42:42

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specifically because the prime layers have a wider HOMO-LUMO gap and, as a consequence, again, if there was recombination happening in the prime layers, we would then see that in the spectrum of each of the individual pixels. 08:42:47 08:42:51 08:42:56 08:42:58 08:43:00

Now, this -- sorry. Go ahead. 08:43:01

BY MR. SHEASBY: 08:43:02

Q. Okay. So now let's dig in. 08:43:02

So the first reason you gave is because of the spectrum of light that is being emitted by the pixel; is that correct? 08:43:05 08:43:07 08:43:10

A. That is correct. 08:43:11

Q. Okay. 08:43:12

A. And the -- 08:43:13

Q. Let's just do it in pieces. I will give you an opportunity to speak about all three. 08:43:14 08:43:17

In your report, do you cite any -- any experimental data that indicates that the spectrum of light does not include the interface layer between the HTML and -- HTL and R EML layer? 08:43:20 08:43:22 08:43:26 08:43:28

MR. SNYDER: Objection to form. 08:43:35

THE WITNESS: So in my report I did not do any specific experimental analysis of the emission from the -- the prime layer. And, again, I see no evidence in any of the documentation that that 08:43:37 08:43:44 08:43:50 08:43:54

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emission exists. 08:43:55

BY MR. SHEASBY: 08:43:56

Q. So I just asked you -- 08:43:57

MR. SHEASBY: Objection. Form. 08:44:00

BY MR. SHEASBY: 08:44:01

Q. -- in your report do you identify any 08:44:02

experimental evidence that [redacted] 08:44:18

MR. SNYDER: Objection to form. 08:44:20

THE WITNESS: [redacted] and 08:44:35

so I did not see any need to personally conduct any 08:44:38

experiments in order to support that -- that -- that 08:44:41

conclusion. 08:44:45

MR. SHEASBY: Objection. Form. 08:44:47

BY MR. SHEASBY: 08:44:47

Q. I asked you in your report do you cite any 08:44:48

evidence that [redacted] 08:44:57

MR. SNYDER: Objection to form. 08:44:59

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THE WITNESS: [redacted]

[redacted], and I did not cite any specific experimental evidence examining that, given the -- again, the -- the reasons that I -- I had described earlier.

MR. SHEASBY: Objection. Form.

BY MR. SHEASBY:

Q. I asked you whether you cite any evidence about [redacted]

MR. SNYDER: Objection to form.

THE WITNESS: [redacted]

MR. SHEASBY: So objection. Form.

BY MR. SHEASBY:

Q. This document, you agree, is [redacted]

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[redacted] 08:46:12

A. I see that notation in this document, but 08:46:16

I disagree that this is a light-emitting surface, and 08:46:19

that light-emitting surface -- 08:46:22

MR. SHEASBY: Objection. 08:46:22

BY MR. SHEASBY: 08:46:23

Q. Go ahead. 08:46:24

A. [redacted]

[redacted] 08:46:36

MR. SHEASBY: Objection. Form. 08:46:38

BY MR. SHEASBY: 08:46:39

Q. We have this document that [redacted]

[redacted] correct? You see 08:46:45

this document? 08:46:50

A. I see this document, yes. 08:46:50

Q. Okay. In your report, do you cite any 08:46:51

experimental evidence to the contrary? 08:46:57

MR. SNYDER: Objection to form. 08:47:00

THE WITNESS: So, again, I disagree that 08:47:01

that surface is a light-emitting surface. [redacted]

[redacted] 08:47:12

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[redacted] 08:47:20

MR. SHEASBY: Objection. Form. 08:47:20

BY MR. SHEASBY: 08:47:21

Q. In your report do you cite any experimental 08:47:21

evidence contradicting this statement on this 08:47:24

document [redacted] 08:47:30

MR. SNYDER: Objection to form. 08:47:33

THE WITNESS: [redacted] 08:47:41

BY MR. SHEASBY: 08:47:43

Q. Right. 08:47:43

MR. SHEASBY: Let's take a break. I'm going 08:47:44

to suspend this, I think, and we're going to -- I'm 08:47:47

going to call the court on Monday morning. 08:47:49

THE VIDEOGRAPHER: Do we have an agreement 08:47:51

to go off the record? 08:47:53

MR. SHEASBY: We can go off. 08:47:55

MR. SNYDER: Yes. 08:47:55

We can go off the record. 08:47:55

THE VIDEOGRAPHER: This marks the end of 08:47:57

media number one. 08:47:59

The time is 8:47 a.m. 08:48:00

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And we are off the record. 08:48:02

(Short recess taken.) 09:07:37

THE VIDEOGRAPHER: This marks the beginning of media unit number two. 09:07:37 09:07:38

The nine is -- time is the 9:07 a.m. 09:07:40

We are on the record. 09:07:42

BY MR. SHEASBY: 09:07:45

Q. What is the wavelength that is emitted at the interface between EML and HTL? 09:07:45 09:07:51

MR. SNYDER: Objection to form. 09:07:56

THE WITNESS: [redacted] 09:08:19

BY MR. SHEASBY: 09:08:21

Q. And what is the experimental evidence that you have cited in your report that supports that assertion? 09:08:21 09:08:23 09:08:26

A. So I do discuss this question of the interface in my report. If you go to my rebuttal report, Paragraph 246, I have some discussion of that. 09:08:29 09:08:31 09:08:37 09:08:42

MR. SHEASBY: Objection. Form. 09:08:54

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BY MR. SHEASBY: 09:08:55

Q. What is the experimental evidence you cite 09:08:56

to support the assertion you just made? 09:08:58

MR. SNYDER: Objection to form. 09:09:01

THE WITNESS: So there -- there are a few -- 09:09:02

again, there are a few reasons that I cite. You 09:09:07

know, the first is, you know, that particular 09:09:13

document that was an interview with -- with a Samsung 09:09:19

engineer [redacted] And so that -- she agrees with me 09:09:29

there. 09:09:33

And, also, you know, Mr. Humphrey, 09:09:34

I understand, in his -- in his declarations, has 09:09:38

stated -- but, again, without any evidence on his 09:09:43

side or any scientific explanation -- how that light 09:09:47

could be -- could be generated. Now -- 09:09:51

MR. SHEASBY: Objection to form. 09:09:53

THE WITNESS: Okay. 09:09:55

BY MR. SHEASBY: 09:09:55

Q. Do you cite any experimental evidence for 09:09:56

your assertion that what is stated on this Samsung 09:09:58

document is incorrect? [redacted]?

09:10:23

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MR. SNYDER: Objection to form. 09:10:24

THE WITNESS: So yeah. 09:10:25

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted] :49

BY MR. SHEASBY: 09:10:50

Q. What is the wavelength of those lumiphores? 09:10:51

A. I don't have it at my fingertips. 09:10:54

I would -- I would need to -- to look more closely at 09:10:57

those documents. It will -- 09:11:01

Q. [redacted] [redacted]

[redacted] [redacted] :07

A. [redacted] [redacted]

[redacted] 09:11:13

Q. And do you cite in your experimental 09:11:15

evidence that [redacted] [redacted]

[redacted] 09:11:23

MR. SNYDER: Objection to form. 09:11:27

THE WITNESS: [redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted] :40

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[redacted] 09:11:45

MR. SHEASBY: Objection. Form. 09:11:45

BY MR. SHEASBY: 09:11:47

Q. I said do you cite any evidence? 09:11:47

MR. SNYDER: Objection to form. 09:11:49

THE WITNESS: I'm sorry. If you could be a little clearer. 09:11:50 09:11:52

The OLEDs themselves are structured with these discrete layers. If you are asking if the -- I'm sorry. 09:11:53 09:12:00 09:12:05

If you could ask that question again. 09:12:05

BY MR. SHEASBY: 09:12:07

Q. Yes. 09:12:08

[redacted], and there is -- 09:12:10 09:12:16

A. That is correct. 09:12:17

[redacted] 09:12:22

Q. And I'm saying do you cite any evidence that [redacted] 09:12:24 09:12:31

MR. SNYDER: Objection to form. 09:12:32

BY MR. SHEASBY: 09:12:33

Q. Any experimental evidence. 09:12:33

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A. Again, [redacted]

[redacted]and I have not done any experiments to examine that question specifically. 09:12:41 09:12:49

Q. Is there any simulations? 09:12:53

MR. SHEASBY: So objection to form. 09:12:55

BY MR. SHEASBY: 09:12:57

Q. Have you done any simulations to examine [redacted] 09:12:57 09:13:02

MR. SNYDER: Objection to form. 09:13:07

THE WITNESS: [redacted] 09:13:28

MR. SHEASBY: Objection. Form. 09:13:29

BY MR. SHEASBY: 09:13:30

Q. I asked you have you done any simulation to see [redacted] :40 09:13:31

MR. SNYDER: Objection to form. 09:13:42

THE WITNESS: So if your question is whether I, personally, have done any such simulation, I have 09:13:44 09:13:46

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not. 09:13:49
BY MR. SHEASBY: 09:13:50
Q. Okay. Now -- so this is page two of 09:13:50
Exhibit A1, which is an excerpt from Exhibit 1, and 09:16:21
there is Korean characters between the EML and the 09:16:26
HTL layer. 09:16:30
Do you see those Korean characters? 09:16:32
A. I see those Korean characters, yes. 09:16:35
Q. And I will mark them with a black box. 09:16:37
Those Korean characters translate as 09:16:48
light-emitting surface. 09:16:52
Were you aware of that fact? 09:16:52
MR. SNYDER: Objection to form. 09:16:54
THE WITNESS: Yes. 09:16:55
I am aware of that fact, and I discuss this 09:17:00
in my report. 09:17:02
BY MR. SHEASBY: 09:17:04
Q. Okay. Let me ask you the next question, 09:17:04
which is what is the HTL layer? 09:17:06
A. So the HTL layer in -- in organic 09:17:11
light-emitting diode is the whole transport layer. 09:17:21
It is one of the layers in which the holes which are 09:17:24
injected from the anode travel towards the emissive 09:17:27
layer, and then the electrons from the other side 09:17:31
travel in, and they meet at the emissive layer. 09:17:35

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Q. And so it is the point at which the holes in the electrons meet that the light transmission occurs -- light transmission occurs? 09:17:38 09:17:47 09:17:50

A. So it is a multistep process. The holes and the electrons both have to meet on an organic semiconductor and form an excited state. That excited state then diffuses some distance in order to find its lowest potential energy, which is generally structured to be on the light-emitting doping. And then when it combines, we get the HOMO-LUMO gap energy of that light emitter, and that is where the light is generated. 09:17:55 09:17:57 09:18:02 09:18:05 09:18:10 09:18:13 09:18:20 09:18:25 09:18:28

Q. And did you do any experimental studies as to whether photons and electrons meet at the interface between the EXR holes and electrons meet at the interface between the EML and HTL layer? 09:18:29 09:18:37 09:18:41 09:18:44

A. Sorry. 09:18:48

If your question is whether I, personally, went into the lab and did any experiments, I did not personally conduct any experiments. 09:18:49 09:18:51 09:18:56

Q. And did you do any simulations? 09:18:58

A. If you are asking if I, personally, did any simulations, I, personally, did not do any simulations. 09:19:02 09:19:05 09:19:08

Q. Okay. What is a functional layer? 09:19:09

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MR. SNYDER: Objection to form. 09:19:19

THE WITNESS: So a functional layer is something which is discussed in the patents, and I also discuss this in my reports. Give me a second, and I will just use the exact language that I used, which is from the specification from the patent. 09:19:20 09:19:24 09:19:26 09:19:30 09:19:34

So the -- the functional layer is the layer of the device which has a discrete and specific function. 09:19:54 09:19:59 09:20:03

BY MR. SHEASBY: 09:20:04

Q. Can a layer be made up of sublayers? 09:20:50

A. I don't offer an opinion on whether a layer could be made up of sublayers. Each layer is a layer, as understood to a person of ordinary skill in the art, and, again, that can deliver that -- that function. 09:20:53 09:20:59 09:21:03 09:21:08 09:21:12

Q. Yeah. 09:21:12

But my question is can a layer be made up of sublayers? 09:21:13 09:21:17

MR. SNYDER: Objection to form. 09:21:18

THE WITNESS: So -- and I haven't offered an opinion on whether a layer can consist of sublayers. 09:21:21 09:21:23

BY MR. SHEASBY: 09:21:27

Q. Is there anything in the patent that excludes a layer from consisting of sublayers? 09:21:27 09:21:30

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A. So if we look at the text of the patent, the -- the '164 patent, I'll -- I'll read the section which discusses this. And -- 09:21:33 09:21:42 09:21:47

Q. You don't need to read the section. You can just tell me the section you are referring to. 09:21:50 09:21:53

A. If we go to column three, line fifty-three. 09:21:55

THE REPORTER: What line, please? 09:22:04

THE WITNESS: Sorry. 09:22:06

It is line fifty-three in the '164 patent. 09:22:08

BY MR. SHEASBY: 09:22:23

Q. Yes. 09:22:23

Okay. So back to my question. 09:22:23

Can a functional layer be made up of sublayers? 09:22:26 09:22:30

MR. SNYDER: Objection to form. 09:22:31

THE WITNESS: So, again, each layer is a layer, and so I don't offer an opinion on whether it can be made from sublayers. But, again, each layer needs to be a layer which has a specific function. 09:22:34 09:22:37 09:22:45 09:22:48 09:22:51

BY MR. SHEASBY: 09:22:52

Q. And in layer means one or more layers in patentese; correct? 09:22:52 09:22:56

MR. SNYDER: Objection to form. 09:22:57

THE WITNESS: I'm not speaking as if I am 09:22:59

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writing a patent. I'm answering the question as it would be viewed by a person of ordinary skill in the art. 09:23:01 09:23:05 09:23:09

BY MR. SHEASBY: 09:23:09

Q. I understand that. 09:23:09

But do you understand that the patent says at least one organic functional layer? Do you see that? 09:23:10 09:23:13 09:23:17

A. I do. And right after that it lists several possible examples, for example, an emissive layer, an electronic transport layer, and so on. And so the fact that it says an organic functional layer and then enumerates those layers tells us that the layer envisioned in the specification of the patent is one of those layers, such as the emissive layer or one of the transport layer. 09:23:18 09:23:23 09:23:29 09:23:33 09:23:39 09:23:42 09:23:45 09:23:49

Q. And is it known in the art that an emissive layer can, itself, be made up of sublayers? 09:23:50 09:23:54

MR. SNYDER: Objection to form. 09:23:58

THE WITNESS: Again, the -- I don't offer an opinion on whether there are sublayers. The emissive layer is a layer of the device, and -- and it is the layer which offers that specific function of being emitted. 09:23:59 09:24:01 09:24:05 09:24:08 09:24:13

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BY MR. SHEASBY: 09:24:13

Q. I know. 09:24:15

I'm asking you in the art was it understood that an emissive layer to the -- can be made up of sublayers? 09:24:15 09:24:18 09:24:22

A. Yeah. 09:24:23

I'm sorry. I am not sure exactly how I can clarify my answer further. 09:24:25 09:24:28

Q. Sir, you purport to be a person of ordinary skill in the art at the time of the patent, at least. Persons of ordinary skill in the art understood that functional layers, like emission layers, could be made up of multiple layers. 09:24:31 09:24:35 09:24:35 09:24:37 09:24:39

MR. SNYDER: Objection to form. 09:24:41

THE WITNESS: So, again, I think we may be getting into somewhat of a semantic discussion. But the emissive functional layer is a layer, and if you have a specific context in which I can offer a more nuanced opinion, I would be happy to discuss that more. 09:24:42 09:24:46 09:24:49 09:24:55 09:25:01 09:25:05

BY MR. SHEASBY: 09:25:05

Q. Sure. 09:25:05

In the context of OLED, would it rec- -- was it recognized that emission -- emissive layers could be made up of multiple sublayers? 09:25:05 09:25:05 09:25:10

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MR. SNYDER: Objection to form. 09:25:14

THE WITNESS: So, again, the -- the emissive layer is a layer of the device, and there is, again, a compositional structure to it that helps it function. And that -- that structure makes it, itself, a layer. 09:25:15 09:25:19 09:25:23 09:25:27 09:25:33

Now -- yeah. I'll -- I'll leave my answer there. 09:25:35 09:25:39

BY MR. SHEASBY: 09:25:39

Q. Okay. And can that emission layer be laid down in multiple steps? 09:25:39 09:25:42

A. The emissive layer can be laid out in multiple steps where, for example, we can have the deposition of components that make the emissive layer, and where they are deposited, say, in sequence or, you know in -- in the evaporator, in many cases for structural balance reasons, the first part, and a second part may be made in different chambers even if they have the same composition; so there could be multiple steps. 09:25:46 09:25:49 09:25:52 09:25:58 09:26:06 09:26:11 09:26:15 09:26:16 09:26:20

Q. And can the emissive layer have different composition of different depths? 09:26:21 09:26:25

A. So there can be some differences in the composition in different parts of the emissive layer. 09:26:27 09:26:30

Q. Okay. I'm going to ask you the next 09:26:34

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question, which is a functional layer for light emission is a layer that emits light; is that correct? 09:26:36 09:26:41 09:26:44

MR. SNYDER: Objection to form. 09:26:44

You can finish your previous answer. 09:26:46

THE WITNESS: Well, I didn't get to finish my previous answer, but that's okay. I can answer the new question. 09:26:49 09:26:52 09:26:55

Oh, I'm sorry. Can you ask your question again? I lost my train of thought because I was thinking about the composition question. 09:26:57 09:26:59 09:27:02

BY MR. SHEASBY: 09:27:04

Q. Oh, sure. 09:27:04

So my question was -- well, let's actually have it -- I'll -- I'll withdraw it, and I'll reask it in a different way. That is probably the easiest way of doing it. 09:27:04 09:27:08 09:27:11 09:27:15

A. Okay. 09:27:16

MR. SHEASBY: And just for the good order, I'm going to go ahead and mark A1 and A2 as exhibits, just so we have them. 09:27:20 09:27:22 09:27:28

(Deposition Exhibit Number A1 was marked for identification.) 09:27:28 09:27:30

(Deposition Exhibit Number A2 was marked for identification.) 09:27:30 09:29:43

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BY MR. SHEASBY: 09:29:43

Q. Okay. I have just added the PowerPoints A1 and A2 to the exhibit list. 09:29:43 09:29:46

So a light-emitting functional layer is the material that emits light in the pixel. 09:29:50 09:30:05

A. So the light-emitting functional layer, the EML, the emissive layer, is the layer in the device that emits light in an organic light-emitting diode. 09:30:10 09:30:14 09:30:18

Q. Different question. 09:30:22

The -- the -- the -- the functional layer that performs light emission -- so if a functional -- so a light emission functional layer, it would be a layer that emits light; correct? 09:30:23 09:30:26 09:30:29 09:30:35

MR. SNYDER: Objection to form. 09:30:38

THE WITNESS: I would not use those words to describe that layer, and a person of ordinary skill in the art would not use those words to describe it that way. 09:30:40 09:30:43 09:30:45 09:30:47

BY MR. SHEASBY: 09:30:47

Q. Okay. What is the function of a light emission layer? 09:30:48 09:30:51

MR. SNYDER: Objection to form. 09:30:53

THE WITNESS: Again, I -- the -- the -- that expression, light emission layer, is not a phrase that would normally be used by a person of ordinary 09:30:53 09:30:56 09:30:59

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skill in the art; so, again, there -- I hesitate to offer an opinion. I really want to be precise in my description of where the light is generated and in the description of the layers using the standard terminology that is used in the organic light-emitting diode community. 09:31:02 09:31:07 09:31:13 09:31:16 09:31:20 09:31:27

BY MR. SHEASBY: 09:31:27

Q. And that is emission layer? 09:31:30

A. EML, the emissive layer specifically. 09:31:37

Q. Well, in the patent it says the organic functional layer can be an emission layer. That is at column three, line sixty through sixty-three. 09:31:40 09:31:40 09:31:44

Do you see that? 09:31:49

A. I -- I see that, yes. 09:31:49

And that is the EML, as I would describe it in -- in English that it is translated from German, so.... 09:31:51 09:31:55 09:31:59

Q. Well, the organic functional layer can be an emission layer and be doped with at least one emitted material. 09:31:59 09:31:59 09:32:05

Do you see that? 09:32:05

A. I see that, yes. 09:32:06

Q. And what is the function of the emission layer in that passage? 09:32:07 09:32:10

MR. SNYDER: Objection to form. 09:32:12

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THE WITNESS: Again, I -- that layer is the emissive layer, the EML, which is doped with the light-emitting component, and that generates the light that is inside the organic light-emitting diode. 09:32:12 09:32:15 09:32:20 09:32:23 09:32:26

BY MR. SHEASBY: 09:32:26

Q. The organic functional layer can be an emission layer. 09:32:26 09:32:31

That is the layer that generates the light within the OLED? 09:32:32 09:32:34

A. So, again, I, personally, would not use that word. But the emissive layer, the EML, is the region of AMBI polar semiconductor in which the light is generated. 09:32:37 09:32:39 09:32:43 09:32:49

Q. Right. 09:32:49

In the patent it just says emission layer, though. 09:32:50 09:32:51

It doesn't say EML; right? 09:32:51

A. The patent uses the words emission layer. 09:32:54

Q. Yes. 09:32:56

And the purpose of the function emission layer is to emit light; is that correct? 09:32:56 09:33:00

MR. SNYDER: Objection to form. 09:33:03

THE WITNESS: So, again, as described specifically in the patent, it is the region which 09:33:03 09:33:05

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I am describing as the EML, which is doped with the lumiphore, which is where the light is generated, as I mentioned. 09:33:08 09:33:12 09:33:16

BY MR. SHEASBY: 09:33:16

Q. All right. 09:33:16

MR. SHEASBY: Objection. Form. 09:33:18

BY MR. SHEASBY: 09:33:19

Q. The emission light emits light; correct? 09:33:19

A. So, again, I disagree with the use of that term emission layer. And, again, the patent describes the various layers in the device. And in my explanation, I am just describing that EML, which is that emissive layer, which is doped with the dopings, is, indeed, where the light is emitted. 09:33:24 09:33:27 09:33:32 09:33:35 09:33:40 09:33:44

Q. So the emission layer is where the light is emitted; correct? 09:33:47 09:33:50

A. So, again, I wouldn't use those words personally, but the patent is mapping to the EML, which is the region where the device is doped and where the excitons are then transferred to the lumiphores in order to shine out of the organic light-emitting diode. 09:33:51 09:33:54 09:33:58 09:34:02 09:34:07 09:34:18

Q. Right. 09:34:18

In other -- any excitons transferred to lumiphores at the interface between the R prime and 09:34:18 09:34:18

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the EML layer? 09:34:20

A. So, yeah. 09:34:21

They are -- the dopings are inside the EML, 09:34:23
and so to the degree that the EML extends that 09:34:27
interface, of course, there can be -- of course, 09:34:30
there is nothing special about that interface, and 09:34:34
the -- the excitons have a relatively large diffusion 09:34:37
length, something like twenty nanometers within the 09:34:42
device, and so they are not intending to go to any 09:34:46
specific spot. They diffuse and recombine throughout 09:34:49
the volume of the emissive layer. 09:34:53

MR. SHEASBY: So objection to form. That is 09:34:57
not the question I asked. 09:34:59

THE WITNESS: If you could ask it again. 09:35:00

MR. SHEASBY: And I'll actually just say 09:35:02
objection to form. 09:35:07

BY MR. SHEASBY: 09:35:07

Q. The question I ask when lumiphores recombine 09:35:07
with excitons, you say there was a twenty nanometer 09:35:12
range in which they can be located; correct? 09:35:16

A. So yeah. 09:35:18

So just to rephrase that, the -- the 09:35:20
excitons are formed on the host typically, not 09:35:24
always. And then they diffuse and recombine on the 09:35:28
lumiphores. And so that -- there is a whole fostered 09:35:35

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diffusion process that we can get into in which the excitons can move some distance within the organic light-emitting diode. But if that happens, it has to be energetically downhill; so that only happens within the EML, which is where those -- the dopings exist that give us the light from the organic light-emitting diode. 09:35:41 09:35:45 09:35:50 09:35:53 09:35:57 09:36:01 09:36:04

Q. And what if there is any dopings at the interface between 700 angstroms and 800 angstroms? 09:36:04 09:36:08

A. I'm sorry. 09:36:14

Are we speaking about wavelength or sometimes, like -- are -- you are talking about in the cross section of the device -- 09:36:16 09:36:22 09:36:24

Q. Yes. 09:36:26

A. -- specific? 09:36:26

Q. Yes. 09:36:28

A. So -- 09:36:29

MR. SNYDER: Objection to form. 09:36:30

THE WITNESS: -- if there are dopings within the diffusion length, then it is possible for the exciton to diffuse there as long as the energy of the doping is equal to or smaller than the energy of the parent exciton. 09:36:30 09:36:32 09:36:36 09:36:41 09:36:46

BY MR. SHEASBY: 09:36:46

Q. [redacted] 09:36:48

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A. [redacted]

[redacted] 09:36:55

Q. [redacted]

[redacted] 09:36:59

A. So there is some discussion of this in my report, and, actually, we have some testimony. If you just give me a moment, I will bring it up. 09:37:03 09:37:05 09:37:09

So one of the discussions -- and I did not personally conduct this interview, [redacted] 09:38:54

[redacted] 09:39:11

And the -- the second testimony we have from -- from Samsung is with Mr. Noh, again, also from a deposition taken there. And so Mr. Noh never -- and, apparently, [redacted] 09:39:12 09:39:23 09:39:30

[redacted] And I described in my analysis of this in my report as well. 09:39:46 09:39:51

Q. Okay. So let's split it into pieces. 09:39:53

[redacted] 09:40:02

A. I don't believe that I personally brought up 09:40:03

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that issue in any of my discussions with Samsung engineers. 09:40:06 09:40:10

Q. Okay. [redacted] 09:40:17

A. I did not think it was necessary, given the strength of the evidence, and so I did not request for any additional study to be performed. 09:40:18 09:40:24 09:40:26

MR. SHEASBY: Objection. Form. 09:40:28

BY MR. SHEASBY: 09:40:29

Q. I asked you if you had asked for any data that had been generated by Samsung [redacted] 09:40:29 09:40:36

MR. SNYDER: Objection to form. 09:40:38

THE WITNESS: I'm sorry. 09:40:40

I believe I already answered that question. But just to be clear, I did not believe it to be necessary and so I did not ask for any additional data beyond the testimony from the two employees and, again, some of the other evidence of that. 09:40:41 09:40:43 09:40:46 09:40:49 09:40:56

BY MR. SHEASBY: 09:40:56

Q. And did you ask -- you said that Ms. Seo testified [redacted]; is that correct? 09:40:56 09:41:07

A. That is correct. That was her testimony. 09:41:08

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Q. You understand that [redacted]; correct? 09:41:10

MR. SNYDER: Objection to form. 09:41:13

THE WITNESS: [redacted] 09:41:33

BY MR. SHEASBY: 09:41:34

Q. Great. 09:41:35

So now here is the question: [redacted] 09:41:40

A. So I -- again, I did not think it to be necessary. I have made many OLEDs in my lifetime and have studied questions of doping placement and layer formation in -- in great detail. We can talk about those if you are interested. [redacted] 09:42:18

MR. SHEASBY: Objection. Form. 09:42:21

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BY MR. SHEASBY: 09:42:22

Q. I asked you whether you requested any data from Samsung. That is all I asked. 09:42:22 09:42:25

A. Okay. I will repeat my answer, which is I did not think it to be necessary; so I did not request any additional data from Samsung on that point. 09:42:28 09:42:31 09:42:34 09:42:38

Q. Did you request any simulations from Samsung on that point? 09:42:38 09:42:42

A. Similarly, I did not believe it to be necessary; so I did not request any simulations from Samsung on that point of the diffusion specifically. 09:42:43 09:42:46 09:42:49

Q. Okay. Let's talk about did you measure the HOMO or LUMO levels of the materials that are present in the pixels in the light-emitting functional layers? 09:42:53 09:43:06 09:43:11 09:43:18

A. Sorry. 09:43:18

Can you be more specific? Are we speaking about my experience in general or about any specific devices that are at question in any of my report. 09:43:19 09:43:23 09:43:26

Q. Devices that are at issue in this case. 09:43:29

A. So for the specific devices accused at issue, I did not personally go in the laboratory and measure the HOMO or the LUMO levels of those semiconductor materials. 09:43:32 09:43:35 09:43:38 09:43:42

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Q. Did you ask Samsung for the data they had in the HOMO or LUMO levels? 09:43:44 09:43:47

A. So Samsung provided extensive data and analysis regarding the HOMO and LUMO levels of the materials that I cite in my report, and so I was able to use that information as provided by Samsung. Any missing data I was at liberty to request. 09:43:50 09:43:57 09:44:01 09:44:04 09:44:10

Q. I asked you if you requested any data from Samsung on the subject. 09:44:13 09:44:17

A. I don't recall having to ask for any data beyond what was already supplied to me. I believe I had a complete set for the discussion and analysis that I have in my report. 09:44:20 09:44:25 09:44:28 09:44:32

MR. SHEASBY: Okay. I have marked the -- Humphrey's report Exhibit A. 09:44:34 09:44:59

(Deposition Exhibit Number 7 was marked for identification.) 09:44:59 09:45:03

BY MR. SHEASBY: 09:45:03

Q. Why don't you open that up. And that would be Exhibit A to the Humphrey's report, which would be Exhibit 7. 09:45:04 09:45:10 09:45:13

A. Seven. I will put it up. 09:45:20

Okay. I have the report open. 09:45:35

Q. Okay. And why don't we turn to Paragraph 189. 09:45:43 09:45:46

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A. Okay. I am there now. 09:46:13

Q. The patents don't require actual LUMO and HOMO values. 09:46:15 09:46:26

They just require relative LUMO and HOMO -- LUMO-HOMO values in comparison to the first, second, and third matrix; correct? 09:46:28 09:46:31 09:46:33

A. That is correct. 09:46:35

The patent only requires relative positioning of the HOMO and LUMO values. 09:46:35 09:46:38

Q. And if we go to Paragraph 192, it talks about blue host, blue doping, and blue prime materials. 09:46:42 09:46:49 09:46:53

Do you see that? 09:46:54

A. I see that, yes. 09:46:55

Q. And what is a matrix material? 09:46:56

MR. SNYDER: Objection to form. 09:47:01

THE WITNESS: So -- matrix material is a disputed term; so give me one second just to bring up my discussion there. 09:47:02 09:47:12 09:47:17

So, you know, there is some dispute and -- you know, I understand that Pictiva and Samsung have different proposed constructions. And my understanding is also that there is not yet a claim construction order; so if that is issued, we probably need to follow that specifically. 09:48:10 09:48:12 09:48:17 09:48:20 09:48:24 09:48:29

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Now, my understanding is Samsung has proposed the construction, a continuous phase of the mixture of matrix materials, which I agree with. And that Pictiva has proposed the construction plain and ordinary meaning, which they proclaimed as the phrase does not need to be construed. 09:48:31 09:48:34 09:48:39 09:48:43 09:48:47 09:48:53

BY MR. SHEASBY: 09:48:55

Q. And what is a continuous phase? 09:48:55

A. So a continuous phase would be, again, a block of material or a region of material which is -- which is continuous, which is not interrupted. 09:48:58 09:49:02 09:49:06

Q. What does it mean for material to be not interrupted? 09:49:10 09:49:19

A. So what -- I -- I don't want to invent a new term here, but it would mean that the material is in a single -- I want to use the word continuous, but that it is in a single region, and that -- that material is all a -- simply connected through -- through the layer of material. 09:49:20 09:49:31 09:49:34 09:49:42 09:49:46 09:49:52

Q. And let's go to Paragraph 205 in Humphrey Exhibit A. 09:49:54 09:50:31

A. (Witness complies.) 09:50:41

205, okay. I am there now. 09:50:56

Q. In the chart he lists the first matrix material, second matrix material, and a third matrix 09:50:59 09:51:04

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material. 09:51:09

Do you see that? 09:51:09

A. I see that, yes. 09:51:10

Q. Are those matrix materials? 09:51:11

MR. SNYDER: Objection to form. 09:51:13

THE WITNESS: So, again, Humphrey describes them as matrix materials. Now, whether they are matrix materials in the meaning of the -- of the patent, I disagree that those are matrix materials because they are not all continuous in one layer. 09:51:15 09:51:20 09:51:27 09:51:33 09:51:37

BY MR. SHEASBY: 09:51:41

Q. Which ones -- you say they are not all continuous in one layer. 09:51:41 09:51:44

Is that what you said? 09:51:45

A. Yes. That is correct. 09:51:46

Q. Okay. Is the first matrix material he listed a matrix material? 09:51:47 09:51:50

A. [redacted] 09:52:28

Q. [redacted] 09:52:38

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Is that what you are saying? 09:52:40

A. That is correct. 09:52:41

[redacted] 09:53:23

Q. So you consider a matrix in the layer to be -- mean the same thing? 09:53:25 09:53:28

MR. SNYDER: Objection to form. 09:53:31

THE WITNESS: So a matrix is that mixture of materials in a layer, and so I'm not sure that the reverse is necessarily true. But if we describe a matrix as I have described in my construction before, the proposed construction, it would be a mixture of the materials in a layer. 09:53:32 09:53:38 09:53:42 09:53:46 09:53:49 09:53:52

BY MR. SHEASBY: 09:53:54

Q. What is the -- let's go back to Exhibit 1 at .pdf page seven. 09:54:27 09:54:41

A. Give me a minute to bring it up. 09:54:42

Okay. I am there now. 09:55:04

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Q. What is the HOMO and LUMO values in the ETL layer? 09:55:09 09:55:19

A. I don't have those in memory. I would have to see if they are present in another part of the document, but this -- this page does not tell us what the ETL HOMO and LUMO layers are. 09:55:20 09:55:29 09:55:31 09:55:36

Q. Did you ask Samsung's engineers if the HOMO-LUMO values in the ETL, EML, and HTL layers, respectively, satisfy the limitation of claim one that talks about a first matrix material, a second matrix material, and a third matrix material that have various comparative amounts of LUMO and HOMO? 09:55:39 09:55:42 09:55:48 09:55:53 09:55:57 09:56:01

MR. SNYDER: Objection to form. 09:56:06

THE WITNESS: So the EML and the ETL are different layers, and so I just -- I'm not sure I understand your question because the ETL and the EML are not part of the same matrix. 09:56:07 09:56:13 09:56:19 09:56:25

BY MR. SHEASBY: 09:56:27

Q. I understand that. 09:56:27

A. I'm not sure how one would consider those to then meet the requirements of -- of the -- patent claim. 09:56:28 09:56:33 09:56:38

Q. Is there a matrix within the ETL? 09:56:39

A. I would say yes. 09:56:44

Q. Okay. Is there a matrix within the EML? 09:56:45

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A. Yes. 09:56:49

I would -- I would agree with that 09:56:49

statement. 09:56:51

Q. Is there a matrix within the HTL? 09:56:51

A. Yes. 09:56:55

I agree with that statement. 09:56:55

Q. What are the various HOMO-LUMO values of 09:56:56

those three matrices? 09:57:00

A. In looking separately, I don't have it 09:57:03

committed to memory. But, again, the -- you can look 09:57:07

up -- if you would like, I can pull up more 09:57:14

documentation. That analysis is available to us for 09:57:18

those layers separately. And then we can -- we can 09:57:21

find what those HOMO-LUMO levels are. 09:57:27

Q. And you -- 09:57:31

A. I don't have those memorized. I'm sorry. 09:57:32

Q. Did you put that in your report? 09:57:35

A. The HOMO and LUMO level specifically of all 09:57:37

the layers, I did not specifically enumerate those in 09:57:41

my report, no. 09:57:45

Q. Do you know if they satisfy the comparative 09:57:45

requirements of the claim limitation? 09:57:49

A. So, again, I -- I disagree that those layers 09:57:52

are all part of the same matrix, in which case I can 09:57:57

confidently say that they don't satisfy the claim 09:58:02

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limitation, which requires all of those to be intermixed into a single layer. 09:58:05 09:58:09

Q. So you believe the claims require the first matrix, the second matrix, and the third matrix to be -- yeah. I understand what you are saying. 09:58:12 09:58:14 09:58:18

I am actually specifically asking is the matrix material in the ETL, what is its LUMO and HOMO relative to the matrix material in the EML and the HTL? 09:58:21 09:58:27 09:58:34 09:58:38

MR. SNYDER: Objection to form. 09:58:39

THE WITNESS: So that is knowable, and if you would like, we can -- unfortunately, this document doesn't have those details. I don't remember it from memory. But we -- we could certainly look separately and -- and enumerate what those layers are. Those are -- those are known values. I apologize. I just don't have them committed to memory. 09:58:40 09:58:43 09:58:47 09:58:50 09:58:54 09:58:57 09:59:00 09:59:03

MR. SHEASBY: All right. Let's take our break. 09:59:09 09:59:11

THE VIDEOGRAPHER: This marks the end of media unit number two. 09:59:13 09:59:15

The time is 9:59 a.m. 09:59:16

We are off the record. 09:59:18

(Short recess taken.) 10:03:59

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THE VIDEOGRAPHER: This marks the beginning of media unit number three. 10:18:00 10:18:05

The time is 10:18 a.m. 10:18:08

We are on the record. 10:18:09

BY MR. SHEASBY: 10:18:10

Q. Looking back at Exhibit 1, and we're looking at the -- the EML layer. 10:18:11 10:18:14

Now, you said that for there to be emissions, there has to be a conduction of electrons in the transport of -- of holes; correct? 10:18:17 10:18:19 10:18:26

MR. SNYDER: Objection to form. 10:18:33

THE WITNESS: That is correct. 10:18:34

So for the emissive layer to do its work, both the hole and an electron have to meet on the semiconductor to form the excited state, and so both electrons and holes need to meet and be injected into one of the components of the EML. 10:18:38 10:18:42 10:18:45 10:18:50 10:18:56

BY MR. SHEASBY: 10:18:59

Q. There is no conduction of electrons in the EML layer; correct? 10:18:59 10:19:01

A. So I disagree with that characterization. The electrons do not flow all the way through the EML, but the electrons need to be able to access the EML in order to form the exciton. 10:19:05 10:19:09 10:19:12 10:19:16

Q. Sir, there is no conduction of electrons in 10:19:19

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the EML layer; correct? 10:19:26

A. I disagree. 10:19:29

Q. The conduction of electrons is not required for the emission of light in the EML layer? 10:19:31 10:19:48

A. I disagree. I'm sorry. I'm not exactly sure what you are asking. 10:19:58 10:20:04

Q. Sure. 10:20:06

There is -- the EML layer emits light; correct? 10:20:06 10:20:10

A. That is correct. 10:20:12

The EML is the emissive layer of the -- of the -- of the OLED, and that is where the light is -- is generated and is emitted from that. 10:20:13 10:20:18 10:20:22

Q. And there is no conduction of electrons in the EML layer because that is not necessary for emission? 10:20:25 10:20:28 10:20:30

A. So electrons need to reach and enter the EML, and so I disagree with the statement that there is no conduction of electrons, as I mentioned before. 10:20:32 10:20:36 10:20:42

Q. Okay. Let me -- let me ask you another question, which is about the -- why don't we go to -- oooh, I'm going to have to mark some more exhibits. 10:20:47 10:20:50 10:21:01

Why don't we go back to SDC_000709. 10:21:04

Let's go back to some of the exhibits. Let's go to Exhibit 3. 10:21:10 10:23:06

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A. (Witness complies.) 10:23:15

Okay. I'm there now. 10:23:19

Q. And let's turn to Page 70993. 10:23:20

A. (Witness complies.) 10:23:44

Q. [redacted] 10:24:09

MR. SNYDER: Objection to form. 10:24:10

THE WITNESS: [redacted] 10:24:26

BY MR. SHEASBY: 10:24:27

Q. And is -- are those forms of vaporization? 10:24:28

MR. SNYDER: Objection to form. 10:24:33

THE WITNESS: Yes. 10:24:34

[redacted] 10:24:42

BY MR. SHEASBY: 10:24:44

Q. And does that page depict the chambers in which that -- that occurs? 10:24:44 10:24:47

A. So this document shows some of the structure of the sources that are used, but -- but it does not show the whole chamber generally. 10:24:51 10:24:54 10:24:58

Q. And what do you mean, the structure of the 10:25:01

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sources? 10:25:04

A. So the [redacted] -- 10:25:05

strictly speaking, evaporation is when the material 10:25:12

melts, and not all of it melts. But when that 10:25:17

process occurs, that happens out of a source out of 10:25:20

a small furnace, and sometimes it is linear, 10:25:24

sometimes it is circular. [redacted]

[redacted] 10:25:40

There is the rest of the chamber, and there 10:25:42

are other structures also inside the system, which is 10:25:45

why I say it is just a section where the source 10:25:49

materials are stored and the schematic description of 10:25:53

how they are configured. 10:25:58

Q. [redacted]

[redacted]? 10:26:01

MR. SNYDER: Object- -- 10:26:05

THE WITNESS: That is my understanding; [redacted]

[redacted] 10:26:20

BY MR. SHEASBY: 10:26:22

Q. And what materials are used in the METL 10:26:22

layer? 10:26:33

MR. SNYDER: Objection to form. 10:26:34

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THE WITNESS: I'm not sure which ones are used in -- in the general case. The document describes what sources are loaded, but not all of them are used in every device, and that depends upon the recipe; so we have to look at the construction of each individual device in order to say what is in the ETL layer. 10:26:36 10:26:38 10:26:46 10:26:48 10:26:51 10:26:55 10:27:00

BY MR. SHEASBY: 10:27:01

Q. Are there any processes in which the E- -- in which the ETL layer is manufactured and which the materials that make up that ETL layer are not both evaporated in the same chamber? 10:27:02 10:27:05 10:27:09 10:27:12

A. So our -- I'm sorry. 10:27:17

Are you asking the question in general or are you asking about Samsung's process? 10:27:22 10:27:24

Q. The accused Samsung processes. 10:27:26

A. [redacted] 10:27:45

Q. [redacted] 10:27:47

MR. SNYDER: Objection to form. 10:27:50

THE WITNESS: [redacted] 10:27:52

[redacted] 10:27:54

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BY MR. SHEASBY: 10:28:05

Q. How do you jointly vaporize materials within a chamber? 10:28:49 10:28:56

A. So the -- this question of joint vaporization is a -- is a complicated one, and so in -- one -- one way that material could be jointly vaporized would be, for example, to mix the material together into a single crucible and then evaporate it from that single crucible. 10:28:58 10:29:05 10:29:09 10:29:13 10:29:15 10:29:22

Q. What are the other ways of joint vaporization? 10:29:25 10:29:28

A. So I discussed this a little bit in my report. There are some other examples, for example, that are offered by -- in -- in Werner251. Let me just figure those out. But for sure that is one example where -- which has been discussed in the -- in the patent literature and in the literature. And, you know, I -- there -- there may be other ways as well. 10:29:28 10:29:31 10:29:36 10:29:45 10:29:47 10:29:50 10:29:54 10:29:57

Q. Have you ever performed joint vaporization in a chamber? 10:29:57 10:30:00

A. So I have done codeposition of materials, but I'm not certain that that would necessarily qualify as joint vaporization because of the types of systems that I was using. 10:30:02 10:30:10 10:30:13 10:30:17

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Q. Why is codeposition not joint vaporization? 10:30:21
A. So joint vaporization -- if you just give me a second and let me just pull up the -- the language that I use. 10:30:27 10:30:32 10:30:35
Q. Let me ask it this way. 10:31:56
A. Sure. 10:31:58
Q. For the 2.- -- for the '223 patent, is there any description of simultaneous vaporization through comixing in the specification? 10:31:58 10:32:09 10:32:14
MR. SNYDER: Objection to form. 10:32:19
THE WITNESS: So the -- the '223 patent describes the -- the benefits of the patent as obtained by joint vaporization, and so it basically is describing a process where there is substantial mixing and coordination that occurs as part of that joint vaporization process. 10:32:20 10:32:25 10:32:28 10:32:36 10:32:39 10:32:44
BY MR. SHEASBY: 10:32:45
Q. Right. 10:32:45
And that is what I am asking you. 10:32:45
Where is that? Where does it say in the '223 patent that the -- the materials must be mixed in advance for there to be joint vaporization? 10:32:47 10:32:51 10:32:53
A. That is just an example of one way that one could consider creating a situation where there is joint vaporization. 10:32:56 10:33:01 10:33:03

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MR. SHEASBY: Objection. Form. 10:33:05
BY MR. SHEASBY: 10:33:05
Q. Where does the patent talk about premixing 10:33:06
the materials are involved in joint vaporization? 10:33:09
A. Sorry. I was responding to your question 10:33:12
and example of how one could conduct joint 10:33:14
vaporization. 10:33:17
MR. SHEASBY: Objection. Form. 10:33:17
BY MR. SHEASBY: 10:33:18
Q. Where does the patent describe mixing in 10:33:19
advance the two materials that are involved in joint 10:33:21
vaporization? 10:33:25
MR. SNYDER: Objection to form. 10:33:25
THE WITNESS: So the -- the '223 patent does 10:33:26
not describe that mixing. That was -- 10:33:28
BY MR. SHEASBY: 10:33:31
Q. So let me ask the next question, which is 10:33:31
where does the '223 patent describe that the -- the 10:33:33
substances in the joint vaporization process must be 10:33:37
simultaneously deposited? 10:33:41
MR. SNYDER: Objection to form. 10:33:43
THE WITNESS: So, again, the -- the '223 10:33:44
patent discusses joint vaporization and describes 10:33:52
that joint vaporization as providing the complex 10:33:57
agent and the other coordination processes that are 10:34:03

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the benefits of the patent. 10:34:05

MR. SHEASBY: Objection. Form. 10:34:07

BY MR. SHEASBY: 10:34:08

Q. Where does the '223 patent describe simultaneous deposition through vaporization? 10:34:08 10:34:11

MR. SNYDER: Objection to form. 10:34:14

THE WITNESS: So the -- give me a moment, and I'll -- I'll take a quick look at an example. 10:34:15 10:34:30

Sorry. Would it be -- I think the '223 patent is -- let's see. It is -- 10:35:06 10:35:32

BY MR. SHEASBY: 10:35:34

Q. It is not. 10:35:34

A. If you would like me to refer specifically to it, then it would be great if you could introduce that. 10:35:36 10:35:38 10:35:44

MR. SHEASBY: This will be marked as Exhibit 13. 10:36:32 10:36:34

(Deposition Exhibit Number 13 was marked for identification.) 10:36:34 10:36:53

BY MR. SHEASBY: 10:36:53

Q. Let me ask you a question. 10:36:53

If you evaporate something at the same time, is that -- will that result in joint vaporization? 10:36:55 10:36:58

A. Not necessarily. 10:37:00

Q. All right. 10:37:01

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A. It really depends on the details of the deposition, the pressure, the reactivity of the two materials, the degree of intermixing. 10:37:02 10:37:04 10:37:08

Q. So what exactly -- what actually is required for joint vaporization? 10:37:11 10:37:13

A. So as described in the patent, joint vaporization is the -- the -- the -- the -- the final outcome is that coordination process that the patent describes. 10:37:15 10:37:21 10:37:26 10:37:31

MR. SHEASBY: Objection. Form. 10:37:34

BY MR. SHEASBY: 10:37:35

Q. What is joint vaporization? 10:37:36

MR. SNYDER: Objection to form. 10:37:38

THE WITNESS: The patent itself, again, doesn't describe the -- you know, there is no line specifically on what there is, but it is this formation of complexes the -- the general definition that the patent offers. 10:37:39 10:37:52 10:37:57 10:38:01 10:38:07

BY MR. SHEASBY: 10:38:09

Q. What is the common and ordinary meaning of joint vaporization? 10:38:09 10:38:11

MR. SNYDER: Objection to form. 10:38:13

THE WITNESS: So the -- again, I -- in my -- in my report I describe -- if you go to paragraph fifty-two in my noninfringement report, I provide 10:38:14 10:38:48 10:38:54

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that, you know, at least a POSITA would understand that joint vaporization required that the metal compound and the organic compound could be coevaporated so that they are present together in the vapor phase. And so, again, it also depends on the pressure because that determines how much interaction the two materials will have in the vapor phase. If the pressure is very low, then the mean free path is long. If the pressure is high, they have more opportunity to interact. 10:39:02 10:39:04 10:39:07 10:39:07 10:39:10 10:39:15 10:39:19 10:39:22 10:39:25 10:39:29

But it also depends on the structure of the evaporation sources and whether the plumes are allowed to interact in a way that permits that reaction to occur in the vapor phase; so it is not a simple understanding, but that is generally what a person of ordinary skill in the art would recognize as joint vaporization. 10:39:30 10:39:32 10:39:35 10:39:39 10:39:42 10:39:47 10:39:50

BY MR. SHEASBY: 10:39:54

Q. Is any of that described in the patent? Does the patent say anything about immediately present in the same vapor phase? 10:39:54 10:39:59 10:40:01

A. So the -- the -- the patent states joint vaporization. It offers cotton, for example, as an example. It does not have a strict definition of what is or is not joint vaporization. 10:40:07 10:40:13 10:40:17 10:40:22

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MR. SHEASBY: Objection. Form. 10:40:25
BY MR. SHEASBY: 10:40:26
Q. Does the patent describe that there must be coevaporation such that both the -- the meta complex and the organic compound are immediately present in the same vapor phase? 10:40:26 10:40:30 10:40:35 10:40:39
A. So I'm sorry. I think I have already answered that. The -- the -- the patent does not specifically describe what joint vaporization is or is not. 10:40:46 10:40:49 10:40:50 10:40:53
Q. It is not the question I asked. 10:40:53
MR. SHEASBY: Objection. Form. 10:40:55
BY MR. SHEASBY: 10:40:56
Q. Does the patent ever describe an embodiment in which there is coevaporation such that both the complex and the compound are immediately present in the same vapor phase? 10:40:56 10:40:59 10:41:03 10:41:06
MR. SNYDER: Objection to form. 10:41:08
THE WITNESS: I have to take a quick look one more time at the patent. Just give me a moment. 10:41:19 10:41:21
If we go to column fourteen, for example, in line fifteen it describes the situation that I described earlier as an example in which the two components are mixed together in one -- in one -- in one vessel, one crucible, and then are vaporized from 10:42:02 10:42:07 10:42:12 10:42:15 10:42:20

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a joint vessel as one possible way to conduct that joint vaporization. 10:42:25 10:42:30

BY MR. SHEASBY: 10:42:31

Q. It also discusses joint vaporization by using two separate vessels; correct? 10:42:32 10:42:34

MR. SNYDER: Object to the form. 10:42:40

THE WITNESS: So there is a sentence before that except for with the phrase however. 10:42:40 10:42:46

BY MR. SHEASBY: 10:42:46

Q. Right. 10:42:51

A. So I -- that might be a counterexample -- 10:42:52

Q. Well -- 10:42:57

A. -- saying that that may or may not be joint vaporization. But there is a sentence there that also describes using two different vessels. Again, joint vaporization is a complicated issue, and it depends on the details of the interaction after the material was evaporated as well. 10:42:57 10:43:02 10:43:05 10:43:09 10:43:12 10:43:15

Q. So this describes two options in the patent, one in which the metal complex in the organic compound can be vaporized from two different vessels, which are stationed separated from each other. 10:43:17 10:43:20 10:43:24 10:43:28

Do you see that? 10:43:30

MR. SNYDER: Objection to form. 10:43:30

THE WITNESS: I see that. 10:43:31

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It is also, however, followed by however, and then that describes another option, which is the joint vessel option. 10:43:32 10:43:36 10:43:41

BY MR. SHEASBY: 10:43:42

Q. Right. 10:43:42

So it describes separate vessels and joint vessels; correct? 10:43:42 10:43:45

MR. SNYDER: Objection to form. 10:43:46

THE WITNESS: Both of those options are -- are listed in that paragraph. 10:43:47 10:43:55

BY MR. SHEASBY: 10:43:56

Q. And are joint vessels required necessarily for joint vaporization? 10:43:56 10:43:59

A. So as I mentioned before, it is not a requirement that joint vessels be used for joint vaporization. 10:44:02 10:44:08 10:44:13

Q. Let me ask you the next question -- 10:44:13

A. I'm sorry. 10:44:15

Q. -- which is -- let me ask you another question. 10:44:15 10:44:17

Have you ever done joint vaporization? 10:44:18

A. Okay. 10:44:21

MR. SNYDER: You can finish your previous answer to the question. 10:44:22 10:44:24

THE WITNESS: Okay. 10:44:25

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BY MR. SHEASBY: 10:44:25

Q. Have you ever done joint vaporization? 10:44:26

A. Can I finish my previous answer or at least make a note that I didn't get to finish? 10:44:27 10:44:31

Q. Sure. 10:44:33

Have you ever done joint vaporization? 10:44:34

A. So I will just say I didn't get to finish my previous answer. Sorry. 10:44:35 10:44:42

So I have performed joint vaporization using the method where we have mixed materials together and evaporated them together in an attempt to get them to react. But when making OLEDs, I -- generally, the type of equipment I have used personally, those codeposition in the way in which the vapor plumes do not overlap. 10:44:43 10:44:48 10:44:53 10:44:56 10:45:02 10:45:05 10:45:08

Q. Separate vessels? 10:45:09

A. So in those cases, yes. Those were separate vessels and separated by baffle, which prevents the material from redepositing. There are a number of functional reasons why you often don't want the plumes to overlap. 10:45:11 10:45:16 10:45:21 10:45:25 10:45:29

Q. And that is how you have done it for OLEDs? 10:45:30

A. That is -- that is correct. That is my usual approach in making OLEDs. 10:45:36 10:45:39

Q. Okay. [redacted] 10:45:42

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[redacted]

10:45:54

A. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted].

10:46:19

MR. SHEASBY: And so objection. Form. 10:46:21

BY MR. SHEASBY: 10:46:22

Q. [redacted]

[redacted]

[redacted]

[redacted]:35

MR. SNYDER: Objection to form. 10:46:37

THE WITNESS: [redacted]

[redacted]

10:46:42

BY MR. SHEASBY: 10:46:42

Q. [redacted]

[redacted]

10:46:49

MR. SNYDER: Objection to form. 10:46:50

THE WITNESS: [redacted]

[redacted]

[redacted]

10:46:57

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[redacted] 10:47:11

BY MR. SHEASBY: 10:47:14

Q. [redacted] 10:47:17

MR. SNYDER: Objection to form. 10:47:18

THE WITNESS: [redacted] :33

BY MR. SHEASBY: 10:47:35

Q. [redacted] 10:47:39

MR. SNYDER: Objection to form. 10:47:39

THE WITNESS: I disagree with that 10:47:40

characterization. 10:47:42

BY MR. SHEASBY: 10:47:42

Q. Okay. Why don't we go to -- [redacted] :56

MR. SNYDER: Objection to form. 10:47:57

THE WITNESS: Again, I disagree with that 10:47:58

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statement. [redacted]

[redacted]

[redacted]

[redacted]. 10:48:09

BY MR. SHEASBY: 10:48:11

Q. Why don't we -- why don't you download 10:48:23

Exhibit 12. 10:48:26

(Deposition Exhibit Number 12 10:48:26

was marked for identification.) 10:49:00

THE WITNESS: (Witness complies.) 10:49:00

Okay. I have it downloaded. 10:49:01

BY MR. SHEASBY: 10:49:03

Q. This is the testimony of Mr. Jo; correct? 10:49:20

A. That is correct. 10:49:26

Q. He testifies: 10:49:27

[redacted]

[redacted] 10:50:10

[redacted] 10:50:11

[redacted]

[redacted] 10:50:18

MR. SNYDER: Objection to form. 10:50:19

THE WITNESS: Sorry. Let me pull up the 10:50:21

section that you are referring to. 10:50:24

I'm sorry. Could you ask your question 10:50:38

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again? 10:50:41
BY MR. SHEASBY: 10:50:41
Q. Sure. 10:50:42
[redacted] [redacted]
[redacted] [redacted]
[redacted] [redacted]
[redacted] 50:51
MR. SNYDER: Objection to form. 10:50:53
THE WITNESS: So, again, I disagree with 10:50:54
that as the characterization. The question that was 10:50:57
asked by the -- the -- by Ms. Zhong, she is -- 10:51:02
BY MR. SHEASBY: 10:51:09
Q. Let me do it crisply. 10:51:09
He is testifying regarding the METL layer; 10:51:11
correct? 10:51:16
MR. SNYDER: Objection. 10:51:16
THE WITNESS: So sorry. 10:51:17
Are we asking about the -- the mixed ETL; 10:51:22
right? The METL? 10:51:27
BY MR. SHEASBY: 10:51:27
Q. Yeah. 10:51:28
I'm using the acronym, the METL. 10:51:28
A. The METL, great. 10:51:32
So -- because the next layer is metal. 10:51:34
Q. I understand. 10:51:37

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A. No problem; so yes. 10:51:38

[redacted] 10:52:05

Q. All right. We'll do it in pieces. 10:52:08

Does the claim say simultaneous deposition? 10:52:10

A. So the claim says joint vaporization. 10:52:14

Q. Does it say simultaneous deposition? 10:52:17

A. So I do not believe that that phrase appears in the patent. 10:52:20 10:52:25

Q. Okay. And Mr. Jo testifies: 10:52:26

[redacted] 10:52:39

Do you see that testimony? 10:52:42

A. I see that testimony. 10:52:43

Q. And do you -- do you agree or disagree with that testimony? 10:52:45 10:52:48

A. So I disagree that it produces the result that you are describing. [redacted] 10:52:48 10:52:52

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[redacted] 10:53:03

Q. Not the question I asked. 10:53:05

The question I asked is evaporation is 10:53:06

a form of vaporization; correct? 10:53:09

A. That is correct. 10:53:11

Q. [redacted] 10:53:20

A. So, again, in different areas the materials 10:53:21

are being heated and the materials are being 10:53:24

evaporated, and that does happen in the same chamber 10:53:27

at the same time. 10:53:31

Q. Okay. Let me ask the next question, which 10:53:32

is [redacted] 10:54:00

MR. SNYDER: Objection to form. 10:54:03

THE WITNESS: Sure. 10:54:08

I just -- I just want to finish my 10:54:09

qualification of the previous answer, which is -- 10:54:11

///

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BY MR. SHEASBY: 10:54:14

Q. So, sir -- sir, just -- sir -- 10:54:14

A. Okay. I just want to make it clear that I had a qualification to make to what I said before, and I -- 10:54:17 10:54:19 10:54:24

Q. Your witness is -- your -- your -- your attorney is just coaching you, and so I -- I don't agree with that, but that is -- that is for another day. 10:54:26 10:54:27 10:54:29 10:54:32

So if we go to the result -- what -- what is the result of joint vaporization? 10:54:32 10:54:40

MR. SNYDER: Objection to form. 10:54:43

THE WITNESS: So I'll -- again, I'll just -- I want to make it clear on the record that I had a further qualification to my statement in which I disagree that that evaporation at the same time is -- because it is happening temporally at the same time means that the evaporation is happening on the same parts of the substrate at the same time together. And that is very clear both from the -- from my report, as well as from Samsung documents and with the interview. 10:54:47 10:54:50 10:54:53 10:54:56 10:55:00 10:55:03 10:55:07 10:55:11 10:55:13 10:55:17

MR. SHEASBY: So objection. Form. Nonresponsive. 10:55:18 10:55:19

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BY MR. SHEASBY: 10:55:19

Q. I'm merely asking whether you disagree or 10:55:19

agree with the testimony of Mr. Jo [redacted] [redacted]

[redacted] [redacted]

[redacted] 10:55:29

Correct or incorrect? 10:55:31

MR. SNYDER: Objection. 10:55:34

THE WITNESS: So, again, it -- there is 10:55:34

a lot of other testimony that is also here describing 10:55:36

the details of how that deposition happens. [redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] 10:56:02

MR. SHEASBY: Objection. Form. 10:56:06

BY MR. SHEASBY: 10:56:07

Q. Is what Mr. Jo says at page forty, lines 10:56:07

eighteen through twenty-two, correct or incorrect? 10:56:12

MR. SNYDER: Object to the form. 10:56:17

THE WITNESS: So, again, it is technically 10:56:17

correct that [redacted] [redacted]

[redacted]. But Mr. Jo -- there 10:56:25

is a lot of other testimony in which he qualifies 10:56:29

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that and explains why -- 10:56:32

MR. SHEASBY: Objection. 10:56:35

THE WITNESS: Okay. 10:56:36

BY MR. SHEASBY: 10:56:36

Q. I'll ask it again. 10:56:36

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted] :44

MR. SNYDER: Objection to form. 10:56:49

THE WITNESS: [redacted] [redacted]

[redacted] [redacted]

[redacted] 56:54

BY MR. SHEASBY: 10:56:59

Q. Okay. Then let me ask you the next 10:56:59

question, which is what is the end result of joint 10:57:02

vaporization, as described in the patent, in terms of 10:57:05

the layer that is created? 10:57:07

A. Okay. I just want it to be clear that I had 10:57:09

an initial qualification, but -- 10:57:12

Q. I don't know what you are talking about, 10:57:14

sir. 10:57:17

MR. SHEASBY: So objection. Form. 10:57:17

BY MR. SHEASBY: 10:57:19

Q. What is the end result of the joint 10:57:19

vaporization process that is described in the patent? 10:57:22

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A. So the patent describes joint vaporization as delivering the benefit of coordination in the system. 10:57:24 10:57:27 10:57:31

Q. And what does coordination mean? 10:57:32

A. So coordination is another disputed term, and I don't -- 10:57:35 10:57:39

Q. Okay. That is fine. It is disputed. 10:57:46

What does it mean to -- for -- to you? 10:57:48

A. So just give me a second. I have an explanation that I just want to make sure I follow exactly. 10:57:51 10:57:57 10:58:00

So one of the -- so there were two -- again, there were two constructions that have been proposed, and, you know, there is a claim construction that comes down from the court, and I, of course, follow that. But one -- the construction that is proposed by Samsung is the formation of a dative bond in the structure, and the construction that is proposed by Pictiva is a bonding interaction. 10:59:03 10:59:06 10:59:10 10:59:13 10:59:16 10:59:20 10:59:24 10:59:28

Q. [redacted] 10:59:48

A. So no. 10:59:53

It is my opinion that [redacted] 10:59:54

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[redacted] 11:00:00

Could you ask the question again? 11:00:04

MR. SHEASBY: Objection. Form. 11:00:06

THE WITNESS: No problem. Yep. 11:00:07

BY MR. SHEASBY: 11:00:09

Q. [redacted] 11:00:18

A. So it is my opinion that, again, [redacted] 11:00:35

Q. Okay. Did you do any experimental studies to determine if there was any bonding interaction? 11:00:37 11:00:41

A. So as I describe in my report, I, personally, did not do any experiments, but I did rely on a number of both experiments and models that were performed by others, including the work that was done by Dr. Miller. There was some experiments performed by Professor Park, and we also had some information from the air down of the mixed two that provided some additional support and information. 11:00:45 11:00:50 11:00:53 11:00:56 11:01:00 11:01:06 11:01:10 11:01:13

Dr. Miller also did some modeling in order to support the -- the conclusions that formed part of 11:01:16 11:01:20

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the basis of the conclusions I concluded as well. 11:01:23
MR. SHEASBY: Objection. Form. 11:01:26
BY MR. SHEASBY: 11:01:27
Q. I asked you if you had done any experiments 11:01:27
or simulations. 11:01:31
MR. SNYDER: Objection to form. 11:01:32
THE WITNESS: So I, personally, did not 11:01:33
conduct any experiments or simulation. I didn't see 11:01:34
it as necessary, given the -- the wealth of 11:01:38
information that was available to me. 11:01:40
MR. SHEASBY: Objection. Form. 11:01:41
BY MR. SHEASBY: 11:01:42
Q. I just asked you if you did any experiments 11:01:42
or simulations. I didn't ask you why. 11:01:45
Do you understand that? 11:01:47
MR. SNYDER: Objection to form. 11:01:48
THE WITNESS: I did not find it to be 11:01:49
necessary, and so I did not personally conduct any 11:01:54
experiments or simulations. 11:01:57
MR. SHEASBY: Objection. Form. 11:01:59
BY MR. SHEASBY: 11:02:00
Q. I did not ask you why. I just asked you if. 11:02:01
Do you understand that? 11:02:04
MR. SNYDER: Objection to form. 11:02:05
THE WITNESS: So I understand. I just want 11:02:06

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to make sure I am giving the clearest and most accurate answer to your question. 11:02:08 11:02:10

BY MR. SHEASBY: 11:02:12

Q. So answer my question. 11:02:12

Did you do any experiments or simulations? Yes or no? 11:02:14 11:02:16

MR. SNYDER: Objection to form. 11:02:18

THE WITNESS: I, personally, did not conduct any experiments or simulation and, instead, relied on others and the work that they did. 11:02:18 11:02:21 11:02:25

BY MR. SHEASBY: 11:02:27

Q. Did you ask Samsung if it had any internal experiments or simulations on the subject? 11:02:27 11:02:31

A. I had a significant amount of data from Samsung, including some results they had performed based on XPS and other analysis, but I did not ask for any additional measurements to be taken by Samsung. 11:02:33 11:02:37 11:02:41 11:02:45 11:02:48

Q. Did you ask for any measurements to be taken by Samsung? 11:02:48 11:02:53

A. I did not ask Samsung specifically to take any measurements. 11:02:53 11:02:56

Q. Do the claims require a metal complex with a high disposition and ability to provide free electrons? 11:02:56 11:03:35 11:03:39

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A. So the claims specifically do not offer that restriction. That is, however, one of the benefits that is described in the specification. And the specification is clear that the material that is being deposited needs to have that ability to coordinate. And having that in a high disposition, the ability to reconfigure the bonding, as well as the free electrons that can form the -- the -- the reaction that is needed for coordination is required by the patent in the light of the specification. 11:03:39 11:03:54 11:03:59 11:04:02 11:04:05 11:04:08 11:04:13 11:04:16 11:04:20 11:04:24

MR. SHEASBY: Objection. Form. 11:04:28

BY MR. SHEASBY: 11:04:28

Q. Do the claims require a high disposition and ability to provide free electrons for the metal complex? Yes or no? 11:04:29 11:04:33 11:04:37

MR. SNYDER: Objection to form. 11:04:38

THE WITNESS: Again, I'm just trying to give the clearest answer and the most complete answer. And so the claims are silent about the exact details of the material that is required for the doping. 11:04:39 11:04:41 11:04:44 11:04:47

BY MR. SHEASBY: 11:04:52

Q. Okay. Do the claims require that the central METL atom be able to coordinate with additional ligands? 11:04:52 11:05:10 11:05:16

A. So yeah. 11:05:19

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The claims describe the metal complex with the central METL atom, and they require them to be able to coordinate, and so it depends on the exact situation that we're talking about. But that would be one of the criteria that one could use to establish whether that material can coordinate. 11:05:25 11:05:29 11:05:34 11:05:38 11:05:41 11:05:45

Q. Did the claims require being able to coordinate with additional ligands? 11:05:49 11:05:53

MR. SNYDER: Objection to form. 11:05:56

THE WITNESS: So the -- it requires -- claims require that there be a central METL atom that can coordinate, and so if it is not able to coordinate, then it would not satisfy the claim requirement. 11:05:57 11:06:03 11:06:07 11:06:11 11:06:16

BY MR. SHEASBY: 11:06:18

Q. Does claim two require that the coordination occur in the gas phase? 11:06:51 11:06:54

A. So claim two says that the coordination happens due to the joint vaporization, and so while claim two only uses the phrase joint vaporization, and it is understood by a person of ordinary skill in the art that while the molecules are in the gas phase is when they are the most reactive and, as a consequence, I would say that in general for the coordination to happen, claim two does -- does imply 11:07:05 11:07:08 11:07:11 11:07:15 11:07:18 11:07:22 11:07:25 11:07:30

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that that is happening in the gas phase. 11:07:36

Q. Does -- claim eleven actually requires that 11:07:38

the coordination occur in the gas phase; correct? 11:07:42

A. So claim eleven uses a different term. It 11:07:45

uses the term simultaneous vaporization, and then it 11:07:50

says that that coordination happens in the gas phase. 11:07:54

My understanding of claim two comes from this phase 11:07:57

joint vaporization, which is defined earlier as being 11:08:00

a process which encourages that coordination 11:08:05

reaction, and that is the basis for my previous 11:08:08

answer. 11:08:12

Q. Is simultaneous vaporization the same as 11:08:12

joint vaporization? 11:08:16

A. No. Not necessarily. 11:08:16

Q. What is broader? 11:08:19

A. Simultaneous vaporization would be broader. 11:08:21

Q. And so you actually think there is -- in 11:08:25

a gas phase a limitation in claim two in place of it? 11:08:31

A. Again, I haven't offered a line on what is 11:08:36

or is not joint vaporization. But I do offer the 11:08:39

opinion earlier in my report that it is understood 11:08:42

that joint vaporization has that ability to react and 11:08:46

form whatever direction is associated with 11:08:52

coordination before condensation. And so, again, all 11:08:58

the examples that I discuss that involve vaporization 11:09:03

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are -- are going to happen in that gas phase. 11:09:07

Q. So the claims -- claim two requires that the 11:09:12

coordination occur in the gas phase? 11:09:16

A. Again -- 11:09:19

MR. SNYDER: Objection to form. 11:09:20

THE WITNESS: Yeah. 11:09:21

Claim two says that it is due to joint 11:09:22

vaporization, and the details there are then -- 11:09:26

again, we need to understand the -- whether -- you 11:09:30

know, exactly how the deposition is happening when we 11:09:33

make that determination of whether or not joint 11:09:36

vaporization is occurring. 11:09:40

BY MR. SHEASBY: 11:09:41

Q. So it is your understanding that joint 11:09:51

vaporization requires coordination in the gas phase? 11:09:53

MR. SNYDER: Objection to form. 11:09:56

THE WITNESS: So joint vaporization requires 11:09:57

the formation of coordination. I had mentioned an 11:10:01

example before in which we could, for example, mix 11:10:05

the materials in the crucible. You can imagine if 11:10:08

the materials melt and react in the crucible and then 11:10:12

vaporize, the reaction can happen, in other words. 11:10:15

MR. SHEASBY: Objection. Form. 11:10:19

BY MR. SHEASBY: 11:10:21

Q. Does joint vaporization require coordination 11:10:21

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in the gas phase? Yes or no? 11:10:23

MR. SNYDER: Objection to form. 11:10:25

THE WITNESS: It only requires coordination. 11:10:26

BY MR. SHEASBY: 11:10:26

Q. Okay. The -- what is a dative bond? 11:10:30

A. So a dative bond is a -- is a -- is a molecular bond where both of the electrons are donated by one of the atoms. 11:10:39 11:10:42 11:10:46

Q. In terms of your analysis of the technical benefits of the patents-in-suit, did you discuss the patents-in-suit with any Samsung engineers? 11:11:13 11:11:16 11:11:21

A. Yes. 11:11:23

I detailed in my report that I did have an interview with three Samsung engineers to confirm some points relating to the process of measurements. 11:11:29 11:11:33 11:11:36

Q. Not the question I asked. 11:11:39

Did you discuss the patents-in-suit with any Samsung engineers? 11:11:40 11:11:43

A. I'm sorry. 11:11:44

Are you asking if that is separate from my interviews which were conducted with counsel or outside of -- outside of the case? 11:11:45 11:11:48 11:11:51

Q. Did you show Samsung engineers the patents and discuss them with them? 11:11:53 11:11:56

A. I'm sorry. 11:11:58

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I'm not sure I understand the question. 11:12:02
So all of the discussions I have had with 11:12:04
Samsung engineers related to these patents are only 11:12:07
those interviews that I -- that I disclosed in my 11:12:11
report. 11:12:13
Q. And did you actually discuss the patents 11:12:14
with them specifically, look at the claims with them? 11:12:16
A. No. 11:12:20
In general, those conversations were 11:12:20
discussions relating to some questions I had about, 11:12:23
you know, what certain documents meant, you know, 11:12:27
translation of some terms, and confirmation again of 11:12:32
certain issues that I wanted to clarify in the 11:12:36
documentation that was sent over. 11:12:38
Q. Did you ask these Samsung engineers their 11:12:41
views on the patents-in-suit? 11:12:44
A. I did not ask them for their opinions on the 11:12:47
patents. The discussions were technical discussions 11:12:53
relating to the document. 11:12:56
Q. What does it mean you deposit something as 11:12:59
a mixture? What is -- what is the result of that? 11:13:44
It requires that there be the exact same con- -- 11:13:47
con- -- concentration of both materials; correct? 11:13:51
MR. SNYDER: Objection to form. 11:13:55
THE WITNESS: I disagree. 11:13:55

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BY MR. SHEASBY: 11:14:04

Q. So what does it mean for two substances to be deposited as a mixture? 11:14:39 11:14:43

A. So for -- to speak generally, for two substances to be a mixture, we have a concentration of one substance, concentration of the other, and the two are combined in a way that distributes the -- the composition between them. 11:14:49 11:14:54 11:14:58 11:15:01 11:15:05

Q. Equal amounts? 11:15:07

MR. SNYDER: Objection to form. 11:15:11

THE WITNESS: I disagree that it means equal amounts; so we have peanut butter and jelly. You can have a different concentration of one or the other, but there is nothing in the word mixture that requires that it be a 50/50 mix of the two materials. 11:15:12 11:15:15 11:15:21 11:15:24 11:15:27

BY MR. SHEASBY: 11:15:31

Q. Are the organic material and the metal complex in the METL present throughout the ETL? 11:15:31 11:15:36

MR. SNYDER: Objection to form. 11:15:45

THE WITNESS: So the METL, as the name implies, is mixed, and so there is -- both materials are present in the ETL throughout that layer. 11:15:47 11:15:53 11:15:57

BY MR. SHEASBY: 11:16:00

Q. Let me ask you the next question, which is -- hmmm. 11:16:00 11:16:02

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Have you ever used Liq in making any OLEDs? 11:16:23
A. I, personally have not used the Liq 11:16:30
equivalent, no. 11:16:33
Q. Have you used any lithium-containing 11:16:33
compounds? 11:16:37
A. Yes. 11:16:38
I often use lithium fluoride as an electron 11:16:38
injection layer. That lithium fluoride is a -- is 11:16:43
a pretty inert salt, and so it is usually -- when 11:16:47
I use it, I put it at the very top layer on top of 11:16:51
the electron transport layer, and that is activated 11:16:55
by the deposition of aluminum, and that forms 11:16:58
aluminum fluoride and releases the lithium as a -- as 11:17:02
a doping at that interphase. 11:17:07
Q. Okay. Hmmm. 11:17:10
Let's go to Exhibit 13 -- sorry. 11:19:32
Exhibit 13? Yes. Go ahead and download that. 11:19:58
A. Okay. 11:20:08
Q. Sorry. Exhibit 14. 11:20:10
A. Exhibit 14? I was going to say Exhibit 13 11:20:13
is the patent. 11:20:19
(Deposition Exhibit Number 14 11:20:19
was marked for identification.) 11:20:32
THE WITNESS: Okay. I have it open. 11:20:32
///

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BY MR. SHEASBY: 11:20:34

Q. Have you reviewed this document? 11:20:54

A. I have seen it before, yes. 11:20:56

Q. In your report, you don't indicate any disputes with this experimental methodology; is that correct? 11:20:58 11:21:03 11:21:08

MR. SNYDER: Objection to form. 11:21:08

THE WITNESS: I detail a number of objections I have to Dr. Schanze's analysis and work in my report; so I would disagree with that statement. 11:21:10 11:21:13 11:21:19 11:21:22

BY MR. SHEASBY: 11:21:22

Q. Now, Exhibit 14 is a report by Novateq. 11:21:23

A. Oh, okay. Sorry. I have Exhibit 15 opened, which also says export. 11:21:29 11:21:37

Q. Yeah. 11:21:39

It is a little bit confusing. 11:21:39

A. Let me clear all of my tabs and go back. Exhibit 14. 11:21:42 11:21:55

Okay. Great. Sorry. 11:22:41

If you could ask your question again. 11:22:44

BY MR. SHEASBY: 11:22:46

Q. Yes. 11:22:47

The question is you don't specify in your report any disputes with the methodology used by 11:22:47 11:22:50

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Novateq in the analysis in Exhibit 14; correct? 11:22:54

MR. SNYDER: Objection to form. Sorry. 11:22:59

Objection to form. 11:23:00

THE WITNESS: So I object to the 11:23:02

interpretation of the results, but I have no 11:23:06

objection specifically to the measurements that were 11:23:10

taken by Novateq. 11:23:13

MR. SHEASBY: Objection. Form. 11:23:16

BY MR. SHEASBY: 11:23:17

Q. In your report you don't identify any 11:23:18

disputes or objections to the methodology used by 11:23:20

Novateq; correct? 11:23:24

MR. SNYDER: Objection to form. 11:23:26

THE WITNESS: So, again, the -- the work 11:23:28

that -- that Novateq did from the perspective of 11:23:31

taking measurements, I did not -- I had no objections 11:23:37

specifically to that analysis. 11:23:44

BY MR. SHEASBY: 11:23:48

Q. Let me ask the next question, which is if 11:23:48

you go to page forty-five of this report. 11:23:51

A. Okay. I just wanted to complete that the 11:23:54

interpretation and the order of the tests I do have 11:23:57

a number of objections to. 11:23:59

MR. SHEASBY: Objection. Form. 11:24:01

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BY MR. SHEASBY: 11:24:02

Q. Do you have any dispute with the methodology used by Novateq? Yes or no? 11:24:02 11:24:04

MR. SNYDER: Objection to form. 11:24:07

THE WITNESS: I'm going to do yes or no. I'll say yes. 11:24:08 11:24:10

BY MR. SHEASBY: 11:24:10

Q. Great. 11:24:12

And so let's go to page forty-five. 11:24:12

A. (Witness complies.) 11:24:23

Okay. 11:24:25

Q. [redacted] 11:24:34

Q. [redacted] 11:25:50

MR. SNYDER: Objection. 11:25:52

THE WITNESS: So I -- following the description in the specification of the -- of the patent, no. It is not. 11:25:53 11:26:02 11:26:09

BY MR. SHEASBY: 11:26:10

Q. What do you mean, following the description? 11:26:10

A. [redacted] 11:26:25

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[redacted] 11:26:42

Q. Not the question I asked. 11:26:49

MR. SHEASBY: Objection to form. 11:26:52

BY MR. SHEASBY: 11:26:52

Q. [redacted] 11:26:56

MR. SNYDER: Objection to form. 11:26:58

THE WITNESS: [redacted] 11:27:11

BY MR. SHEASBY: 11:27:14

Q. Okay. Let's go to paragraph eighty-one of your report. And this is your rebuttal report. 11:27:14 11:27:17

A. (Witness complies.) 11:27:32

Okay. I am there now. 11:27:52

Q. Okay. In -- in this -- in this structure, [redacted]? 11:27:54 11:28:11

MR. SNYDER: Objection. 11:28:17

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THE WITNESS: [redacted]

[redacted]. 11:28:25

MR. SHEASBY: Okay. I have marked a new 11:28:29
exhibit, Exhibit 16. 11:29:29
(Deposition Exhibit Number 16 11:29:29
was marked for identification.) 11:29:31
BY MR. SHEASBY: 11:29:31
Q. Go ahead and download it. 11:29:31
A. (Witness complies.) 11:29:49
Okay. Give me a second to take a look. 11:29:50
MR. SNYDER: Jason, I think we have been 11:29:54
going for over an hour; so if we could take a break 11:29:56
soon. 11:30:00
MR. SHEASBY: Yeah. 11:30:01
Why don't we just break for lunch after this 11:30:01
question -- after this -- this line of questioning. 11:30:04
THE WITNESS: Okay. Great. 11:30:07
I have the reference open. 11:30:10
BY MR. SHEASBY: 11:30:12
Q. Have you looked at this reference 11:30:12
previously? 11:30:14
A. Yes, I have. 11:30:14
Q. And did you have discussions regarding it 11:30:15
with Mr. Kang? 11:30:19

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A. No. 11:30:21
I did not have any discussions with 11:30:22
Mr. Kang. 11:30:24
Q. This article concludes that ETL and Liq 11:30:25
interact through a coordination bond; correct? 11:30:53
A. I disagree under my understanding of the 11:30:57
coordination bond that this article shows that 11:31:00
conclusion. 11:31:03
Q. The article literally states ETL and Liq 11:31:04
interact through a coordination bond; correct? 11:31:09
A. The article uses those words, but I disagree 11:31:12
that the article shows the formation of 11:31:16
a coordination bond. 11:31:18
Q. Great. 11:31:19
So you disagree with Mr. Kang? 11:31:20
A. Again, I would not describe what he shows or 11:31:22
the net effect as a coordination bond. 11:31:26
Q. This is a peer-reviewed publication on 11:31:30
experiments involving Liq; correct? 11:31:34
A. This is a peer-reviewed publication, and 11:31:36
lithium quinolate is used in this publication. 11:31:40
Q. And you have never published on the use of 11:31:43
Liq. 11:31:46
In fact, you have never used Liq in your 11:31:46
entire career; right? 11:31:49

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MR. SNYDER: Objection to form. 11:31:50

THE WITNESS: I have -- I have never 11:31:51
published on the use of Liq quinolate. 11:31:52

BY MR. SHEASBY: 11:31:56

Q. Have you ever used it in your entire career? 11:31:56

A. I don't believe that I have, although -- 11:32:00
yeah. I'll leave it at that. 11:32:04

Q. And you believe that Liq does not form 11:32:06
a coordination bond with ETL; correct? 11:32:11

A. That is correct. 11:32:15

Q. And looking at this article by Samsung 11:32:16
dis- -- Sam- -- from the Samsung display, Researcher 11:32:47
Sunwoo Kang in the peer-reviewed journal, why don't 11:32:54
you read out loud the sentence in blue highlighting? 11:32:55

A. Okay. And, again, this is the language of 11:33:01
the paper, not my position: 11:33:03

"It was found that ETL-Liq complex could 11:33:06
be formed from an attractive interaction 11:33:10
between ETL and Liq through a coordination 11:33:13
bond." 11:33:17

Q. Did you discuss this paper with any of the 11:33:18
Samsung engineers that you talked to? 11:33:20

A. I don't believe this came up in my 11:33:22
discussion with the Samsung engineer. 11:33:25

Q. Did you ask Samsung lawyers to allow you to 11:33:26

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speak to Mr. Kang? 11:33:29
MR. SNYDER: Objection based on the wording 11:33:31
of that question -- 11:33:34
THE REPORTER: I can't hear you at all. 11:33:37
MR. SNYDER: Yes. 11:33:39
Based on the wording of that question, 11:33:40
I instruct the witness not to answer. 11:33:42
BY MR. SHEASBY: 11:33:45
Q. Who do you think knows more about Liq, you 11:33:45
or Mr. Kang? 11:33:50
A. So, again, the word coordination has 11:33:51
a specific meaning and construction, and my 11:33:55
interpretation and answers are based on that specific 11:33:58
meaning and construction. 11:34:01
MR. SHEASBY: Objection. Form. 11:34:03
BY MR. SHEASBY: 11:34:04
Q. I asked you who do you think knows more 11:34:04
about Liq, you or Mr. King? 11:34:08
MR. SNYDER: Objection to form. 11:34:10
THE WITNESS: I don't have an opinion on the 11:34:12
relative expertise that I and Mr. Kang have on the 11:34:13
specifics of lithium quinolate. 11:34:17
BY MR. SHEASBY: 11:34:21
Q. Well, we do know one thing, which is he has 11:34:21
published a peer-reviewed article on the subject; 11:34:24

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correct? 11:34:27

A. He has. That is correct. 11:34:27

Q. You have not; correct? 11:34:28

A. I have not. 11:34:30

Q. And, in fact, you have never used Liq in your entire career, as far as you know; correct? 11:34:30 11:34:34

A. Again, I have not used Liq that I can recall in my career; that is correct. 11:34:36 11:34:41

MR. SHEASBY: Okay. Why don't we break for lunch. 11:34:43 11:34:45

THE VIDEOGRAPHER: Okay. This marks the end of media unit three. 11:34:46 11:34:48

The time is 11:34 a.m. 11:34:50

We are off the record. 11:34:52

(Luncheon recess taken.) 12:39:41

THE VIDEOGRAPHER: This marks the beginning of media unit number four. 12:39:41 12:39:49

The time is 12:39 p.m. 12:39:52

We are on the record. 12:39:54

BY MR. SHEASBY: 12:39:55

Q. Sir, joint vaporization doesn't require a mixture in the gas phase; correct? 12:39:55 12:39:58

A. So, again -- all right. Give me a second to just recalibrate on my report. 12:40:03 12:40:10

But, again, the -- the patent doesn't 12:40:13

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specify where the -- sorry. Let me start again. 12:40:15

Joint vaporization is, again, that -- 12:40:23

that -- that evaporation or vapor- -- vaporization 12:40:27

which allows at least for the opportunity for the 12:40:31

materials to -- to interact. 12:40:34

Q. In a gaseous phase? 12:40:38

A. So, again, it is not a requirement for the 12:40:40

coordination to necessarily happen at a specific 12:40:43

spot, but I -- if you give me a second, I will pull 12:40:45

up my definition in my report. But certainly the gas 12:40:51

phase is one region where there is the opportunity 12:40:57

for interaction to occur. 12:41:01

So in my report -- if we go to paragraph 12:41:44

fifty-two of my noninfringement report, it has some 12:41:47

discussion about what is not joint vaporization. 12:41:54

Again, there is no, really -- it depends in many 12:41:57

cases on some of the details, like the reactivity of 12:42:02

the materials, the degree of interaction, the 12:42:06

pressure that occurs, the overlap of the gas plumes, 12:42:09

during vaporization, et cetera. 12:42:14

And so -- again, there is the opportunity 12:42:16

for that interaction, but it -- it -- whether the 12:42:20

reaction happens exactly in one spot or another is 12:42:29

not so specified. As I say, a POSITA would recognize 12:42:31

joint vaporization requires metal complex. And, 12:42:33

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there again, the compound should be coevaporated so that they are immediately present in the same vapor phase. 12:42:38 12:42:38 12:42:41

Q. And what does it mean to be immediately present in the same vapor phase? 12:42:41 12:42:43

A. So that would mean that at least at some point they are colocated in space while they are in the vapor phase. 12:42:46 12:42:50 12:42:57

Q. What does it mean to be colocated in space? 12:42:58

A. So that would mean that they are in the same location in -- in -- in space in -- during the -- during the vaporization. 12:43:01 12:43:08 12:43:11

Q. What does it mean to be in the same location in space? 12:43:12 12:43:15

A. I'm sorry. 12:43:17

I'm not sure what you are asking, beyond the ordinary meaning of being in the same location. 12:43:18 12:43:21

Q. Yes. 12:43:24

That's what I am asking. 12:43:27

What does it mean to be in the same location? 12:43:28 12:43:30

A. So the -- the vaporization has a particular plume. And the molecules, while they are in space, if they are colocated, they are in the same place. That is -- that is the meaning of colocation. 12:43:31 12:43:38 12:43:41 12:43:46

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Q. So the plumes would overlap? 12:43:48
A. The plumes overlapping is one way for there to be that colocation. 12:43:50 12:43:54
Q. What are the other ways for there to be that colocation? 12:43:56 12:43:59
A. So for -- I don't know that I have the list specifically. You know, I would -- I would say, you know, again, in the evaporation having the plumes overlap is one way that it is possible to have the colocated. 12:44:00 12:44:11 12:44:18 12:44:22 12:44:26
Q. Right. 12:44:26
And I am asking for what are the other ways of colocation that you are aware of? 12:44:27 12:44:29
A. Just thinking here right now, I can't think of any right off the top of my head. 12:44:32 12:44:35
Q. Okay. Why don't you go ahead and download Exhibits 18 through 20. 12:44:37 12:44:52
(Deposition Exhibit Number 18 was marked for identification.) 12:44:52 12:44:57
(Deposition Exhibit Number 19 was marked for identification.) 12:44:57 12:44:57
(Deposition Exhibit Number 20 was marked for identification.) 12:44:57 12:44:58
THE WITNESS: Okay. Okay. I have them downloaded. 12:44:58 12:45:21

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BY MR. SHEASBY: 12:45:22

Q. Okay. So one of the prior arts -- prior references you rely on is the display in what you describe as the Clix2; is that correct? 12:45:22 12:45:24 12:45:27

A. Yes. 12:45:30

The Clix2, yes. 12:45:31

Q. And the Clix2 screen you claim is OLED -- an OLED; is that correct? 12:45:32 12:45:39

A. That is correct. 12:45:40

The Clix2 used an OLED display as its screen. 12:45:41 12:45:46

Q. Did you investigate whether there was a different Clix2 display using the United States versus the one outside the United States? 12:45:46 12:45:48 12:45:53

A. So there is substantial evidence, which I detail in my report, that the Clix2, and every model of the Clix2, used an organic light-emitting diode display. 12:45:56 12:45:58 12:46:01 12:46:06

Q. Not the question I asked. 12:46:06

I said did you investigate it? 12:46:08

MR. SNYDER: Objection to form. 12:46:10

THE WITNESS: So I reviewed the evidence, which I describe in my report. That is the extent of my investigation. 12:46:11 12:46:14 12:46:19

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BY MR. SHEASBY: 12:46:20

Q. Did you speak to the individuals who 12:46:20

manufactured the Clix2? 12:46:22

A. So I, personally, did not -- well, I'm 12:46:25

sorry. 12:46:32

Are we asking about the screen or are we 12:46:33

asking about the finished unit? 12:46:36

Q. The finished? 12:46:39

A. So no. 12:46:41

I did not have an interview with anybody at 12:46:42

Dreamus. I just have their declaration, which is in 12:46:45

the report as well -- is cited in my report. 12:46:48

Q. Okay. So if we go to Exhibit 18 -- first 12:46:52

off, what process was used for the OLED screen in the 12:47:04

Clix2 product? 12:47:11

MR. SNYDER: Objection to form. 12:47:14

THE WITNESS: I'm sorry. 12:47:15

Are you asking about the code name for the 12:47:19

process or a different description? 12:47:22

BY MR. SHEASBY: 12:47:26

Q. What is the name of the process? 12:47:26

MR. SNYDER: Objection to form. 12:47:28

THE WITNESS: So Samsung described this as 12:47:29

[redacted] 12:47:43

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BY MR. SHEASBY: 12:47:43

Q. [redacted]

[redacted] 12:47:53

Q. [redacted]

[redacted] 12:47:57

A. [redacted]

[redacted] 12:48:05

Q. Not the question I asked. 12:48:07

[redacted]

[redacted] 12:48:13

MR. SNYDER: Objection to form. 12:48:15

THE WITNESS: [redacted]

[redacted]

[redacted] 12:48:28

BY MR. SHEASBY: 12:48:29

Q. [redacted]

[redacted] 12:48:33

A. [redacted]

[redacted]

[redacted] 12:48:57

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[redacted]. 12:49:07

Q. So you cite a teardown by a company called Eurofins; correct? 12:49:08 12:49:37

A. That is correct. 12:49:40

Q. And if you go to Exhibit 18, did you supervise the experiments in Exhibit 18? 12:49:41 12:50:17

A. I'm not sure exactly what you mean by supervised. I was involved in helping to confirm the teardown structure and had some discussion with the engineers at Eurofins, but I did not, for example, fly to Europe in order to participate personally in any of the teardown. 12:50:20 12:50:25 12:50:30 12:50:33 12:50:38 12:50:42

Q. And did you tear down the product? 12:50:44

A. I was not personally involved in any of the disassembly or analysis of the product. 12:50:46 12:50:55

Q. Okay. If you turn to page twenty-four of the document, on the right-hand side it has a date of 01/09/2008. 12:50:58 12:51:10 12:51:16

Do you see that? 12:51:18

MR. SNYDER: Objection to form. 12:51:19

THE WITNESS: I do not see that, no. 12:51:22

BY MR. SHEASBY: 12:51:25

Q. Do you see .01.09? 12:51:26

A. So I see numbers on the circuit board, but I disagree that that is a date. 12:51:31 12:51:35

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Q. Okay. What is it then? 12:51:37
A. There are a significant number of numbers 12:51:39
that are on the circuit board. And, again, I see no 12:51:43
reason to believe that that is a date. 12:51:47
Q. Did you ask the manufacturers if it was 12:51:49
a date? 12:51:52
A. I -- as I mentioned, I had no discussion 12:51:53
with the manufacturer. 12:51:58
Q. Did you do anything to confirm that this was 12:51:59
actually an iRiver Clix2 that was sold before the 12:52:02
date of the patents-in-suit in the United States? 12:52:07
This specific product. 12:52:11
MR. SNYDER: Objection to form. 12:52:15
THE WITNESS: So there is significant 12:52:17
evidence that this unit was sold before the priority 12:52:20
date of the patent in evidence. In particular, there 12:52:25
is the sale receipt of the product on its first sale, 12:52:28
which was provided, as well as documentation that the 12:52:33
product was released well before the priority date of 12:52:39
the patents-in-suit. 12:52:43
BY MR. SHEASBY: 12:52:44
Q. So Exhibit 17 is the -- this sale receipt 12:52:44
you are referring to? 12:52:49
A. That is one of the pieces of evidence that 12:52:50
is the sales receipt, yes. 12:52:52

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Q. And who purchased this product? 12:52:54

A. So the product was purchased by -- I think it is on the next page. The -- oh, I guess I don't know. Again, I had no contact with the individual who purchased the product. 12:52:56 12:53:05 12:53:15 12:53:27

Q. Was that individual deposed? 12:53:28

A. I am not aware of that individual being deposed. 12:53:31 12:53:36

Q. Did they submit a declaration? 12:53:37

A. I am not aware of that individual having submitted a declaration. 12:53:42 12:53:45

Q. Do you know if anything was done to authenticate that this receipt related to the actual device that was shipped to Quinn Emanuel, Samsung's counsel? 12:53:45 12:53:48 12:53:52 12:53:57

MR. SNYDER: Objection to form. 12:54:03

THE WITNESS: So this is the customary receipt that one receives from eBay. And so, again, I am not aware of any further authentication that has been attempted. But this is consistent with what one receives when they purchase off eBay. I have done it many times, and this is the normal documentation one receives. 12:54:04 12:54:06 12:54:11 12:54:16 12:54:21 12:54:25 12:54:28

BY MR. SHEASBY: 12:54:28

Q. So the normal documentation is thank you for 12:54:28

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shopping at iRiver America. We are happy to report that your Order Number 235648 shipped on 10/03/2007? 12:54:31 12:54:36

A. Oh, sorry. You are talking about the iRiver receipt, yeah. That is the receipt that the -- the seller received and that they forwarded. 12:54:42 12:54:44 12:54:46

Q. Yeah. 12:54:47

I know that is what the seller received and forwarded. 12:54:47 12:54:51

But what is the evidence that that receipt relates to the actual product that was shipped to Quinn Emanuel? 12:54:53 12:54:55 12:54:57

MR. SNYDER: Objection to form. 12:54:58

THE WITNESS: So, again, I am not aware of any further authentication that has been done. 12:54:59 12:55:02

BY MR. SHEASBY: 12:55:04

Q. Did you do anything to authenticate it? 12:55:04

A. I have no other interaction with the receipt specifically. 12:55:07 12:55:18

Q. [redacted] 12:55:48

A. [redacted] 12:56:04

Q. [redacted] 12:56:10

A. [redacted] 12:56:13

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[redacted] 56:17

Q. [redacted]

[redacted] 12:56:22

A. I did not conduct any experiments examining 12:56:25

the -- the plume. 12:56:29

Q. Did you know the shapes of the vessels that 12:56:31

were used in [redacted] 12:56:33

A. [redacted]

[redacted]

[redacted] 12:56:47

Q. [redacted]

[redacted]

[redacted]

[redacted]

[redacted] 12:56:59

Q. [redacted]

[redacted]

[redacted] 12:57:09

A. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted] :57:42

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[redacted] 12:57:46

Q. Yeah. 12:57:50

And so now I'm asking you did you do a simulation to establish that? 12:57:51 12:57:53

A. So I did not independently do any simulation of the plume shape in -- in the deposition process. 12:57:55 12:58:00

Q. For either [redacted] or the current process? 12:58:05

A. I have not, personally, done any simulation for [redacted] or the current process of the exact shape of the plume direction. 12:58:08 12:58:14 12:58:19

MR. SHEASBY: Okay. I'm marking Exhibit 21. 12:58:20

(Deposition Exhibit Number 21 was marked for identification.) 12:58:20 12:58:56

BY MR. SHEASBY: 12:58:56

Q. Let me know when you get it. 12:58:56

A. Okay. 12:58:58

Q. It may take a minute. 12:59:18

A. Okay. I have the document. 12:59:39

Q. Let's go to Page 77047. 12:59:41

A. (Witness complies.) 12:59:50

Okay. Okay. 13:00:09

Q. You agree that whether electron-conducting layers formed by joint vaporization depends, in part, on the configuration via evaporation chambers? 13:00:15 13:00:18 13:00:22

A. One of the components of considering joint 13:00:28

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vaporization -- joint vaporization is the configuration of the evaporation chamber. 13:00:30 13:00:31

Q. And that would include chamber height, variable baffle height, placement of the shudder -- shudder, and lip length? 13:00:35 13:00:39 13:00:43

A. Yes. 13:00:44

Amongst other considerations, the -- the baffles, the shape of the emitter, and also the pressure in the chamber will also have an effect. 13:00:44 13:00:46 13:00:49

Q. And, in fact, if you go to page -- if you go to Exhibit 31 [sic] and look at 77047, [redacted] 13:00:52 13:01:09

MR. SNYDER: Objection to form. 13:01:11

THE WITNESS: So it shows that, yes. [redacted] 13:01:27

BY MR. SHEASBY: 13:01:28

Q. Did you say shadowing? 13:01:29

A. [redacted] 13:01:35

Q. Right. 13:01:41

And you used shadowing to describe that; correct? 13:01:43 13:01:48

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A. That is one word that can be used to describe that effect. 13:01:49 13:01:51

Q. Okay. Let's turn to your open report at Page 147. 13:01:51 13:04:46

A. (Witness complies.) 13:04:47

This is the .pdf Page 147 or the marked Page 1- -- 13:04:58 13:05:02

Q. Marked Page 147; so it is -- it is -- it is Paragraph 294. 13:05:02 13:05:06

A. Okay. I'm there now. 13:05:08

Q. Where in this document that you cite on Page 147 does it show that the -- that [redacted] 13:05:12 13:05:57

A. So if we look there in that figure, the ETL layer was deposited in the system that is surrounded by the red box. And if you zoom in, you will see on the upper left the chamber, [redacted] is labeled METL. 13:06:05 13:06:16 13:06:21 13:06:29

Q. So you think only that chamber -- so only that chamber was used for METL. 13:06:32 13:06:38

You think that that annotation of METL is only associated [redacted]? 13:06:42 13:06:45

A. So that is my understanding of the structure that is in that top line. The -- as -- as you have seen in the other documentation, [redacted] 13:06:50 13:06:55 13:07:01

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[redacted] 13:07:21

But at least for that top line, it is my understanding [redacted] delivers the METL. In some of the more advanced lines in the future, the configuration may be slightly different. 13:07:23 13:07:25 13:07:30 13:07:35

Q. Right. 13:07:37

And so a couple issues. 13:07:37

That -- you think that your evidence that [redacted] is the chamber that delivers the METL is the fact that there is that word METL written above what you claim [redacted]; is that right? 13:07:42 13:07:45 13:07:50 13:07:52

A. That is one of the pieces of evidence. There is additional documentation in the -- in the -- in the data sheets and in the project breakdown that also discusses the chamber configurations. 13:07:57 13:08:00 13:08:03 13:08:08

Q. [redacted] 13:08:18

A. [redacted] 13:08:34

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Q. Okay. So let's go -- go to the next document. 13:08:35 13:08:40

[redacted] 13:08:53

Q. Where are they? 13:08:57

A. [redacted] :37

THE REPORTER: Are the what? 13:09:42

THE WITNESS: I'm sorry. 13:09:44

Are the crucibles. 13:09:45

BY MR. SHEASBY: 13:09:46

Q. [redacted] 13:09:49

A. [redacted] 13:10:01 13:10:05

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Q. Okay. Let's go to the next page, Paragraph 296. 13:10:05 13:10:11

A. (Witness complies.) 13:10:13

I'm okay. I am there now. 13:10:15

Q. What is the document in page -- on Paragraph 296 depicting? 13:10:18 13:10:23

A. [redacted] 13:10:41

Q. Does this show joint vaporization? 13:10:43

A. [redacted] 13:11:06

Q. And let's go to the next paragraph. It is Paragraph 297. 13:11:08 13:11:20

A. Uh-huh. 13:11:21

Q. This is a document for [redacted] is that correct? 13:11:22 13:11:27

A. That is correct. 13:11:27

Q. And it shows the chamber in which the -- in which -- by the way, what is alignment? 13:11:28 13:11:33

A. [redacted] 13:11:38

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[redacted]. 13:11:47

Q. And where it says 360, what is that column referring to? 13:11:50 13:11:54

A. I'm sorry. 13:11:56

Where are we pointing now? 13:11:57

Q. Paragraph 297, the red box. 13:11:59

A. 297, the red box. I'm sorry. I am just not clear. 13:12:03 13:12:18

Paragraph 297 says: 13:12:18

[redacted] 13:12:34

Q. Right. 13:12:35

[redacted] 13:12:35

A. [redacted] 13:12:43

Q. Okay. Does this document show that they are jointly vaporized? 13:12:43 13:12:48

A. [redacted] 13:12:59

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[redacted] 13:13:02

Q. Okay. [redacted]

[redacted]; correct? 13:13:08

A. That is what this document says, yes. 13:13:12

Q. And the document you cited previously for 13:13:14

the [redacted]process says the -- the -- the METL you claim 13:13:17

is in [redacted] 13:13:22

A. That is what that document shows; correct. 13:13:25

Q. Which one -- is the [redacted]the same as the [redacted] 13:13:28

line? 13:13:32

MR. SNYDER: Objection to form. 13:13:33

THE WITNESS: [redacted]

[redacted] 13:13:47

BY MR. SHEASBY: 13:13:51

Q. Right. 13:13:51

So that is what I'm asking you. 13:13:51

This [redacted]one, what is the date of this 13:13:53

document for this process? 13:13:57

A. I would need to check the original 13:13:58

reference, if you have that available. Cited as 13:14:05

citation in Footnote 235. 13:14:10

Q. I do think I have it. Just give me one 13:14:13

second. 13:14:16

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A. Okay. 13:14:16

MR. SHEASBY: Okay. I have just marked it as a new exhibit. 13:15:04 13:15:08

(Deposition Exhibit Number 22 was marked for identification.) 13:15:08 13:15:16

THE REPORTER: What number? 13:15:16

MR. SHEASBY: It looks like it is twenty-two. 13:15:18 13:15:20

THE WITNESS: So I -- yeah. 13:16:02

So I don't know when the document was -- was first presented, yeah. I would have to -- I would have to check with -- I would have to check with others at Samsung to -- to translate it for me. 13:16:04 13:16:07 13:16:11 13:16:18

BY MR. SHEASBY: 13:16:21

Q. In your report, do you cite any evidence whatsoever that this [redacted] document existed at the time of the -- before the priority date of patents-in-suit? 13:16:22 13:16:24 13:16:28 13:16:32

A. So -- okay. In my report I discuss the review that I had of the process with several engineers at Samsung who worked on the -- the Clix2 product, and they confirmed that the process, as I understood it, was the process used for the Clix1, and that predates the -- the -- the start of the Clix1 production process, which is also then before 13:16:33 13:16:41 13:16:44 13:16:49 13:16:52 13:16:56 13:17:00

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the priority date of the patents that are involved in the suit. 13:17:03 13:17:06

MR. SHEASBY: Objection. Form. 13:17:07

BY MR. SHEASBY: 13:17:08

Q. The document -- SDC_74321, do you cite any evidence whatsoever that that document existed before the priority date of the patents-in-suit? Yes or no? 13:17:08 13:17:16 13:17:19

MR. SNYDER: Objection to form. 13:17:23

THE WITNESS: So I do not cite any specific evidence relating to that document specifically. 13:17:24 13:17:27

BY MR. SHEASBY: 13:17:33

Q. Okay. Why don't you pull down Exhibit 26. 13:17:33

(Deposition Exhibit Number 26 was marked for identification.) 13:17:33 13:18:57

THE WITNESS: I don't see it yet. 13:18:57

BY MR. SHEASBY: 13:19:15

Q. Try it now. 13:19:16

A. Okay. I have the document. 13:19:33

Q. So this is -- this document, Exhibit 26, has a date of May 14th, 2008, on it. 13:19:36 13:20:14

Do you see that? 13:20:18

A. I see that on the cover page, yes. 13:20:19

Q. Yes. 13:20:25

And that is after the alleged date of the -- of the shipment of the -- the Clix2 in 2007 that we 13:20:26 13:20:30

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saw in this e-mail. 13:20:36

Do you see that? 13:20:37

A. That is after that date. 13:20:39

Q. And did you investigation whether the 13:20:41

process -- the [redacted] process changed between 2007 and 13:20:43

2008 in 2009? 13:20:50

A. Yes. 13:20:54

In my report, I have -- if you go to 13:20:55

Paragraph 303 of my opening report, [redacted]

[redacted] 13:21:18

Q. Right. 13:21:21

You realize that is a hearsay document; 13:21:21

correct? 13:21:24

MR. SNYDER: Objection to form. 13:21:24

THE WITNESS: I'm not a lawyer, and so I -- 13:21:26

yeah. 13:21:29

BY MR. SHEASBY: 13:21:30

Q. So here is what I'm asking for. I'm asking 13:21:30

for a document [redacted]

[redacted] 13:22:00

A. I'm sorry. 13:22:18

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Is there a question? 13:22:18

Q. Yes. 13:22:19

I just said that question. [redacted] [redacted]

[redacted] [redacted]

[redacted] 13:22:31

A. So the -- there is substantial documentation 13:22:38
of the process from Samsung. We have testimony 13:22:42
confirming that the process was stable between the 13:22:46
beginning and the end of the project that developed 13:22:50
those materials. And so the documents that we have 13:22:54
all describe the same process, again, as supported by 13:22:59
that testimony, as well as the analysis that we had 13:23:02
performed, which is consistent with that -- that 13:23:05
process, material stack, and process of -- the 13:23:10
teardown of the Clix2 confirmed all of the major 13:23:16
components of the composition and the stack, 13:23:20
confirming that, indeed, the product was made the way 13:23:24
that the documentation supports. 13:23:28

MR. SHEASBY: Objection. Form. 13:23:30

BY MR. SHEASBY: 13:23:31

Q. [redacted] [redacted]

[redacted] [redacted]

[redacted] Point to me the document. 13:23:39

MR. SNYDER: Objection to form. 13:23:43

THE WITNESS: So sitting here right now 13:23:44

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during the deposition, unfortunately, I don't know the exact generation date of all of the documents that I cited, but, again, I am, for all the reasons I described, confident in the statement that the -- [redacted]. And given time to check the production date of all of the documents, I am confident again that there is documentation available that -- that would meet that criteria. But I did not -- 13:23:48 13:23:51 13:23:55 13:24:02 13:24:13 13:24:17 13:24:20 13:24:23 13:24:26

BY MR. SHEASBY: 13:24:27

Q. In -- in your report, point out to me the document you cite [redacted] and that -- 13:24:27 13:24:39

MR. SNYDER: Objection to form. 13:24:41

BY MR. SHEASBY: 13:24:41

Q. Point out to me the document. 13:24:41

A. So, again, sitting here today, I don't know the exact generation date of each of the documents that I relied on. That would require some additional investigation, and I would need to -- to -- to check and see when they were -- when they were provided. 13:24:44 13:24:47 13:24:50 13:24:55 13:24:59

Q. Okay. 13:25:03

A. My -- 13:25:03

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Q. Let me ask you this. 13:25:04

Did you speak to the engineers and tell the 13:25:05

engineers -- say to the engineers at Samsung, [redacted] 13:25:15

Did you ask that of any of the engineers? 13:25:20

A. So, again, my discussion with the engineers 13:25:23

was understanding the stationary of the process, and 13:25:26

they confirmed that the process, after it was 13:25:33

established, remained the same throughout the 13:25:36

project, [redacted] And so that was, again, for 13:25:42

me, adequate to then understand the process and 13:25:46

define it. 13:25:50

I did not have a discussion with the 13:25:51

engineers beyond that -- those parameters. 13:25:53

MR. SHEASBY: Objection. Form. 13:25:57

BY MR. SHEASBY: 13:25:57

Q. Did you ask any Samsung engineer anywhere in 13:25:58

the world or any Samsung attorney anywhere in the 13:26:00

world to [redacted] 13:26:12

MR. SNYDER: I caution the witness not to 13:26:17

reveal the contents of any privileged communication. 13:26:20

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And so on that basis I would instruct the witness not to answer the question without talking to the attorney. 13:26:24 13:26:28 13:26:28

But do not answer the question without talking first to me. 13:26:31 13:26:32

BY MR. SHEASBY: 13:26:32

Q. Did you ask any Samsung employee anywhere in the world [redacted] 13:26:33 13:26:43

MR. SNYDER: I repeat my previous instruction to the extent that Samsung employee also encompasses Samsung's counsel. 13:26:47 13:26:49 13:26:52

MR. SHEASBY: It doesn't. 13:26:55

BY MR. SHEASBY: 13:26:56

Q. You may answer the question. 13:26:56

A. So, again, I have a lot of documentation. And some of that may, indeed, predate that date. Unfortunately, sitting here today, I can't pick out the -- the drafting dates of each of the documents that I relied on. And so with that -- with that caveat, I did not make a specific request for the specific document with -- with that providence. 13:26:58 13:27:03 13:27:06 13:27:09 13:27:14 13:27:19 13:27:24

MR. SHEASBY: Objection. Form. 13:27:27

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BY MR. SHEASBY: 13:27:28

Q. Did you ask a Samsung employee for [redacted] 13:27:29

[redacted] 13:27:36

MR. SNYDER: Objection to form. 13:27:41

THE WITNESS: So, again, with that restriction, I had a lot of documents already produced in my possession, and I was satisfied with their -- with their information; so I did not make that specific request of Samsung employees. 13:27:42 13:27:45 13:27:49 13:27:53 13:27:56

MR. SHEASBY: Objection to form. 13:27:59

BY MR. SHEASBY: 13:28:00

Q. Did you make a request for [redacted] Yes or no? 13:28:07

MR. SNYDER: Objection to form. 13:28:11

THE WITNESS: Yeah. 13:28:12

I'm sorry. I feel like I have already answered that question. 13:28:13 13:28:15

And is there a different way that you would -- 13:28:16 13:28:20

BY MR. SHEASBY: 13:28:20

Q. I'm not allowed to comment on your questioning, sir. That -- I'm not allowed to comment on it. 13:28:21 13:28:23 13:28:26

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A. Okay. That -- that is fine. 13:28:26
Q. So if you can just answer the question. All 13:28:28
I can do is object to form. 13:28:31
A. Okay. I'm sorry. I feel like I have 13:28:35
answered the question. 13:28:38
Q. Okay. We'll try it one more time. It is 13:28:38
a yes-or-no question. 13:28:41
Did you ask any employee at Samsung for 13:28:42
[redacted] 13:28:48
MR. SNYDER: Objection to form. 13:28:53
THE WITNESS: So Samsung produced a large 13:28:54
number of documents, some of which I am confident 13:28:56
were produced before that date. But I did not make 13:28:59
that specific request of any Samsung employees. 13:29:01
MR. SHEASBY: Objection to form. 13:29:05
BY MR. SHEASBY: 13:29:07
Q. Did you ask any Samsung employee for 13:29:07
[redacted] 13:29:14
MR. SNYDER: Objection to form. 13:29:19
BY MR. SHEASBY: 13:29:20
Q. Yes or no? 13:29:21
A. Again, I don't feel this is a yes-or-no 13:29:21
question. I had a large number of documents in my 13:29:24

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possession, and I -- and many of which for particular reasons I am confident predated that date. But I did not make a specific request for any additional documents with that particular date. 13:29:26 13:29:33 13:29:37 13:29:39

MR. SHEASBY: Objection. Form. 13:29:44

BY MR. SHEASBY: 13:29:47

Q. Did any of those documents [redacted] 13:29:54

A. So I show in my report documentation that was produced that details the process used for the -- for the Clix device, and that documentation shows [redacted] And, again, there is substantial documentation and witness testimony that that process was stationary [redacted]. 13:29:56 13:29:59 13:30:14 13:30:16 13:30:19

MR. SHEASBY: Objection. Form. 13:30:25

BY MR. SHEASBY: 13:30:26

Q. Did -- any of the documents you cited that are dated before September of 2008 that have information [redacted]? 13:30:27 13:30:30 13:30:33

A. So, again, sitting here right now, I am not sure which documents have exactly which date. Again, I have that evidence of the process based on the parameters that I had discussed. 13:30:38 13:30:42 13:30:46 13:30:49

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Q. So on this spreadsheet you relied in Paragraph 297, [redacted] 13:30:50 13:30:54

What is [redacted] 13:31:00

A. Sorry. Let me pull that up again. This is in -- 13:31:03 13:31:06

Q. 297. 13:31:08

A. -- my report or are we -- I'm sorry. 13:31:10

Q. Yeah. 13:31:14

Paragraph 297 of your report. 13:31:14

A. 297 of my report. Give me a second to pull that up. 13:31:16 13:31:21

I'm sorry. Paragraph 297? 13:31:33

Q. In Paragraph 297 of your report, sir. 13:31:34

A. This is the opening report? 13:31:37

Q. Yes, sir. 13:31:38

A. Okay. I'm back there now. 13:31:53

Q. What is [redacted] 13:31:54

A. And so [redacted] 13:32:05

I'm sorry. Is -- hmmm. Yeah. I think so. Give me a second. Let me just double-check. 13:32:09 13:32:14

So [redacted] 13:32:45

Q. What is your evidence that it is the code name for the [redacted] 13:32:45 13:32:48

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A. Sorry. Refresh my memory, it had it in Paragraph 302. But in terms of the evidence that was also something that I discussed with Mr. Jo during our conversation, and I specifically asked him about that issue just to confirm. 13:32:51 13:32:56 13:32:58 13:33:04 13:33:07

Q. What is the documentary evidence -- written documentary evidence that [redacted]? 13:33:09 13:33:17

A. Sitting here right now, I can't point specifically to it. But I know it is in other Samsung documentation amongst the process documents and material specs that I cited in my report. But I would need some time to review them in order to point to the specific document that confirms that fact. 13:33:21 13:33:26 13:33:29 13:33:32 13:33:36 13:33:39 13:33:41

Q. Do you cite any document in your report -- discuss any document in your report that defines [redacted]? 13:33:41 13:33:50

A. So I would need to check. I do cite Footnote 238 for the 321 document. But, again, I would need to check my -- 13:33:52 13:33:57 13:34:04

Q. I think I -- I have given you that document -- 13:34:06 13:34:08

A. Same document. 13:34:09

Q. -- so you can check it as much as you want. 13:34:10

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MR. SNYDER: Objection to form. 13:34:14

THE WITNESS: Give me just a second to 13:34:15

check. There are a lot of citations, and so -- and 13:34:17

there were a lot of data sheets and other 13:34:19

documentation; so just give me a moment. 13:34:22

The document doesn't specify. 13:35:21

BY MR. SHEASBY: 13:35:23

Q. Okay. Well, let's dig in a little more. 13:35:23

A. Okay. 13:35:26

Q. Does chamber twelve have the capability of 13:35:26

joint vaporization? 13:35:30

MR. SNYDER: Objection to form. 13:35:32

THE WITNESS: So I don't have, again, the 13:35:33

exact details to understand if that might be 13:35:42

possible, but my understanding, [redacted] 13:36:09

BY MR. SHEASBY: 13:36:10

Q. Okay. Let's go to Werner251. And I believe 13:36:10

that should be -- 13:36:23

A. Exhibit 20? 13:36:31

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Q. Yeah. 13:36:32

That sounds right. Well, yeah. That sounds right. 13:36:34 13:36:38

A. Okay. I'm there now. 13:36:50

Q. Has anyone in the world ever combined the -- a process like the [redacted] process with Werner251? 13:36:52 13:36:57

MR. SNYDER: Objection to form. 13:37:04

THE WITNESS: I -- I'm not sure exactly what you are asking. Werner251 describes a few possible processes and some doping; so I'm not sure what your question is. 13:37:05 13:37:08 13:37:12 13:37:23

BY MR. SHEASBY: 13:37:23

Q. Well, you specify in Paragraph 30 -- 365 you specify a modification that you would make to Clix2 based on Werner251. 13:37:24 13:37:30 13:37:35

A. I have to go there. 13:37:43

Okay. So -- sorry. 13:38:11

You are thinking of the combination of Clix2 and Werner251? 13:38:14 13:38:17

Q. Yes, sir. 13:38:19

I'm asking has anyone in the real world ever made the combination that you propose? 13:38:20 13:38:23

MR. SNYDER: Objection to form. 13:38:26

THE WITNESS: So I -- I can't say whether someone has or has not. 13:38:27 13:38:33

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BY MR. SHEASBY: 13:38:35

Q. Okay. Next question. 13:38:35

Have you ever worked with those materials that you are proposing to swap out of -- of -- of Werner251 in the Clix2? 13:38:39 13:38:47 13:38:52

A. I'm sorry. 13:38:56

Or, more specifically, you are speaking about the paddle wheel-type complexes or -- 13:39:00 13:39:03

Q. Yeah. 13:39:06

The specific complexes that are -- that you are citing in Werner251 and -- 13:39:07 13:39:09

A. So I have not personally used the tungsten W2(hpp4) molecule. 13:39:14 13:39:25

Q. Okay. 13:39:26

MR. SHEASBY: Why don't we take a break while I organize myself. 13:40:44 13:40:46

THE WITNESS: Okay. 13:40:48

THE VIDEOGRAPHER: Okay. This marks the end of media unit number four. 13:40:49 13:40:51

The time is 1:40 p.m. 13:40:53

We are off the record. 13:40:54

(Short recess taken.) 13:57:08

THE VIDEOGRAPHER: This marks the beginning of media unit number five. 13:57:08 13:57:13

The time is 1:57 p.m. 13:57:15

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We are on the record. 13:57:17

BY MR. SHEASBY: 13:57:18

Q. Did you do any analysis as to whether the -- 13:57:20

in your report, did you do analysis as to whether the 13:57:23

materials you proposed to swap in from Werner, how 13:57:26

they would interact with the layers adjacent to the 13:57:30

EML layer? 13:57:34

A. Okay. So we're speaking now about my -- 13:57:38

the -- the -- the Werner -- the Werner modification 13:57:41

that -- that I proposed? 13:57:50

Q. Yes, sir. 13:57:51

A. I did not do any specific analysis relating 13:57:52

to that interaction. 13:57:59

Q. Let me ask the next question. 13:58:00

Did you speak to any Samsung engineers to 13:58:02

see if the Werner materials that you proposed to 13:58:05

introduce would appropriately interact with the 13:58:09

surrounding layers? 13:58:12

A. So my argument is that it would be obvious 13:58:13

to a person of ordinary skill that is not based on 13:58:22

any interviews with Samsung. 13:58:25

MR. SHEASBY: Objection. Form. 13:58:27

BY MR. SHEASBY: 13:58:29

Q. I said did you ask any Samsung engineers 13:58:29

whether the materials you proposed to use from Werner 13:58:32

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would be appropriate and work in a Clix2 process -- the [redacted] process. 13:58:35 13:58:38

A. And I apologize. I believe I have already answered that question, which is that -- that my proposal was based on what I considered to be obvious, and it was not based on any interview with Samsung employees. 13:58:40 13:58:43 13:58:47 13:58:50 13:58:53

MR. SHEASBY: Objection. Form. 13:58:54

BY MR. SHEASBY: 13:58:55

Q. I asked you did you speak to any Samsung employees about your proposal to swap out the Werner -- the -- [redacted] materials with the Werner materials to determine how they interact with other layers? 13:58:55 13:58:57 13:59:00 13:59:06 13:59:09

MR. SNYDER: Objection to form. 13:59:11

THE WITNESS: So, again, I will repeat that my opinion is based on my opinion that that combination is obvious, and it is not based on any interview with any Samsung employees. 13:59:12 13:59:14 13:59:19 13:59:22

MR. SHEASBY: Objection. Form. 13:59:24

BY MR. SHEASBY: 13:59:25

Q. Let's look at Exhibit 19. 13:59:59

A. (Witness complies.) 14:00:02

Q. Wait. Is it Exhibit 19? Yeah. It is Exhibit 19. 14:00:07 14:00:11

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A. Okay. I have the paper up. 14:00:25
Q. Great. 14:00:27
Does Exhibit 19 disclose joint vaporization? 14:00:27
A. So I'm not sure. And there is some 14:00:36
discussion of the deposition, but it is not -- you 14:00:43
know, it is a relatively short paper; so I can't say 14:00:50
whether or not it represents joint vaporization. 14:00:54
Q. Does codeposition necessarily result in 14:00:57
joint vaporization or does joint vaporization -- does 14:01:02
this codeposition necessarily mean there was joint 14:01:06
vaporization? 14:01:09
MR. SNYDER: Objection to form. 14:01:11
THE WITNESS: So, again, not necessarily. 14:01:14
The -- the question of joint vaporization depends on 14:01:16
a number of factors, including the presence of the 14:01:19
materials together; also, their opportunity to 14:01:22
interact; some energetic and kinetic factors. And 14:01:26
so, again, we need to know more details in order to 14:01:33
reach any conclusion about joint vaporization in the 14:01:38
system. 14:01:38
BY MR. SHEASBY: 14:01:39
Q. Why don't you download twenty, twenty-one -- 14:02:05
sorry. Twenty-three, twenty-four, and twenty-five. 14:02:12
(Deposition Exhibit Number 23 14:02:12
was marked for identification.) 14:02:17

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(Deposition Exhibit Number 24 was marked for identification.) 14:02:17

(Deposition Exhibit Number 25 was marked for identification.) 14:02:17

THE WITNESS: Twenty-five is taking a while. 14:02:52

Okay. I have them downloaded. 14:03:00

BY MR. SHEASBY: 14:03:03

Q. Let's pull up Exhibit 23. 14:03:26

A. (Witness complies.) 14:03:29

Okay. I have that up. 14:03:41

Q. So if you go to Exhibit 23, [redacted] 14:04:48

Do you see that? 14:04:55

MR. SNYDER: Objection to form. 14:04:56

THE WITNESS: [redacted] 14:05:08

BY MR. SHEASBY: 14:05:12

Q. Did you ask -- did you have that document translated? 14:05:12

A. I don't know if I did. But, again, the document -- if you are reading through the document, it very, very clearly describes the specification for organic light-emitting diode display. 14:05:14

Q. I understand that. 14:05:37

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[redacted] 14:05:38

A. I would have to check my references to see if this document was translated. But, again, I, even after reviewing this, did not conclude at any point that that statement [redacted] 14:05:44 14:05:46 14:05:52 14:06:01

Q. Did -- did Dreamus make available versions of its devices with LCD displays? 14:06:05 14:06:12

A. I'm sorry. 14:06:16

Are you asking Dreamus as the corporate entity generally? 14:06:19 14:06:23

Q. No. 14:06:24

For the Clix2 product. 14:06:26

A. So.... 14:06:29

MR. SNYDER: Objection to form. 14:06:30

THE WITNESS: So no. 14:06:33

The Clix2 product was only offered in an AMOLED format. 14:06:33 14:06:36

BY MR. SHEASBY: 14:06:37

Q. Okay. So if you go to the spreadsheet, which is Exhibit 24. 14:06:37 14:06:39

A. (Witness complies.) 14:06:42

Q. Go to the sheet one page. 14:07:05

A. (Witness complies.) 14:07:20

Okay. I'm on sheet one. 14:07:20

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Q. Uh-huh. 14:07:25

Okay. Where can I find this? One second. 14:07:54

Hmmm. Let's go -- let's do it in a different way. 14:08:25

Let's go to Exhibit 18. 14:09:37

A. (Witness complies.) 14:09:49

Q. Let's turn to page eight. 14:10:00

A. (Witness complies.) 14:10:04

It is opening. Okay. Page eight. 14:10:09

Q. What are the three matrix materials in the 14:10:14

functional layer in -- in the Clix2 in [redacted] 14:10:18

process? 14:10:25

A. Okay. So I guess I disagree that there are 14:10:28

any matrix materials. Matrix materials, as I discuss 14:10:36

in my report, are only those materials where there 14:10:40

are three components, as defined by the patent. And 14:10:44

there are no layers in the device in which there are 14:10:51

three materials, let alone matrix materials, as -- as 14:10:55

I discuss in my report. 14:10:58

Q. Okay. Let me ask you the next question, 14:11:00

which is if you go to -- hmmm. 14:11:02

Can we go to Segura, which I think is in 14:11:21

paragraph -- what is the paragraph of your report 14:11:25

that has Segura in it? Do you remember? 14:11:27

A. Sorry. 14:11:32

Were you speaking about the combination 14:11:32

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Segura? 14:11:35

Q. Yeah. 14:11:38

Hold on for one second. 14:11:39

MR. SHEASBY: Actually, give me five minutes. Sorry. 14:11:43 14:11:45

Let's go off the record. I have to deal with something. 14:11:46 14:11:49

THE VIDEOGRAPHER: This marks the end of media unit number five. 14:11:49 14:11:51

The time is 2:11 p.m. 14:11:52

We are off the record. 14:11:55

(Short recess taken.) 14:17:54

THE VIDEOGRAPHER: This marks the beginning of media unit number six. 14:17:54 14:17:58

The time is 2:18 p.m. 14:18:00

We are on the record. 14:18:03

BY MR. SHEASBY: 14:18:04

Q. Let's go to the '164 patent. 14:18:05

Do you have it handy? 14:18:13

A. Just give me a moment to bring it up. 14:18:16

Seven. 14:18:30

MR. SNYDER: And, Jason, I don't see that as an exhibit. 14:18:55 14:18:58

Do you have an exhibit number? 14:18:59

THE WITNESS: Yeah. 14:19:02

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Is there an exhibit number? Sorry. 14:19:02

MR. SHEASBY: That will be Exhibit 27. 14:19:47

(Deposition Exhibit Number 27 14:19:47

was marked for identification.) 14:20:04

THE WITNESS: Okay. I have that open. 14:20:04

BY MR. SHEASBY: 14:20:05

Q. Okay. I want to look at claim one. 14:20:05

So it -- it requires an organic functional 14:20:13

layer that has at least three matrix materials; 14:20:18

correct? 14:20:26

A. So that is correct. 14:20:32

There are three matrix materials specified 14:20:36

in claim one. 14:20:39

Q. And those three matrix materials have to be 14:20:40

in a single organic functional layer? 14:20:43

A. That's right. 14:20:48

It specifies there should be one organic 14:20:49

functional layer, and those are the matrix materials 14:20:53

of that functional layer. 14:20:56

Q. And there can be more than those matrix 14:20:56

materials in an organic functional layer, but there 14:21:01

needs to be at least those three; correct? 14:21:02

A. Yes. 14:21:05

There is one layer, but there can be more 14:21:05

materials inside that layer. 14:21:08

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Q. And the layer is defined by the function; is that correct? 14:21:11 14:21:18

MR. SNYDER: Objection to form. 14:21:18

THE WITNESS: Not exclusively. Again, if we look at the specification and the understanding of a person of ordinary skill in the art, there is also an understanding based on, especially the specification, what the layer is. But one of the determining factors is the function of the layer. 14:21:20 14:21:20 14:21:20 14:21:23 14:21:26 14:21:28

BY MR. SHEASBY: 14:21:31

Q. What are the other determining factors? 14:21:31

A. Again, the composition, the -- what the layer does beyond just the electrical function. In some cases the practical function, et cetera. 14:21:40 14:21:42 14:21:46

Q. And specific in this, the emission layer has to be -- in this claim it is an emission layer that has to have at least three matrix materials; correct? 14:21:48 14:21:55 14:21:59

A. So in -- the EML is the layer here, which is described by having these -- these components. 14:22:05 14:22:11

Q. No. 14:22:14

It literally says -- the claim literally says emission layer. It doesn't say EML. 14:22:14 14:22:18

It says emission layer; correct? 14:22:22

A. So that is the language which is in the patent. 14:22:25 14:22:26

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Q. Okay. And so in the patent it specifies an emission layer that is an organic functional layer that has at least three matrix materials in it; correct? 14:22:26 14:22:28 14:22:32 14:22:34

A. The patent describes the organic functional layer with the three matrix materials, and that layer is responsible for the emission in it. 14:22:35 14:22:39 14:22:42

Q. Okay. Now, the -- those matrix materials, what makes a material a matrix material? 14:22:46 14:22:54

A. So, again, there are two possible interpretations here; right? 14:22:58 14:23:04

And I have answered most of your questions under the construction that Samsung has proposed, but I -- I understand also that Pictiva has a different construction. And I got into this a little bit in my report. 14:23:05 14:23:08 14:23:12 14:23:15 14:23:21

Q. I'm just asking for your opinion. 14:23:21

What makes something a matrix material? 14:23:22

A. So, again, there are two constructions, and so I just want to be really careful in my answer because, again -- I have, again, answered a lot of questions, and I want to be clear that there are two possible interpretations. 14:23:25 14:23:32 14:23:36 14:23:39 14:23:46

Q. You can do whatever you want. I am just asking for your interpretation. 14:23:47 14:23:49

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A. Fantastic. 14:23:51
So.... 14:23:52
MR. SNYDER: Objection to form. 14:23:52
THE WITNESS: So give me -- give me one second just to -- just to collect myself for a moment. 14:23:53 14:24:00 14:24:05
Okay. Sorry. Just every time there is a claim construction dispute, I want to be very clear on which construction I am going to be doing an explanation. 14:26:00 14:26:03 14:26:06 14:26:09
So -- so in terms of the matrix material, you know, Samsung has proposed the construction. The first, second, and third matrix materials are different materials and part of the same matrix, and so -- and I agree with that as a general definition of matrix material. 14:26:10 14:26:20 14:26:23 14:26:26 14:26:29 14:26:32
But Pictiva has proposed a different construction, which is the plain and ordinary meaning, which is to say a material that forms a continuous phase. 14:26:34 14:26:36 14:26:39 14:26:42
Now, Samsung's proposal is a little bit more restrictive because it restricts everybody to a single layer. Under Pictiva's understanding, you know, for example, Mr. Humphrey and Dr. Schanze have some considerations which allow for a broader 14:26:44 14:26:47 14:26:50 14:26:54 14:26:59

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definition of what could mean in a layer or within one of the matrix materials. And, again, if there is a claim construction offered by the court, then we'll have to abide by that. 14:27:03 14:27:07 14:27:10 14:27:13

BY MR. SHEASBY: 14:27:14

Q. And what does it mean to be part of the same matrix? 14:27:15 14:27:17

A. So part of the same matrix -- again, the matrix is another one of these disputed terms, and, you know -- and I agree with Samsung's construction as a general matter, which is that it is a continuous phase of the mixture of matrix materials. 14:27:19 14:27:27 14:27:33 14:27:35 14:27:38

But Pictiva has offered an alternative construction, which is to say that they believe it should not be construed and that that should be interpreted under the plain and ordinary meaning. 14:27:41 14:27:47 14:27:49 14:27:51

Q. Okay. 14:27:54

A. And we should examine examples like yours under both constructions just to be careful. 14:27:55 14:27:58

Q. Well, I'm not -- I am asking about your construction. I have said that three times now. 14:28:00 14:28:03

Do you understand that? 14:28:05

A. That's fine. 14:28:06

MR. SNYDER: Objection to form. 14:28:07

MR. SHEASBY: At a break will you instruct 14:28:09

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him to just give the speech you gave about different constructions at the previous break? 14:28:11 14:28:12

MR. SNYDER: Objection to form. 14:28:13

THE WITNESS: So... 14:28:15

MR. SNYDER: And I instruct the witness not to answer on the basis of privilege. 14:28:17 14:28:19

BY MR. SHEASBY: 14:28:19

Q. Did you speak -- 14:28:19

THE REPORTER: On the basis of what? 14:28:19

MR. SNYDER: Privilege. 14:28:25

BY MR. SHEASBY: 14:28:25

Q. Did you speak about your deposition testimony at the last break with your counsel? 14:28:26 14:28:27

MR. SNYDER: I -- to answer that question -- 14:28:30

THE WITNESS: Yeah. No. 14:28:38

BY MR. SHEASBY: 14:28:40

Q. Okay. So what does it mean for the three materials to be part of a continuous phase? 14:28:41 14:28:44

A. So for three materials to be part of a continuous phase is to say that there are three materials that are in a layer that are intermixed. And, as we discussed before, when they are continuous, there is no interruption in the -- the general positioning of the material. 14:28:48 14:28:50 14:28:53 14:28:57 14:28:59 14:29:04

Q. And did -- do they have to be at the same 14:29:06

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concentration at each location in the phase? 14:29:10

A. I think that has to be considered in the 14:29:13
context of a person of ordinary skill in the art, and 14:29:17
I think there can be some difference in the 14:29:21
concentration. But we have to evaluate whether or 14:29:24
not it is a continuous layer or not when we are 14:29:26
making that evaluation. 14:29:29

Q. Right. 14:29:30

And what does it mean for it to be 14:29:30
a continuous layer? 14:29:32

A. Again, I think we have had this 14:29:34
conversation. But the continuous layer is that -- 14:29:37
that layer that has that structure but without 14:29:40
interruption. 14:29:45

Q. What structure? 14:29:45

A. A layer. I don't know how else to define 14:29:48
a layer. A layer is -- is the -- a layer in the 14:29:54
material. 14:30:00

Q. You don't know how to define a layer? 14:30:00

MR. SNYDER: Objection to form. 14:30:04

THE WITNESS: Yeah. 14:30:05

I think a person of ordinary skill would 14:30:06
understand what a layer is in -- in the device. 14:30:08

BY MR. SHEASBY: 14:30:11

Q. Yeah. 14:30:12

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What is a layer in the device? 14:30:12

A. So a layer is, in the sequence of the device, in the vertical dimension or the third dimension, would be one of the parts of the stack of the device. 14:30:16 14:30:18 14:30:25 14:30:29

Q. So a layer is a part of the stack of the device? 14:30:29 14:30:32

MR. SNYDER: Objection to form. 14:30:32

THE WITNESS: That is one definition that one could apply. 14:30:33 14:30:38

BY MR. SHEASBY: 14:30:38

Q. Any other definitions? 14:30:38

A. Sitting here right now, I guess I can't think of another one. But, again, if we speak to a person of ordinary skill, they would understand what a layer is when we speak about -- and organically with that instruction. 14:30:42 14:30:45 14:30:49 14:30:52 14:30:55

Q. Right. 14:30:56

And what is that? 14:30:57

MR. SNYDER: Object to the form. 14:31:01

THE WITNESS: So, again, it would be as we build the device and the third dimension -- so the device is generally relatively large in two dimensions. The device -- there are deposited layers in the material, and those layers then form the 14:31:02 14:31:04 14:31:07 14:31:13 14:31:18

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layers of the system. 14:31:21
BY MR. SHEASBY: 14:31:22
Q. Does the layer have to be deposited 14:31:22
simultaneously, all of the matrix materials in it? 14:31:25
A. So there is no -- as long as we can somehow 14:31:28
form that mixture, I don't believe that is necessary 14:31:36
that it has to be formed simultaneously. The 14:31:39
specification, the patent all discuss the formation 14:31:44
of that layer, and if there is some way to do it 14:31:48
without them, I don't see how. 14:31:51
Q. So there is no obstacle? You don't have to 14:31:55
form all the matrix materials in the functional layer 14:31:58
simultaneously? 14:32:01
A. The -- so if we are purely speaking about 14:32:02
the mixture of matrix materials as the matrix, the -- 14:32:10
it is the final product which is being described. 14:32:17
Q. Okay. So the layer doesn't have to be 14:32:20
formed simultaneously, and the matrix materials don't 14:32:24
have to be deposited simultaneously? 14:32:27
MR. SNYDER: Objection to form. 14:32:29
THE WITNESS: I'm sorry. 14:32:30
Could you ask that question again? 14:32:32
BY MR. SHEASBY: 14:32:34
Q. Sure. 14:32:34
The layer doesn't have to be formed at one 14:32:35

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moment in time. 14:32:38

It could be formed iteratively? 14:32:40

MR. SNYDER: Objection to form. 14:32:43

THE WITNESS: So I guess I'm not sure 14:32:44

I agree with iteratively. But if the layer has grown 14:32:49

and if it has that mixed construction, then it -- it 14:32:53

is a mixed layer. 14:32:58

BY MR. SHEASBY: 14:33:00

Q. It can grow in multiple steps? 14:33:00

MR. SNYDER: Objection to form. 14:33:04

THE WITNESS: So it is -- again, without 14:33:06

trying to define specific details, in general, the 14:33:12

sequence is not specified by the -- by the -- by the 14:33:18

term under -- under either construction. 14:33:22

BY MR. SHEASBY: 14:33:25

Q. Okay. So I'm actually asking you to define 14:33:25

details. 14:33:28

Do you understand that? 14:33:32

A. So if you ask your question again, I might 14:33:33

be able to give a better answer. But as a general 14:33:37

matter, the term matrix or matrix material doesn't 14:33:40

specify the time at which the matrix is made and so 14:33:45

it specifies the structure after the matrix is done. 14:33:49

Q. And how about the layer? Can the layer be 14:33:54

formed in multiple steps? 14:34:08

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MR. SNYDER: Objection to form. 14:34:11

BY MR. SHEASBY: 14:34:12

Q. Functional layer. 14:34:13

A. So, again, the functional layer -- there is no requirement in the term functional layer that is temporal. What matters is the layer has its formative device. 14:34:15 14:34:20 14:34:26 14:34:30

Q. Let's go to Exhibit A of the Humphrey report. 14:34:31 14:36:22

A. That's Exhibit Number 7? 14:36:37

Q. I believe so. 14:36:39

A. (Witness complies.) 14:36:43

Okay. I'm there now. 14:36:44

Q. Okay. Hmmm. 14:36:46

Okay. Let's go to Paragraph 205. 14:37:47

A. (Witness complies.) 14:37:59

Okay. I'm there now. 14:38:09

Q. So there are HOMO and LUMO values reported on -- on -- in the table in Paragraph 205? 14:38:10 14:38:16

A. I see those, yes. 14:38:18

Q. And putting aside the actual numbers, do those reflect the relative magnitude of difference between HOMO and LUMO values for the materials that are identified in that chart? 14:38:20 14:38:24 14:38:27 14:38:32

MR. SNYDER: Objection to form. 14:38:34

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THE WITNESS: Give me a moment to double-check how those were measured. But if they were measured the same way, then their relative values would be comparable. 14:38:36 14:38:41 14:38:43 14:38:47

MR. SHEASBY: Now -- objection. Form. 14:38:49

BY MR. SHEASBY: 14:38:50

Q. I'm asking you as an expert, are the relative HOMO and LUMO values for those materials consistent with the numbers that are reported in this chart? 14:38:51 14:38:54 14:38:58 14:39:01

MR. SNYDER: Objection to form. 14:39:03

THE WITNESS: I have those numbers in my report. If you give me a moment, I can double-check using my method. 14:39:07 14:39:09 14:39:13

BY MR. SHEASBY: 14:39:18

Q. And tell me where you are going in your report. 14:39:19 14:39:22

A. Yeah. 14:39:22

Going to Page 225. Okay. So yeah. If you go to Paragraph 418, that is some indications of this particular measurement, and I just wanted to check the references. I looked up the references for how Mr. Humphrey had determined these, and the -- the reference for the [redacted] doesn't specify the measurement method. And that is the alleged first 14:39:35 14:40:08 14:40:13 14:40:15 14:40:19 14:40:23 14:40:28

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matrix material; whereas, the other two materials were -- sorry. 14:40:33 14:40:38

The -- the [redacted], and so the -- the same technique generally has to be used in order to guarantee that the relative levels are correct. Measuring HOMO and LUMO is pretty complicated, unfortunately, and so there are some built-in biases for that particular method, and so it can be really challenging to confirm that the relative HOMO and LUMO levels are correct if they are measured through different methods or, in one case at least here, we don't even know the method. 14:40:49 14:40:57 14:41:01 14:41:06 14:41:09 14:41:13 14:41:17 14:41:21 14:41:26

MR. SHEASBY: Objection. Objection. Form. 14:41:29

BY MR. SHEASBY: 14:41:31

Q. The question I asked you was do you have different data on what the relative HOMO and LUMO measures are for any of the materials that Mr. Humphrey cites in his report -- or Dr. Humphrey cites -- Mr. Humphrey cites in his report? 14:41:31 14:41:33 14:41:37 14:41:39 14:41:42

A. So I did not do any measurement of the HOMO and LUMO levels. And I -- I made my comments based on Mr. Humphrey's -- Mr. Humphrey's analysis, and I have highlighted some concerns that I have. 14:41:48 14:41:54 14:41:58 14:42:03

MR. SHEASBY: Objection. Form. 14:42:06

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BY MR. SHEASBY: 14:42:07

Q. I said did you -- did you reach -- did you have a different -- did you reach a conclusion of what the relative HOMO and LUMO levels are for the matrix materials that Mr. Humphrey identifies in this report? 14:42:07 14:42:10 14:42:12 14:42:15 14:42:19

A. I'm sorry. Could you ask that again? 14:42:24

Q. Sure. 14:42:26

Did you reach a conclusion on what the relatively -- relative HOMO and LUMO levels are for the materials that Mr. Humphrey identifies in his report as matrix materials? 14:42:27 14:42:30 14:42:32 14:42:35

A. So no. 14:42:37

I did not offer an opinion or conclusion on the relative HOMO and LUMO levels for these materials. 14:42:37 14:42:39 14:42:43

Q. And did you ask Samsung engineers what the relatively level -- rel- -- relative HOMO and LUMO levels were for these materials? 14:42:43 14:42:47 14:42:48

A. No. 14:42:50

Again, I -- in my report I detail my -- my concerns about Mr. Humphrey's technique, and none of that is a product of any discussion with Samsung engineers. 14:42:51 14:42:57 14:43:00 14:43:04

MR. SHEASBY: Objection. Form. 14:43:05

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BY MR. SHEASBY: 14:43:06

Q. Did you speak to any Samsung engineers about what the relative HOMO and LUMO levels are for the materials Mr. Humphrey identifies as matrix materials in his report? 14:43:06 14:43:08 14:43:11 14:43:15

A. So I did not have any explicit discussion with any Samsung engineers regarding the measurements of the HOMO and LUMO levels of the materials in Mr. Humphrey's report. 14:43:17 14:43:22 14:43:27 14:43:30

Q. Okay. Do you have the technical capability of calculating HOMO and LUMO levels? 14:43:32 14:43:38

A. From simulation? 14:43:42

Q. From any source. 14:43:44

A. So I, personally, have access to the software that can do it, but I do not attempt to or generally simulate materials in order to calculate the HOMO or LUMO levels in any level of detail. 14:43:47 14:43:53 14:43:59 14:44:03

Q. Have you ever calculated HOMO and LUMO levels from materials? 14:44:07 14:44:09

A. I have -- I have in the past used software to calculate energy levels of organic semiconductors. 14:44:11 14:44:16

MR. SHEASBY: Objection. Form. 14:44:25

BY MR. SHEASBY: 14:44:26

Q. Have you ever used -- calculated HOMO and LUMO levels for matrix materials, such as those 14:44:26 14:44:30

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specified in the '164 patent? 14:44:33
MR. SNYDER: Objection to form. 14:44:39
THE WITNESS: So I have not done any 14:44:40
simulation for any materials or the types of 14:44:42
materials which are being described here using any 14:44:45
simulation software. 14:44:50
BY MR. SHEASBY: 14:44:51
Q. Okay. 14:44:51
A. The simulations I have performed have been 14:44:51
for primarily organic photovoltaic applications, 14:44:54
which are somewhat different. 14:44:56
Q. Okay. And have you asked Samsung how they 14:44:57
pegged the HOMO and LUMO levels of their materials? 14:45:04
A. So the Samsung documentation, which 14:45:10
describes the HOMO and LUMO levels, generally 14:45:12
references the measurements, and Mr. Humphrey also 14:45:16
uses some of those references as well. But I did not 14:45:20
have any particular questions or discussion with 14:45:24
Samsung about analyzing any materials forming. 14:45:26
Q. For the '164 patent you propose combining 14:45:31
the Clix2 with a number of different references; 14:45:47
correct? 14:45:52
A. Yes, I do. 14:45:55
Q. And in the real world, have those references 14:45:56
ever been combined with the Clix2? 14:45:59

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MR. SNYDER: Objection to form. 14:46:02
THE WITNESS: So yeah. 14:46:03
There have been a large number of 14:46:06
innovations in the organic light-emitting diode 14:46:09
space, and so I can't speak specifically as to which 14:46:12
ones may or may not have been developed based on my 14:46:16
proposed accommodations. 14:46:20
BY MR. SHEASBY: 14:46:20
Q. Did you ask any Samsung engineers if they 14:46:34
have ever combined the references in the way you 14:46:37
have -- where -- whether it would be reasonable to 14:46:39
combine the references -- references in the way you 14:46:41
disclose? 14:46:44
A. I have not had any discussions with Samsung 14:46:47
engineers regarding the specific combinations of 14:46:54
references that I had proposed. 14:47:00
MR. SHEASBY: I pass the witness. 14:47:02
MR. SNYDER: All right. Give us a few 14:47:05
minutes. 14:47:07
THE REPORTER: What did you just say? 14:47:17
MR. SHEASBY: He said give us a few minutes. 14:47:17
THE REPORTER: After that. 14:47:20
MR. SNYDER: Yeah. 14:47:21
Let's go off the record. 14:47:22
We'll come back in fifteen minutes. 14:47:25

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THE VIDEOGRAPHER: Okay. This marks the end of media unit number six. 14:47:25 14:47:27

The time is 2:47 p.m. 14:47:30

We are off the record. 14:47:34

(Short recess taken.) 15:06:56

THE VIDEOGRAPHER: This marks the beginning -- oh, sorry. 15:06:56 15:07:57

This marks the beginning of media unit number seven. 15:07:58 15:08:01

The time is 3:08 p.m. 15:08:05

We are on the record. 15:08:07

MR. SNYDER: The defendants don't have any questions for the witness, but we would like to designate the deposition transcript as confidential, attorneys' eyes only pursuant to the protective order. 15:08:07 15:08:08 15:08:08 15:08:12 15:08:16

Also, we object to including as an exhibit documents that the witness did not discuss. 15:08:16 15:08:20

MR. SHEASBY: Okay. Thank you. 15:08:25

THE VIDEOGRAPHER: Mr. Sheasby, before we go off the record -- oh, he left already. 15:08:27 15:08:31

Okay. Mr. Snyder, do you need a copy of the video? 15:08:33 15:08:36

MR. SNYDER: Yes. 15:08:36

We are going to need the video, yes. 15:08:37

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THE VIDEOGRAPHER: Do you want it synced with the transcript? 15:08:40 15:08:42

MR. SNYDER: Yes, please. 15:08:43

THE VIDEOGRAPHER: Okay. Perfect. 15:08:44

Suzanne, anything on the record or can I take us off? 15:08:44 15:08:45

MR. SNYDER: We are good. 15:08:45

THE VIDEOGRAPHER: Okay. Then this concludes the deposition. 15:08:46 15:08:47

And we are off the record at 3:08 p.m. 15:08:50

Given by Dr. Ioannis Kymissis -- sorry. Kymissis. 15:08:53 15:09:00

Total number of media units used was seven and will be retained by Veritext. 15:09:00 15:09:03

THE REPORTER: And when do you want the final? 15:09:03 15:09:33

MR. SNYDER: Final by June 17. 15:09:33

(Deposition Exhibit Number 4 was marked for identification.)

(Deposition Exhibit Number 5 was marked for identification.)

(Deposition Exhibit Number 6 was marked for identification.)

(Deposition Exhibit Number 8 was marked for identification.)

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(Deposition Exhibit Number 9
was marked for identification.)
(Deposition Exhibit Number 10
was marked for identification.)
(Deposition Exhibit Number 15
was marked for identification.)
(Deposition Exhibit Number 17
was marked for identification.)
(3:08 p.m.)

--ooOoo--

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STATE OF CALIFORNIA)
) ss.
COUNTY OF KERN)

I, IOANNIS KYMISSIS, Ph.D., do hereby certify:

That I have read the foregoing deposition;

That I have made such changes in form and/or substance to the within deposition, as might be necessary to render the same true and correct;

That having made such changes thereon, I hereby subscribe my name to the deposition.

I declare, under penalty of perjury, that the foregoing is true and correct.

Executed this _____ day of _____, 2025, at _____, California.

_____
IOANNIS KYMISSIS, Ph.D.

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STATE OF CALIFORNIA)
) ss.
COUNTY OF KERN)

I, B. Suzanne Hull, a Certified Shorthand Reporter in the State of California, holding Certificate Number 13495, do hereby certify that IOANNIS KYMISSIS, Ph.D., the witness named in the foregoing deposition, was by me duly sworn; that said deposition, was taken Saturday, June 14, 2025, at the time and place set forth on the first page hereof.

That upon the taking of the deposition, the words of the witness were written down by me in stenotypy and thereafter transcribed by computer under my supervision; that the foregoing is a true and correct transcript of the testimony given by the witness.

Pursuant to Federal Rule 30(e), transcript review was requested.

I further certify that I am neither counsel for nor in any way related to any party to said action, nor in any way interested in the result or outcome thereof.

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Dated this 17th day of June, 2025, at Bakersfield, California.



B. Suzanne Hull, CSR No. 13495

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Ioannis Kymissis, Ph.D.
johnkym@gmail.com

JUNE 17, 2025

RE: Pictiva Displays International LTD v. Samsung Electronics Co., Ltd., Et Al.
6/14/2025, Ioannis Kymissis, Ph.D., (#7338172).

The above-referenced transcript has been completed by Veritext Legal Solutions and review of the transcript is being handled as follows:

__ Per CA State Code (CCP 2025.520 (a)-(e)) – Contact Veritext to schedule a time to review the original transcript at a Veritext office.

__ Per CA State Code (CCP 2025.520 (a)-(e)) – Locked .PDF Transcript - The witness should review the transcript and make any necessary corrections on the errata pages included below, notating the page and line number of the corrections. The witness should then sign and date the errata and penalty of perjury pages and return the completed pages to all appearing counsel within the period of time determined at the deposition or provided by the Code of Civil Procedure. Contact Veritext when the sealed original is required.

__ Waiving the CA Code of Civil Procedure per Stipulation of Counsel - Original transcript to be released for signature as determined at the deposition.

__ Signature Waived – Reading & Signature was waived at the time of the deposition.

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_X_ Federal R&S Requested (FRCP 30(e)(1)(B)) – Locked .PDF Transcript - The witness should review the transcript and make any necessary corrections on the errata pages included below, notating the page and line number of the corrections. The witness should then sign and date the errata and penalty of perjury pages and return the completed pages to all appearing counsel within the period of time determined at the deposition or provided by the Federal Rules.

__ Federal R&S Not Requested - Reading & Signature was not requested before the completion of the deposition.

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Pictiva Displays International LTD v. Samsung Electronics Co., Ltd., Et Al.

Ioannis Kymissis, Ph.D. (#7338172)

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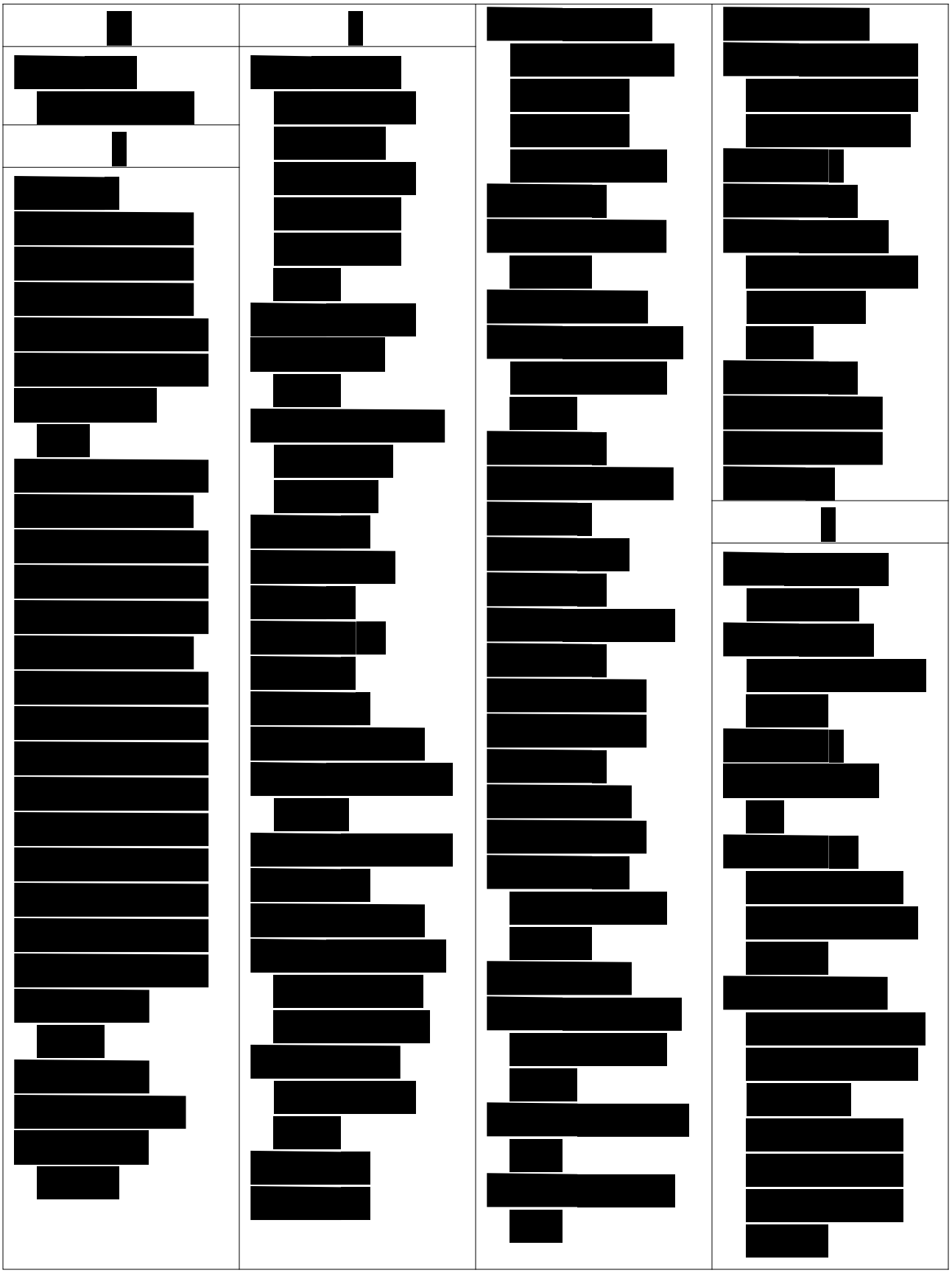
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(Ioannis Kymissis, Ph.D.) Date

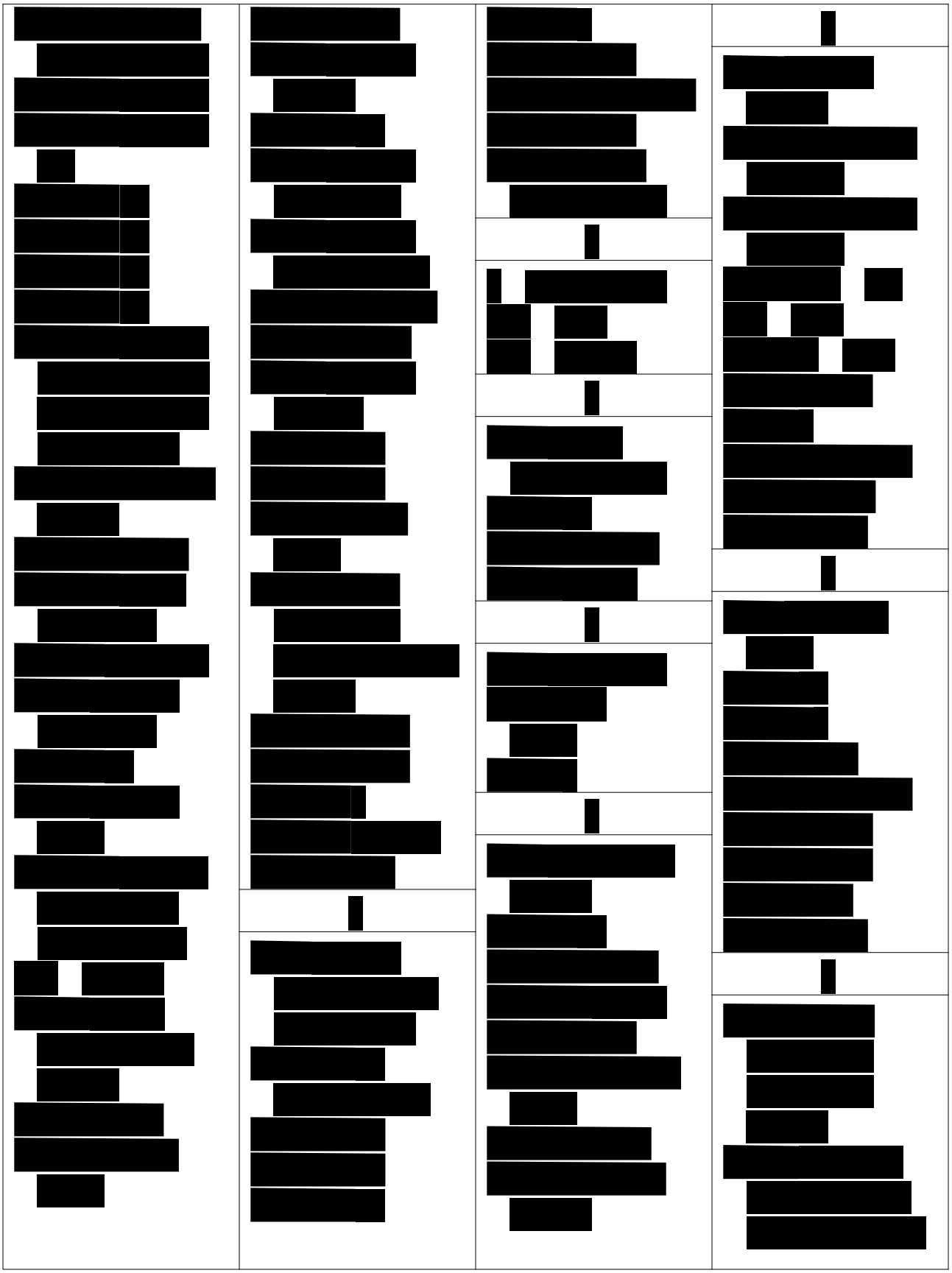
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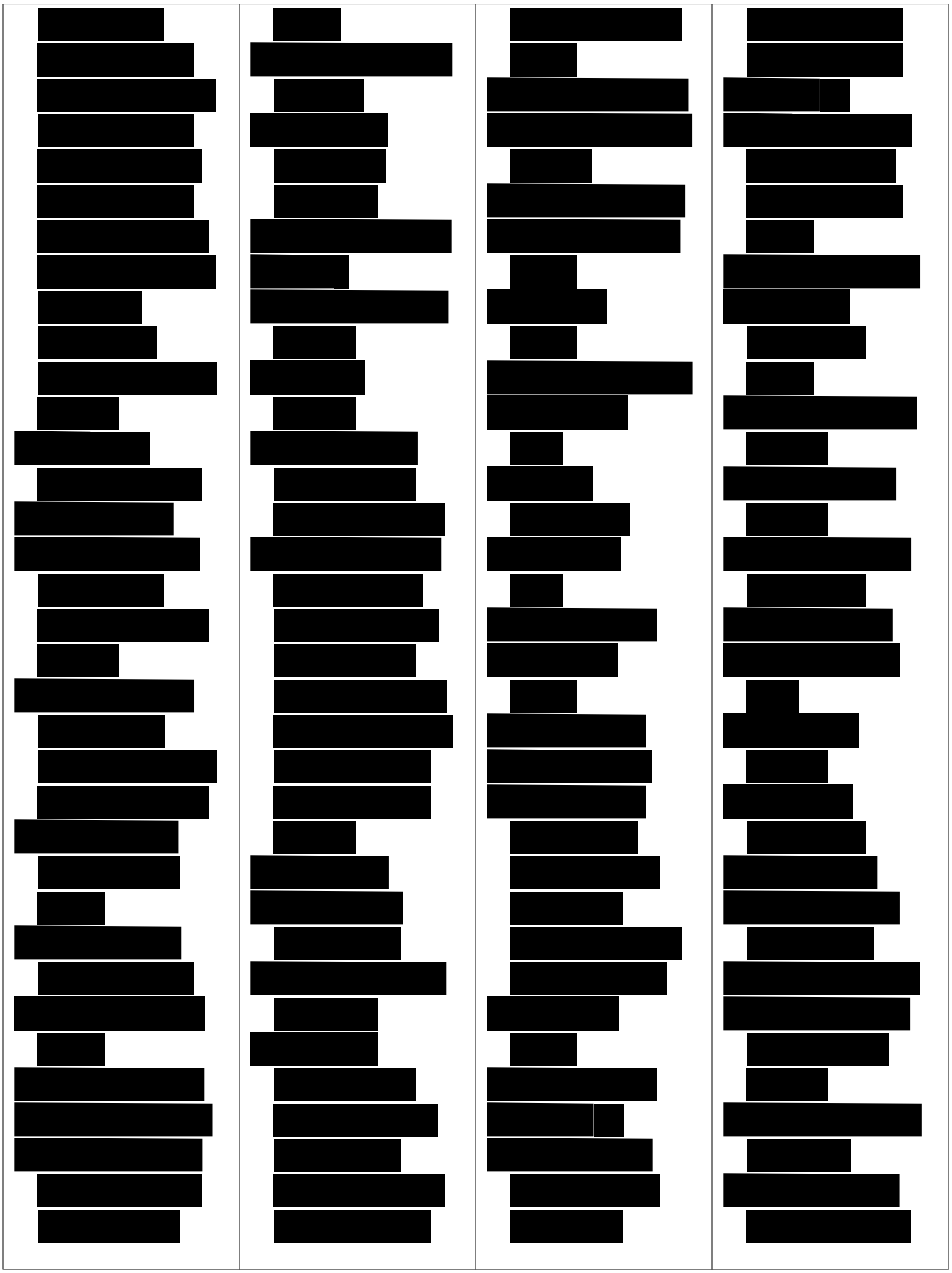
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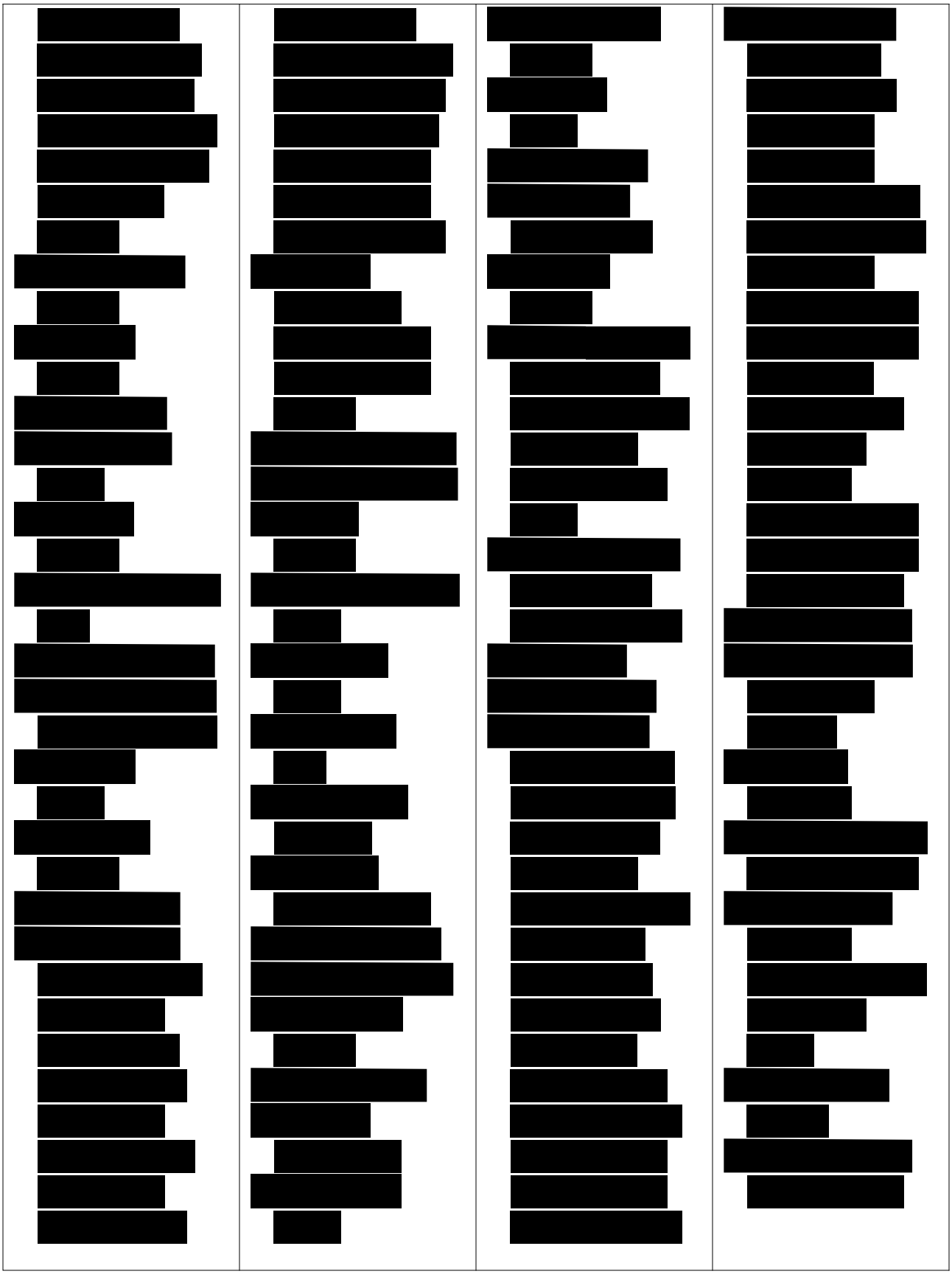
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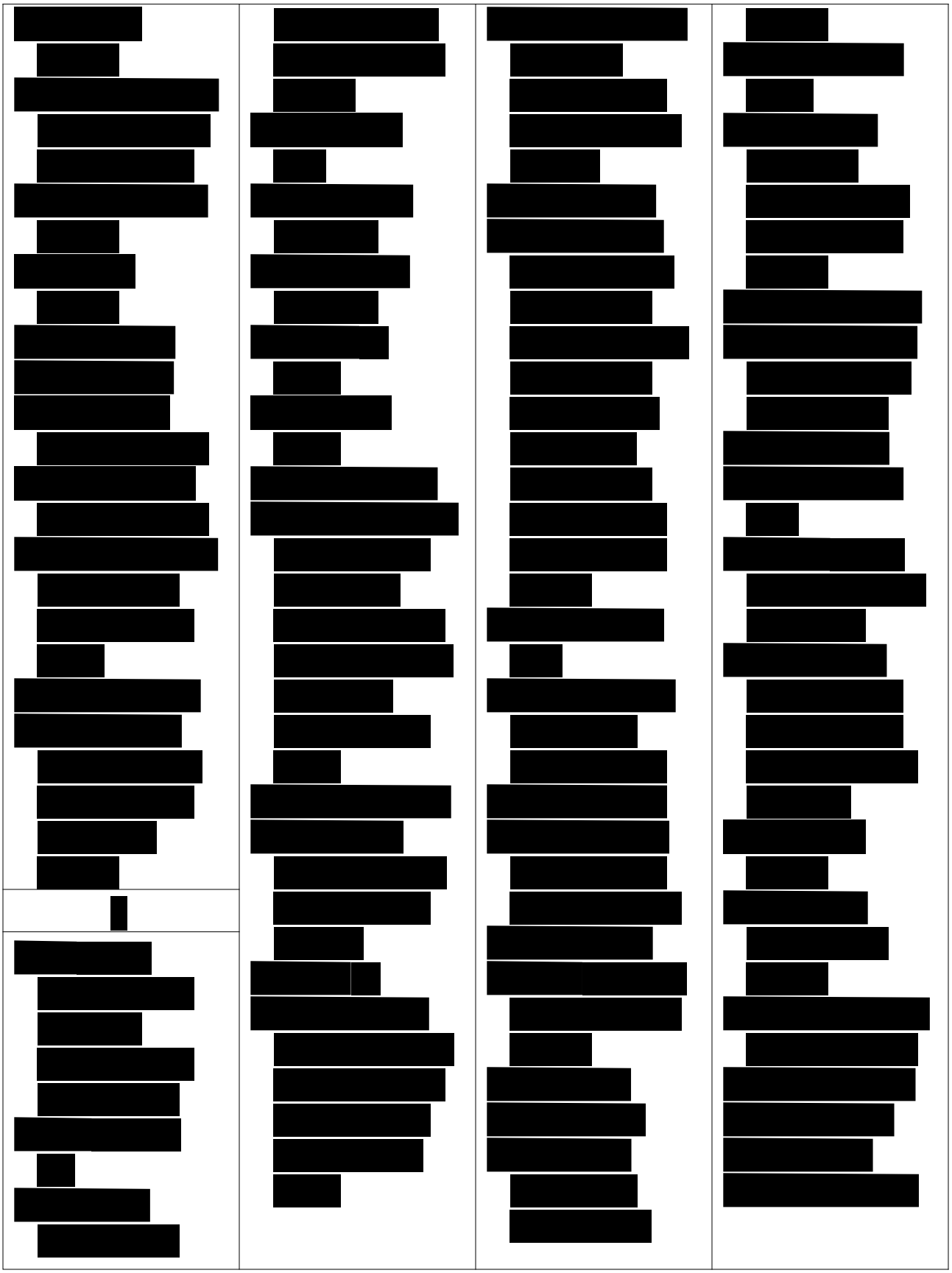
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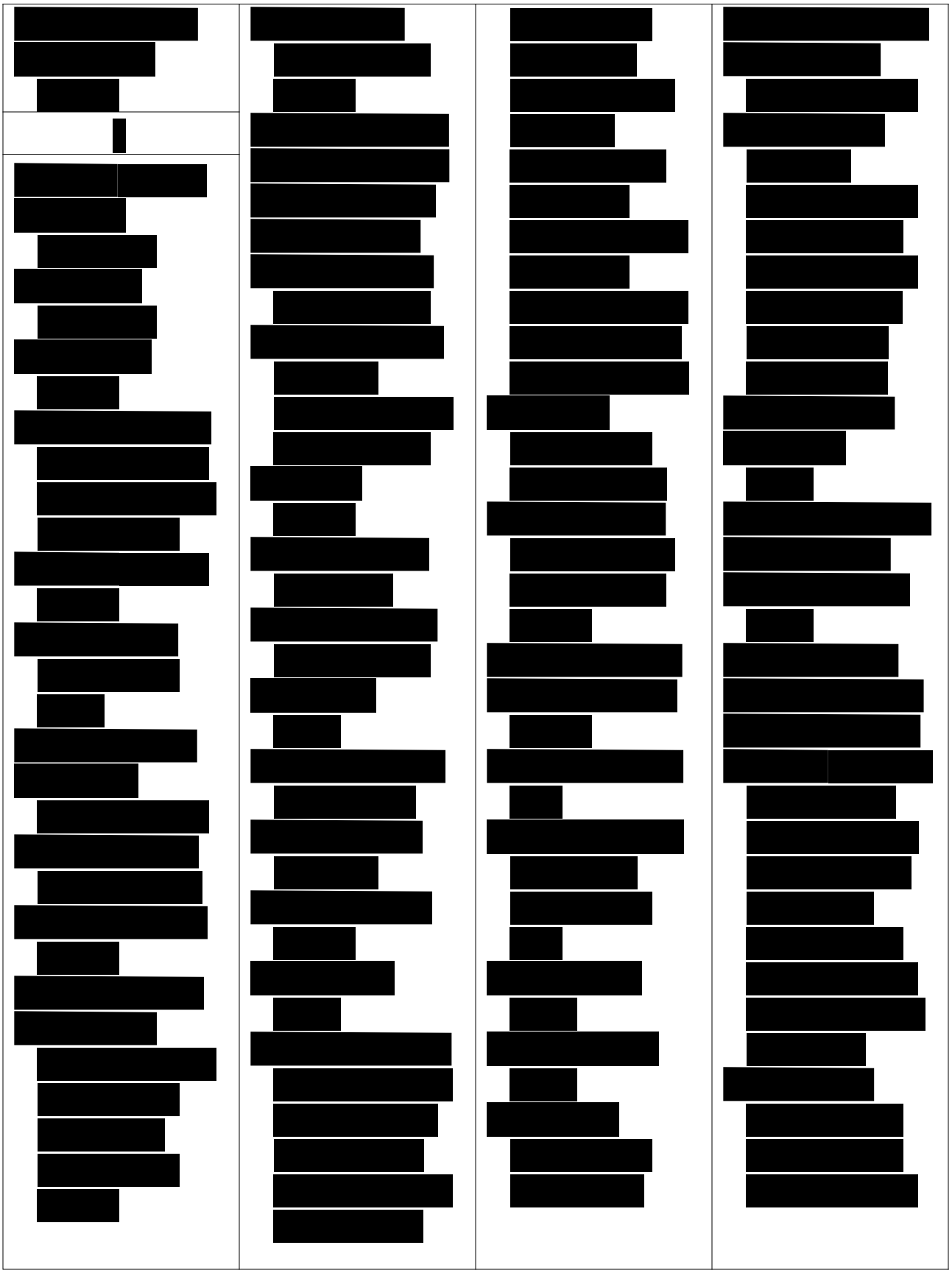
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[attempted - business]



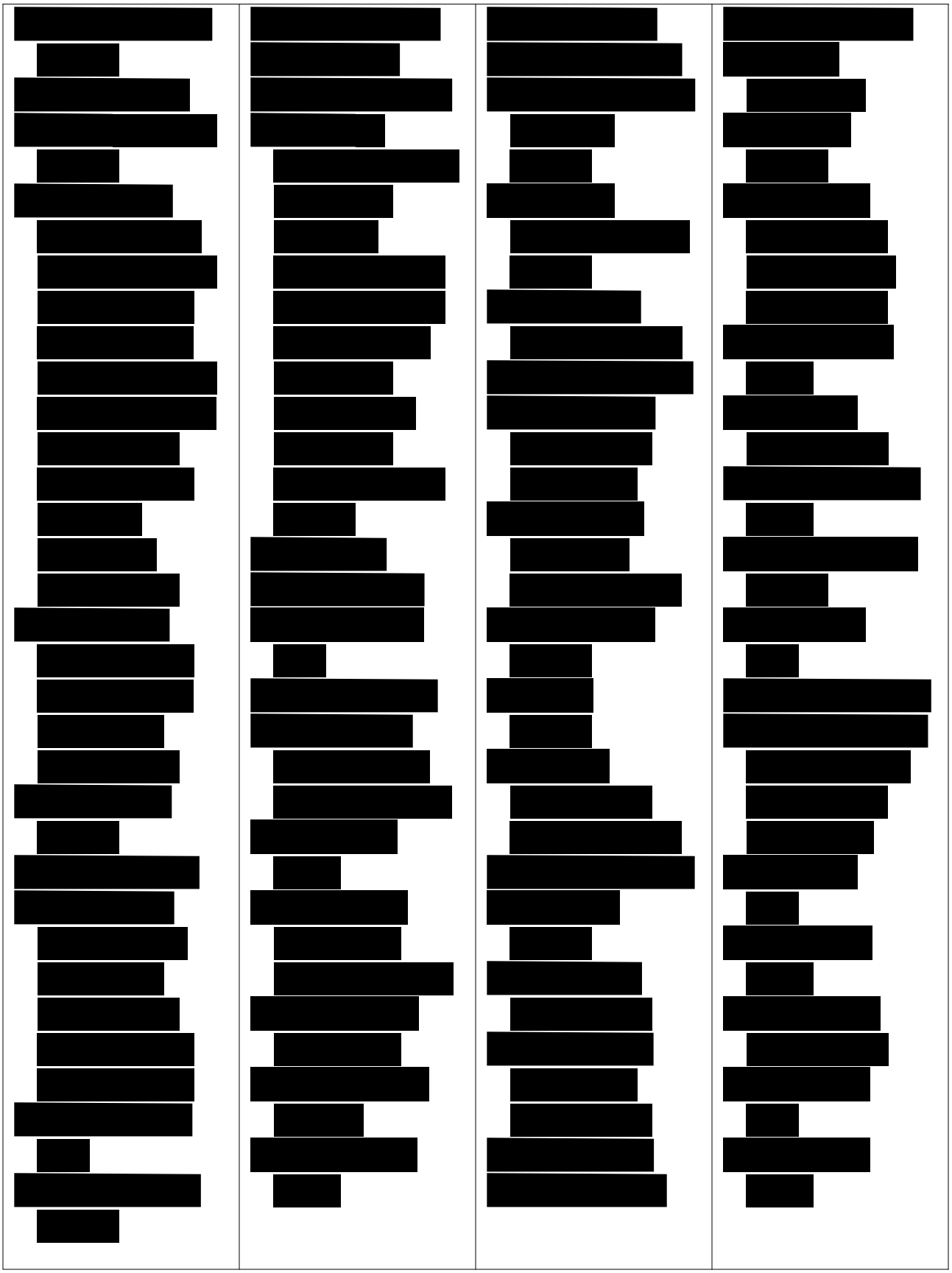
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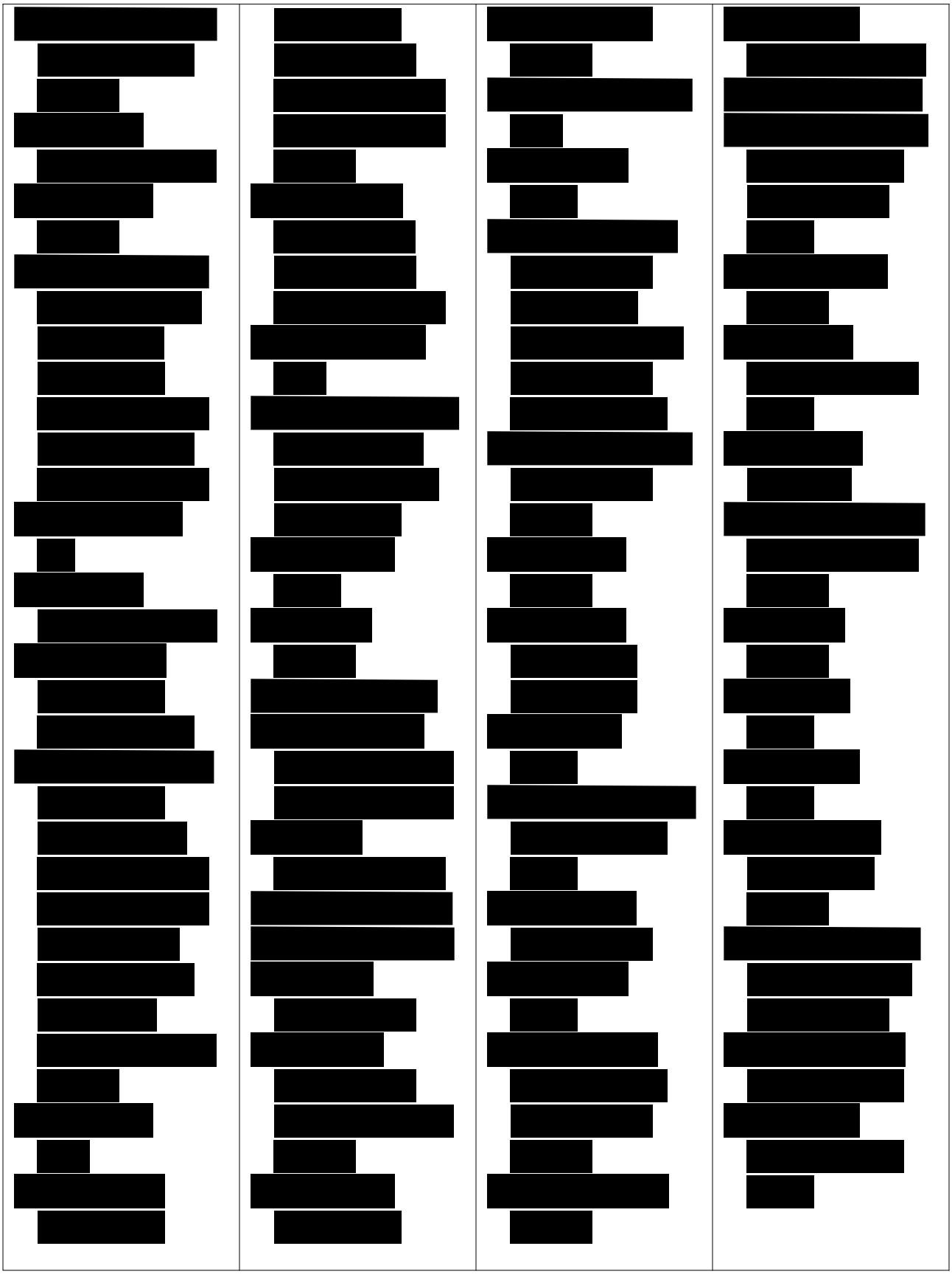
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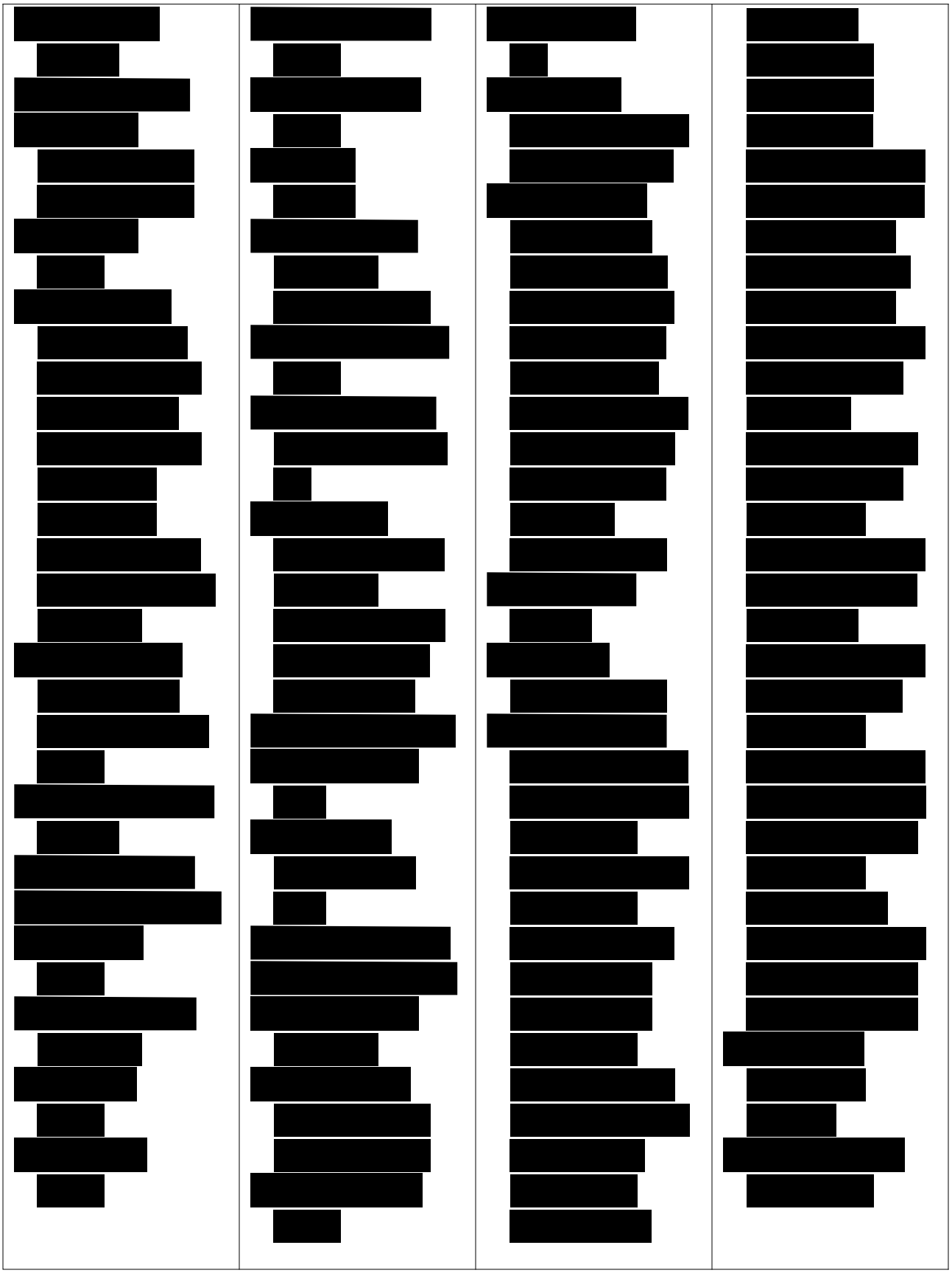
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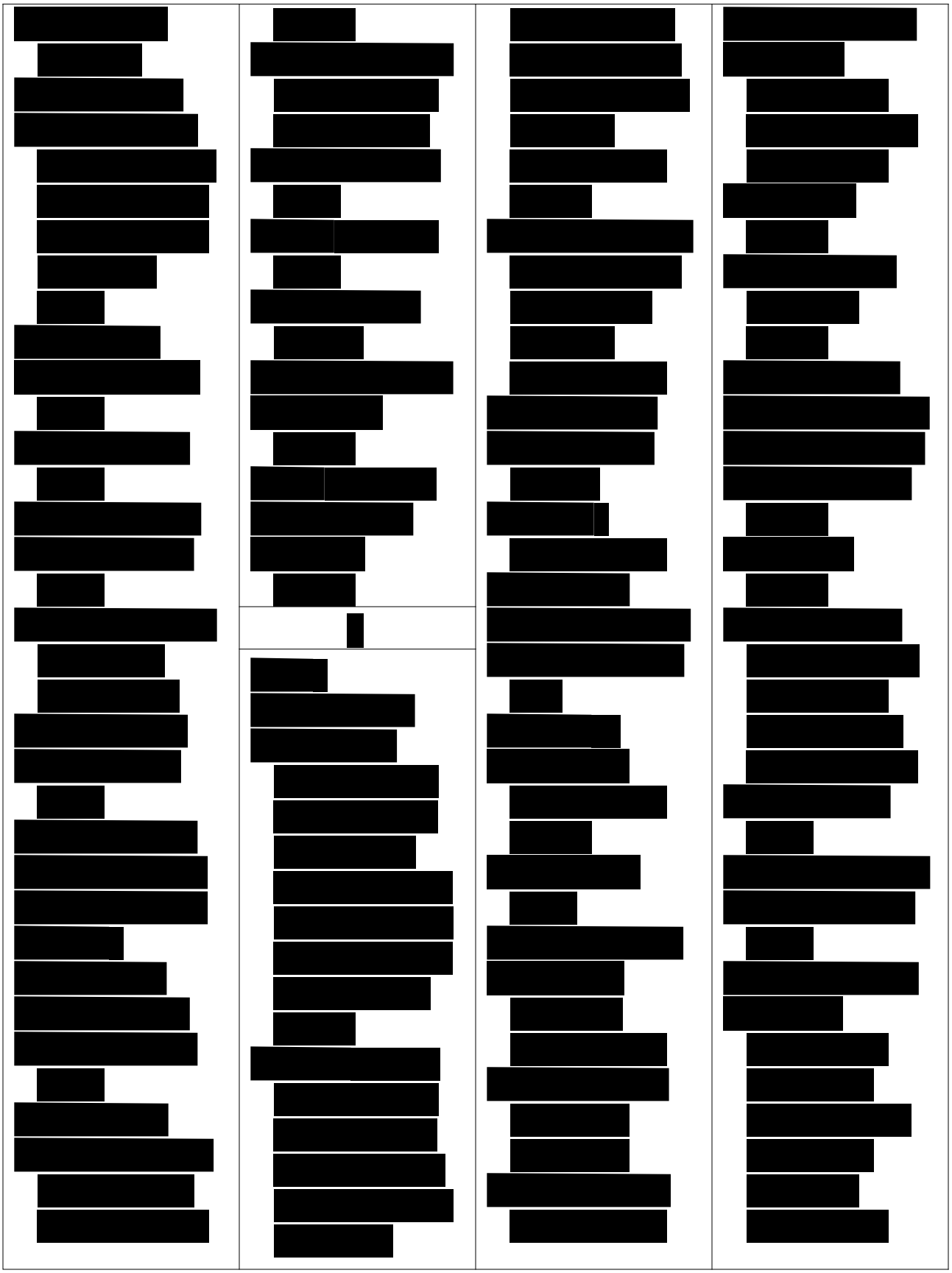
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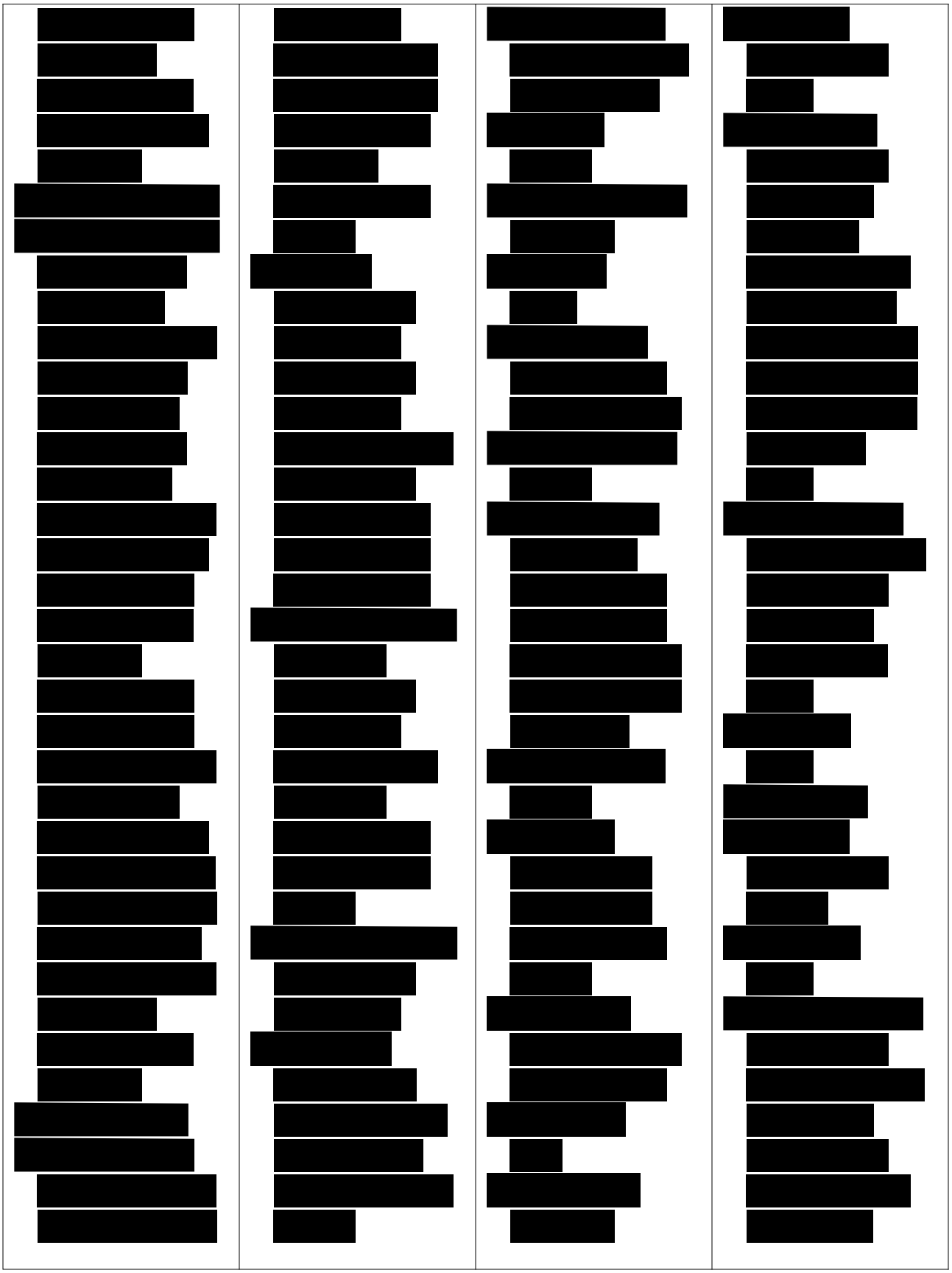
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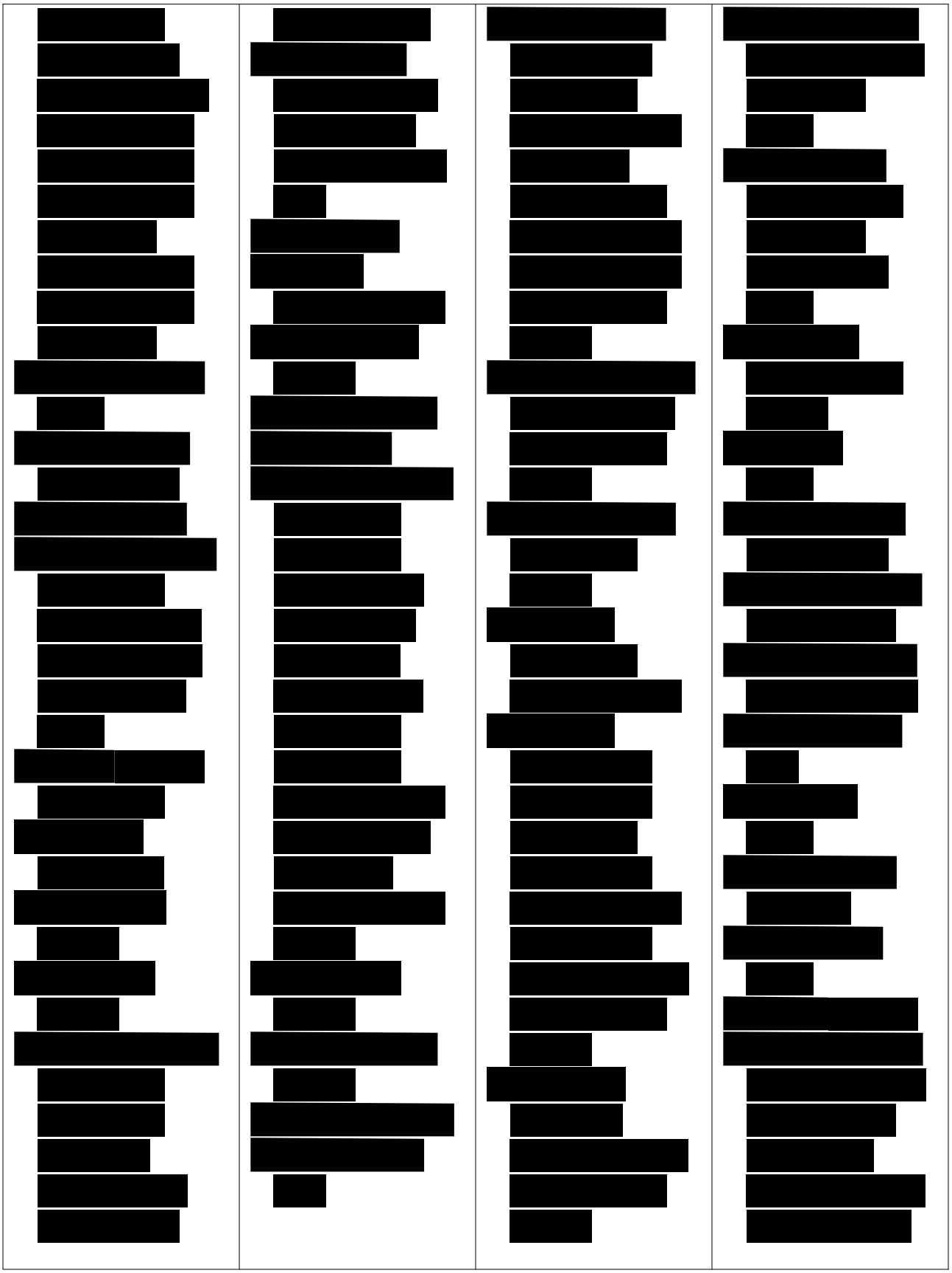
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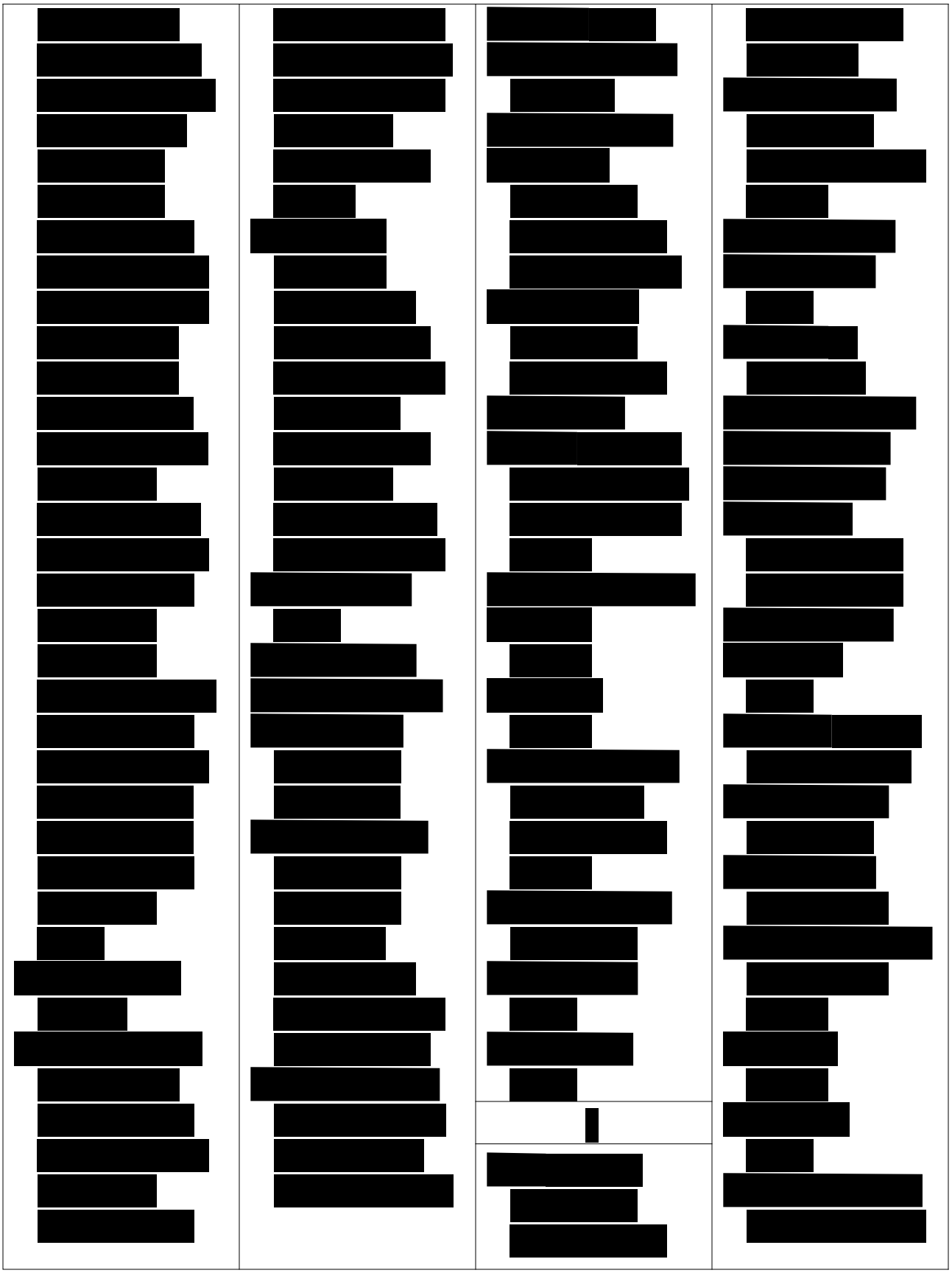
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[different - document]



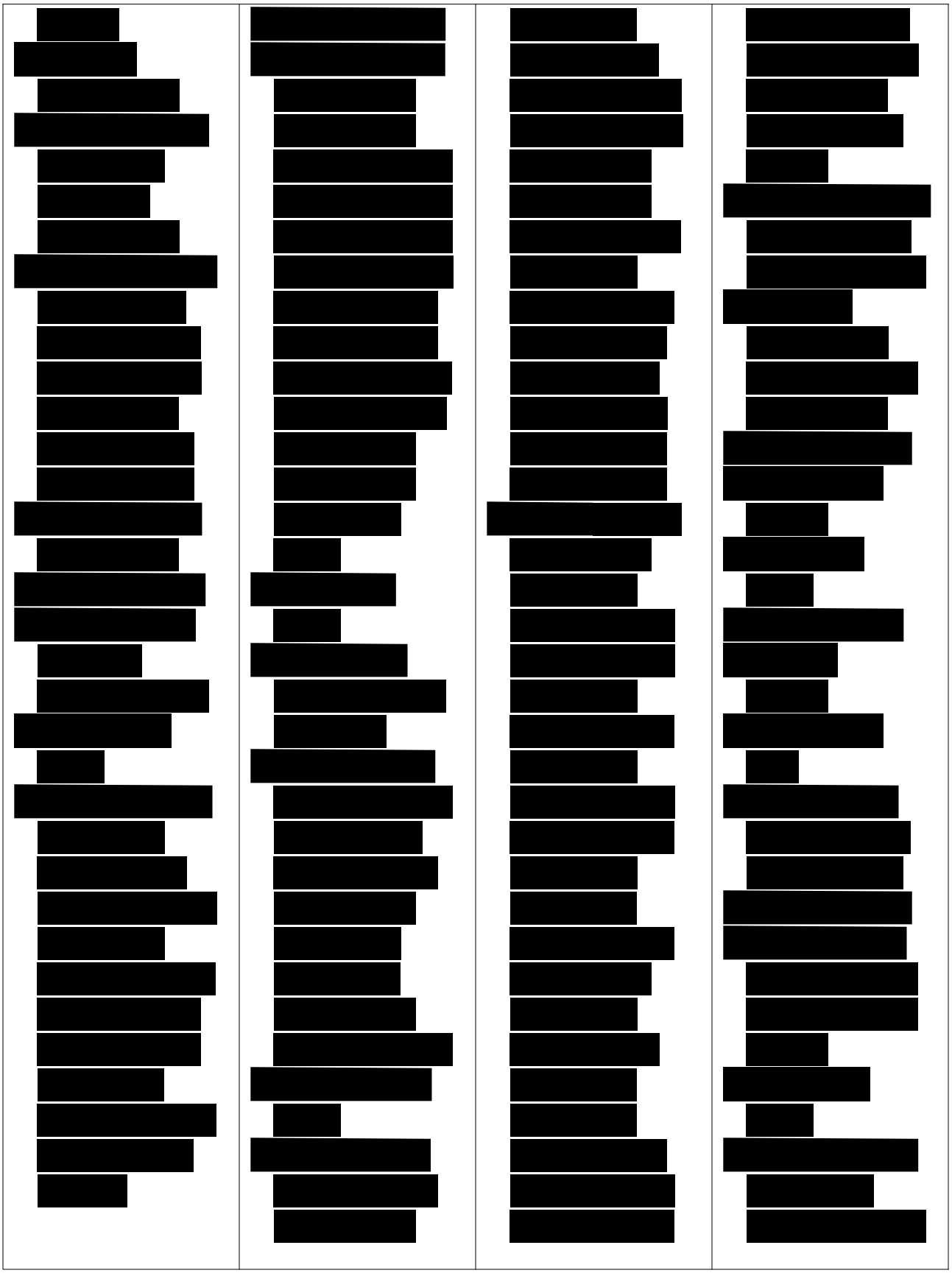
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[document - electron]



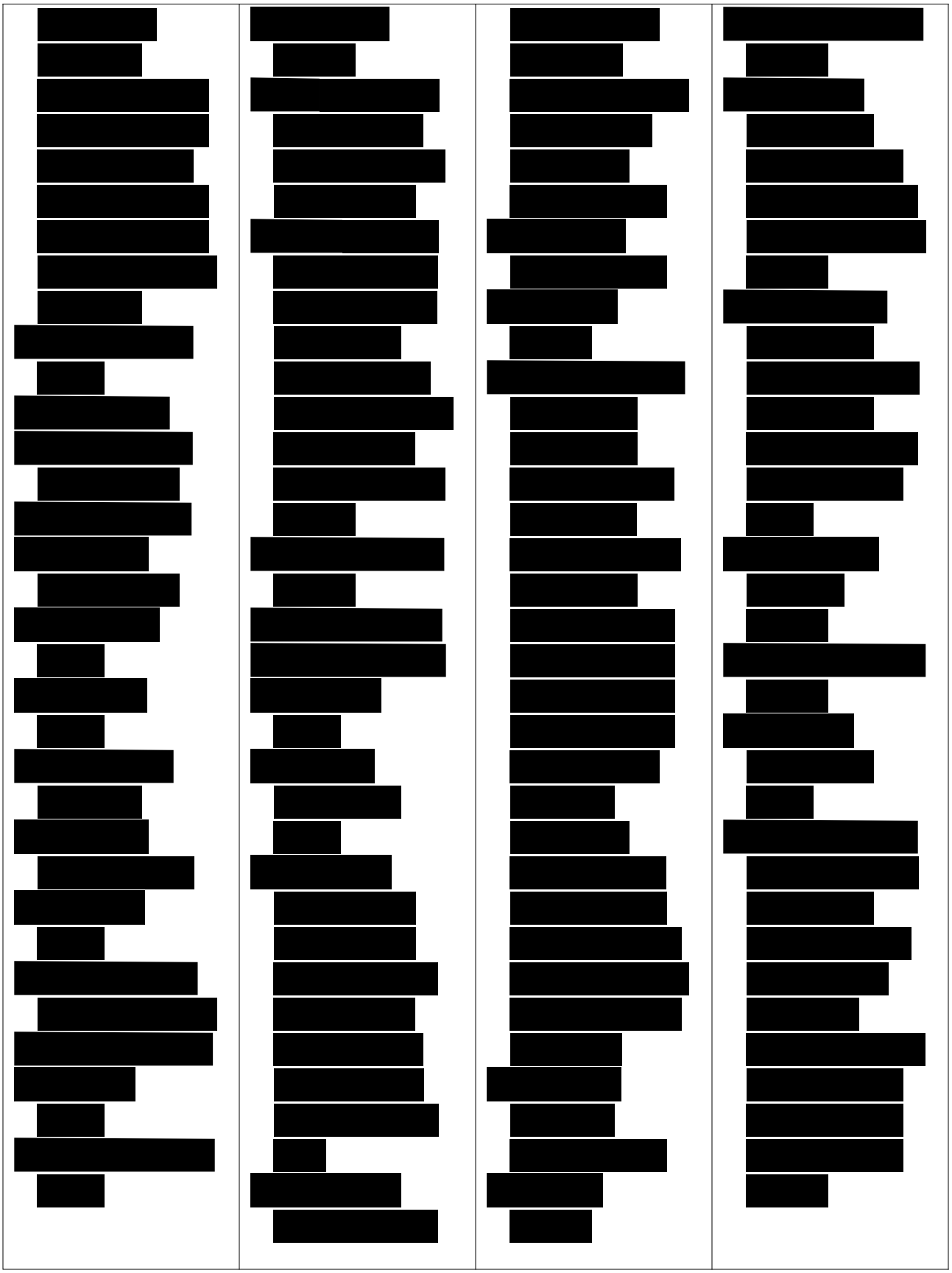
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[electron - engineers]



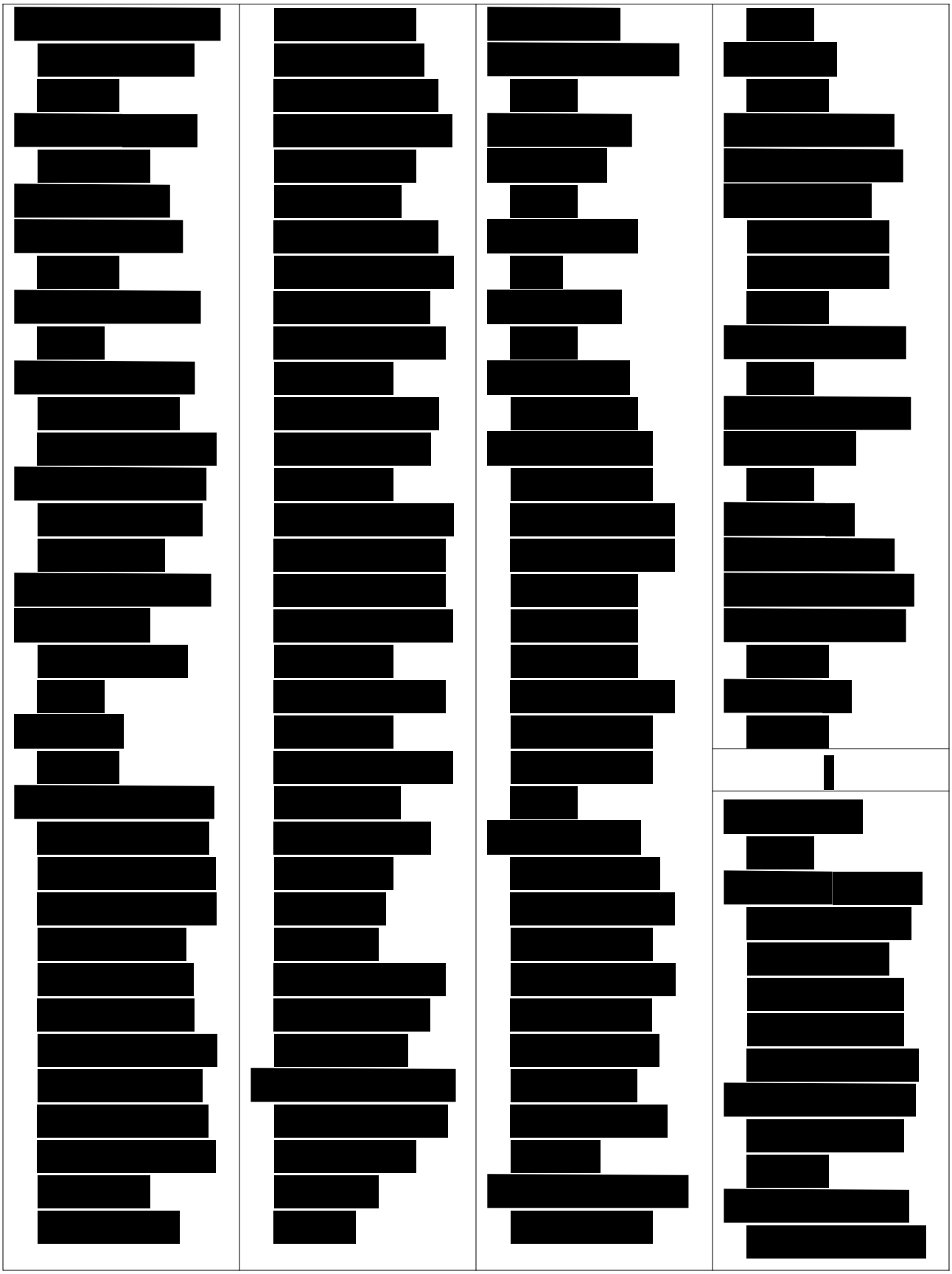
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[engineers - example]



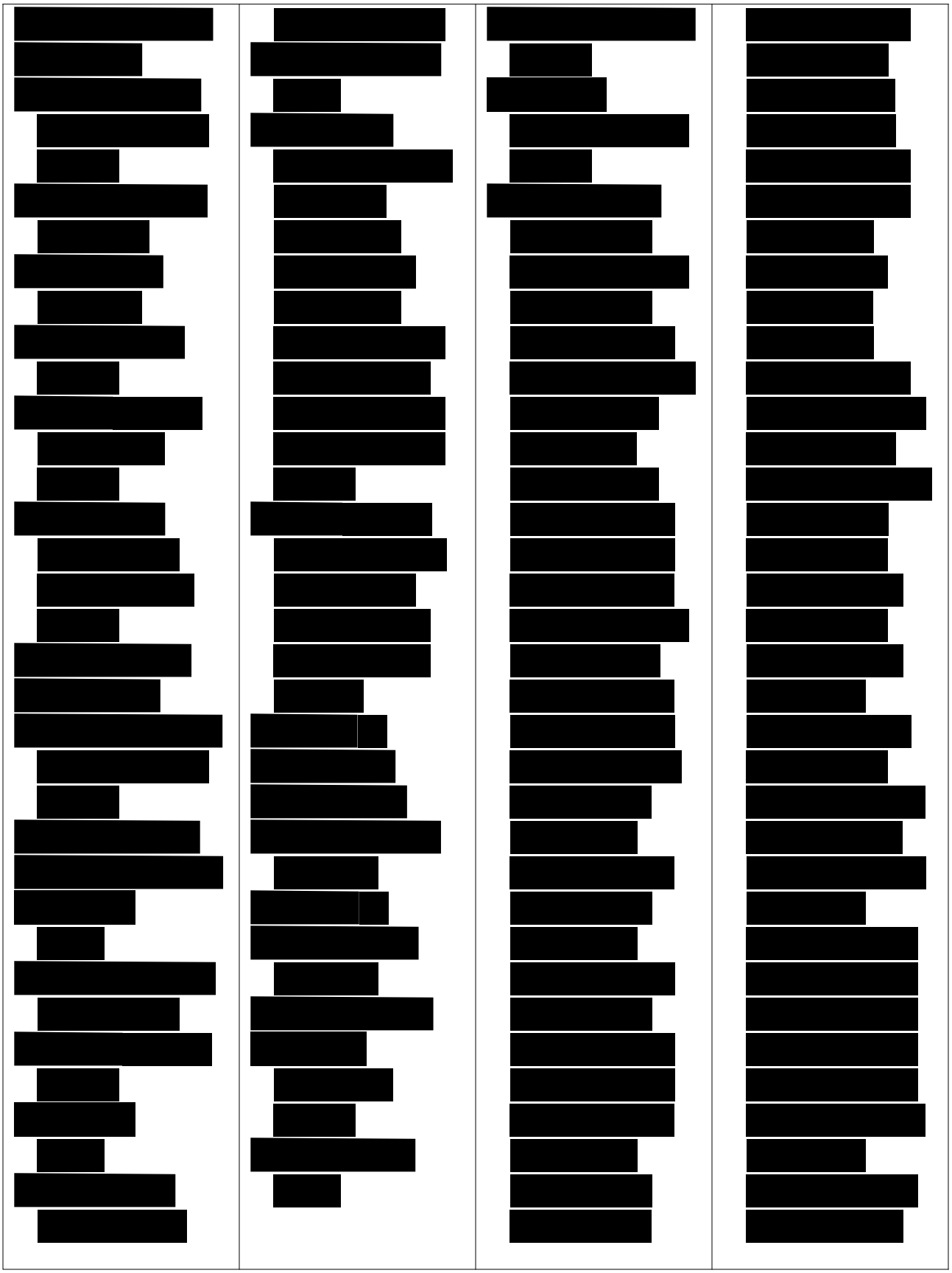
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[examples - faculty]



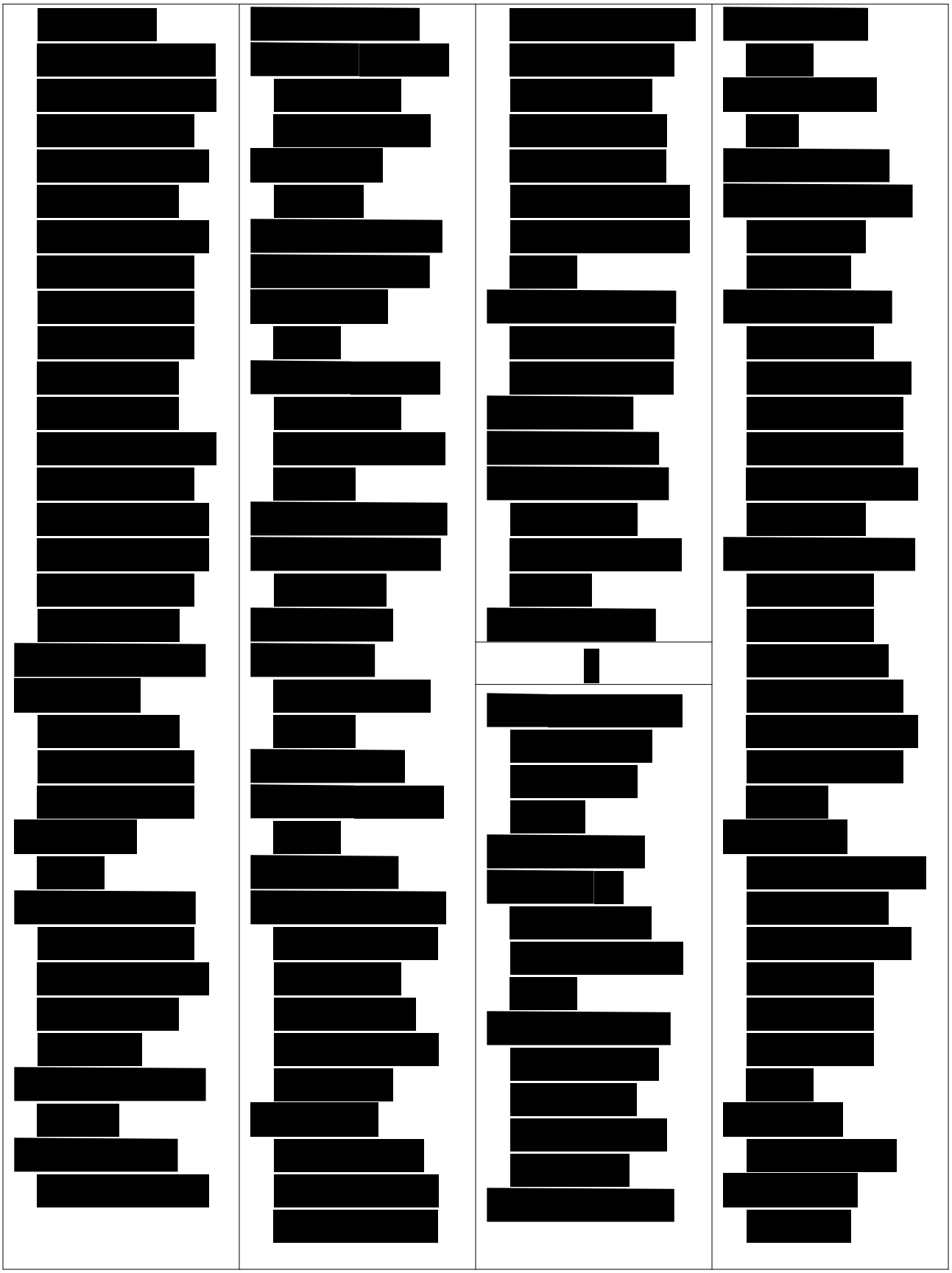
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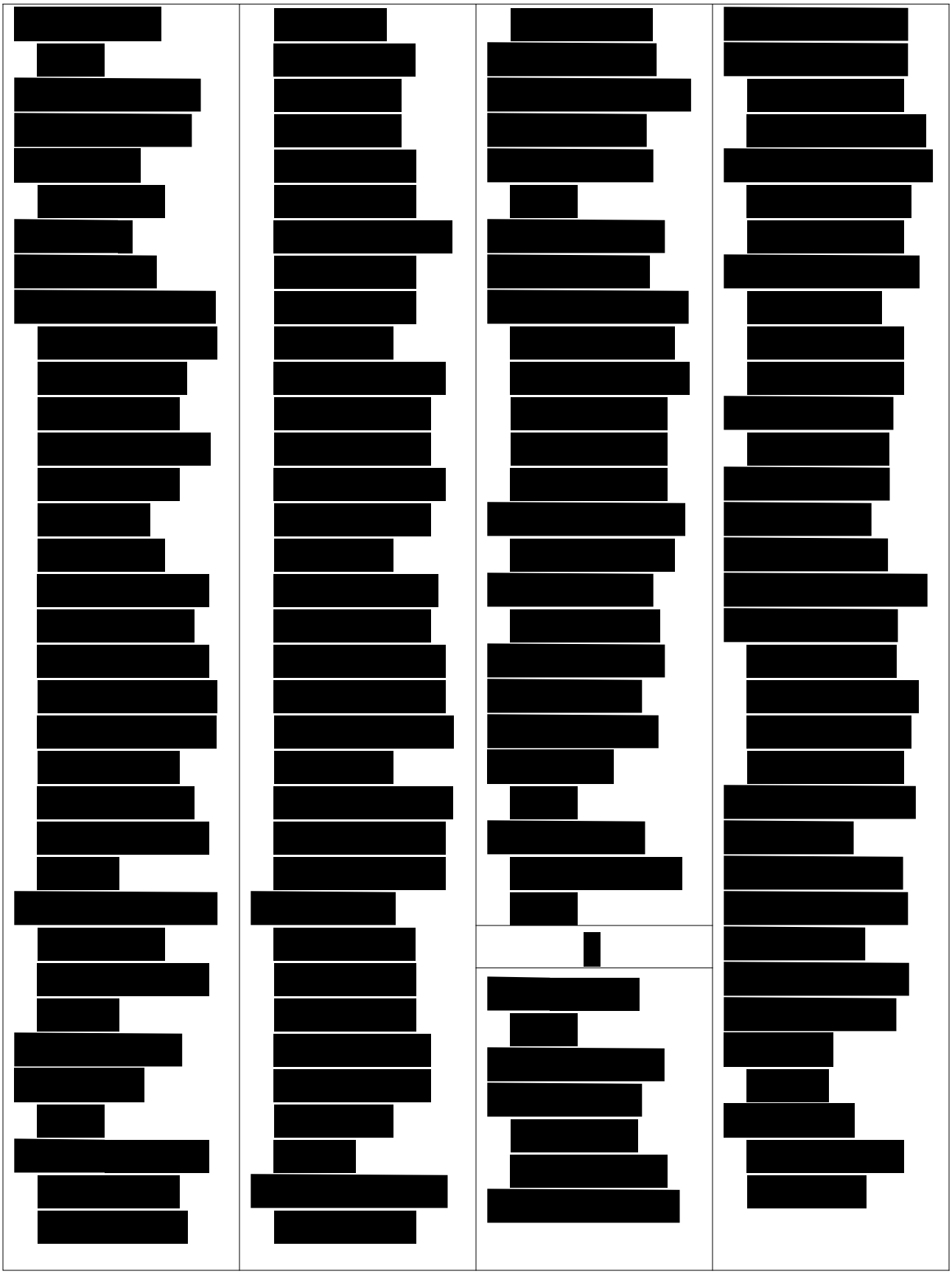
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[form - generation]



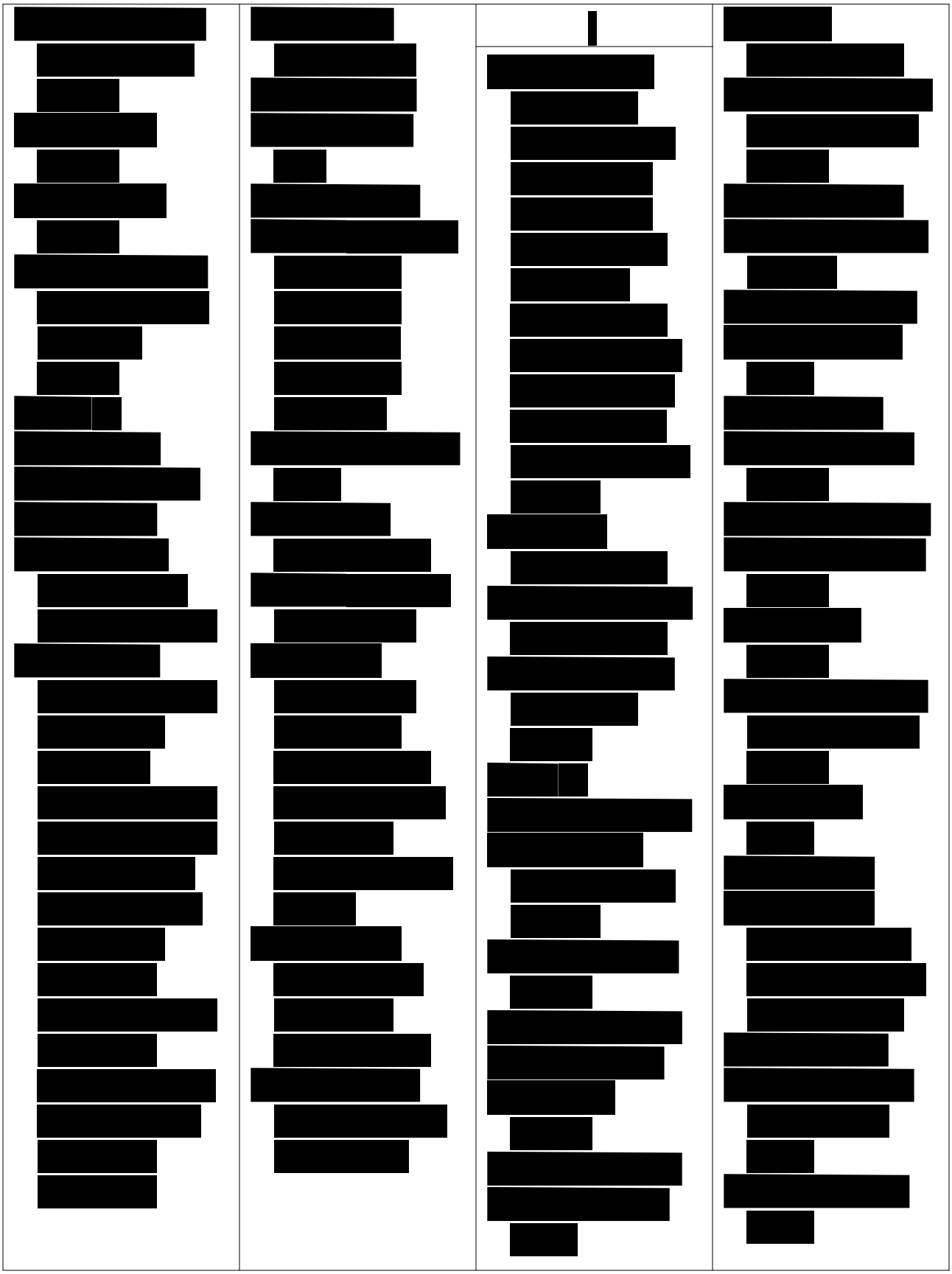
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[geometrical - hexameric]



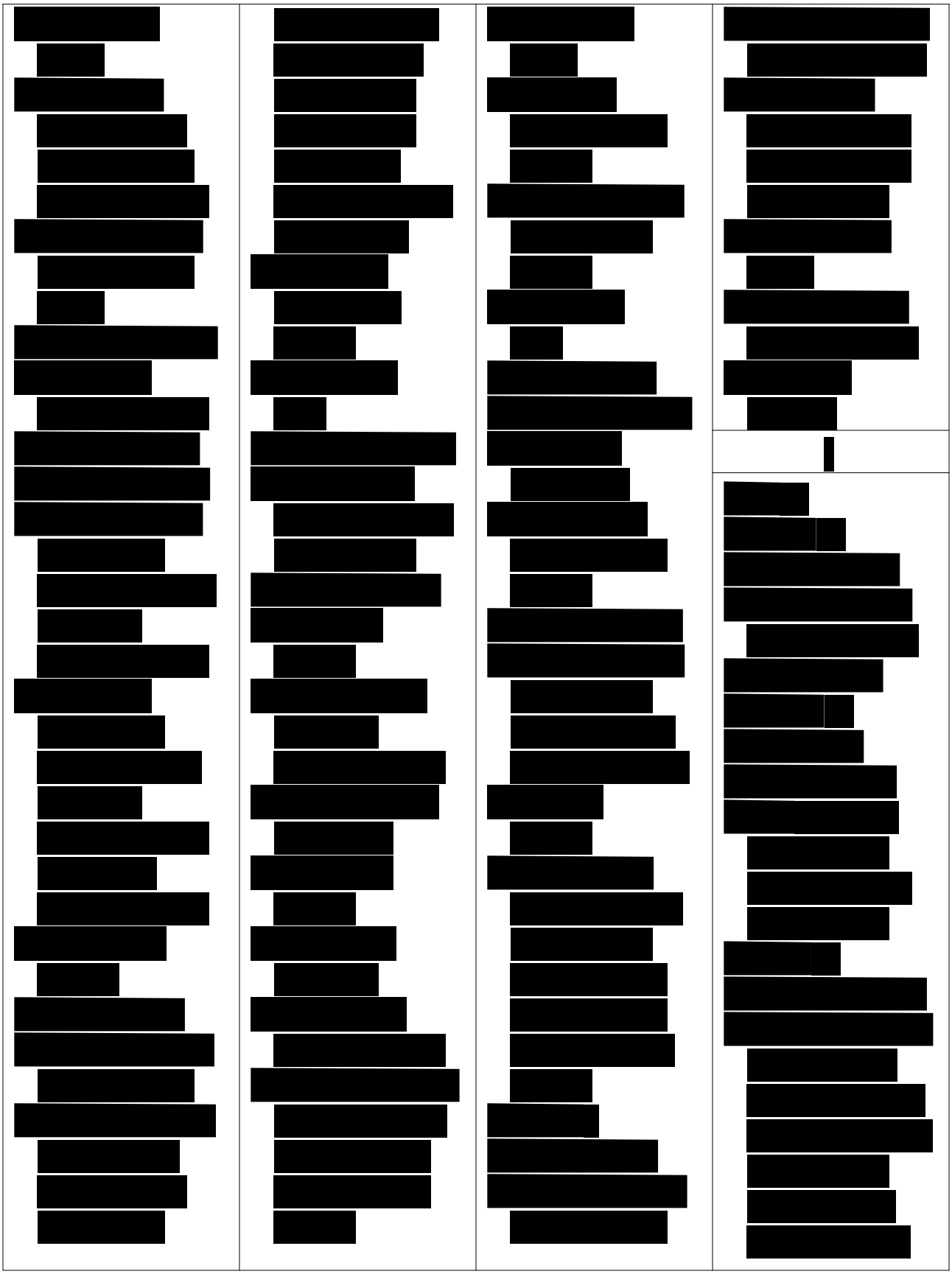
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[high - injection]



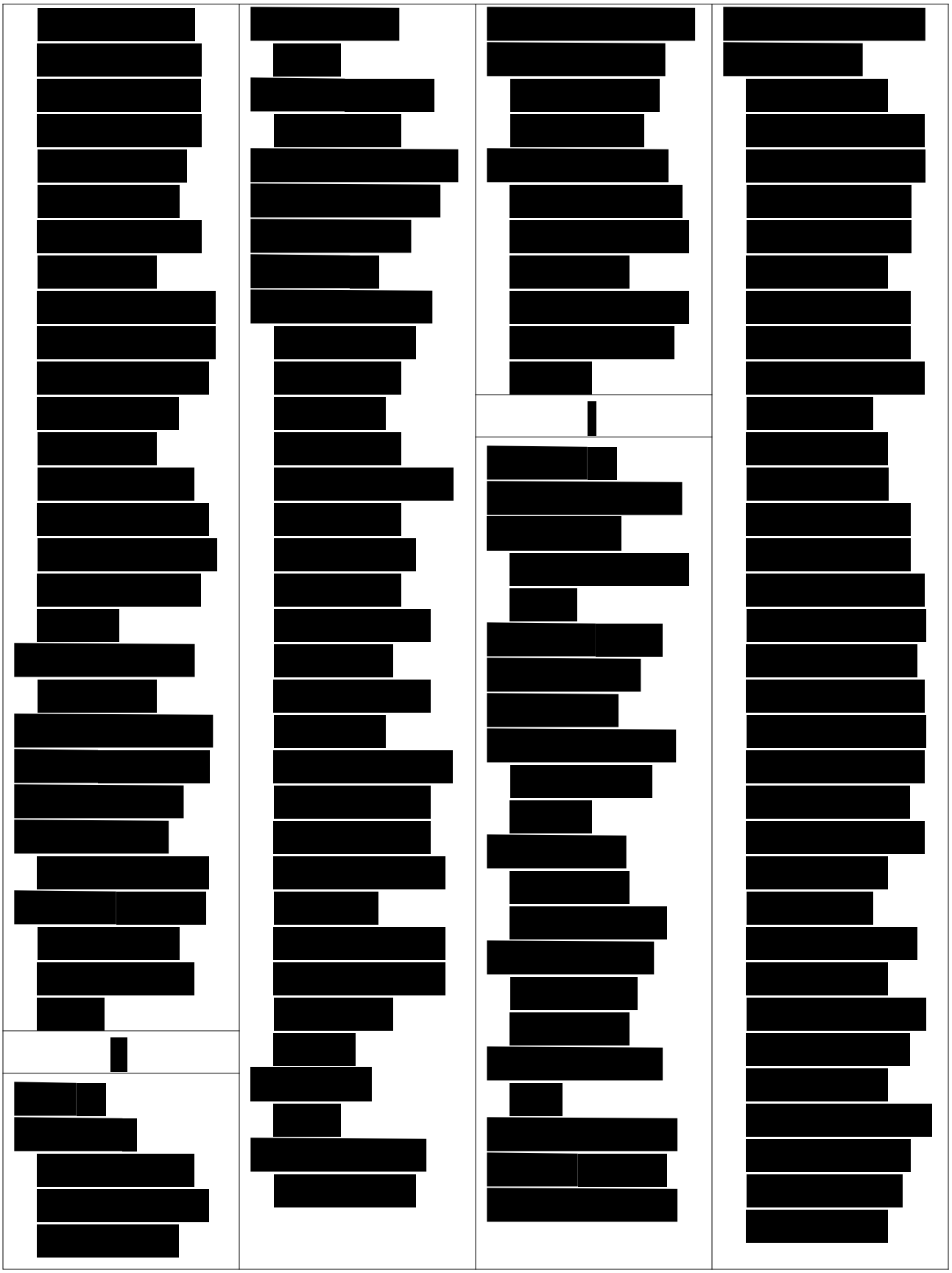
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[innovations - joint]



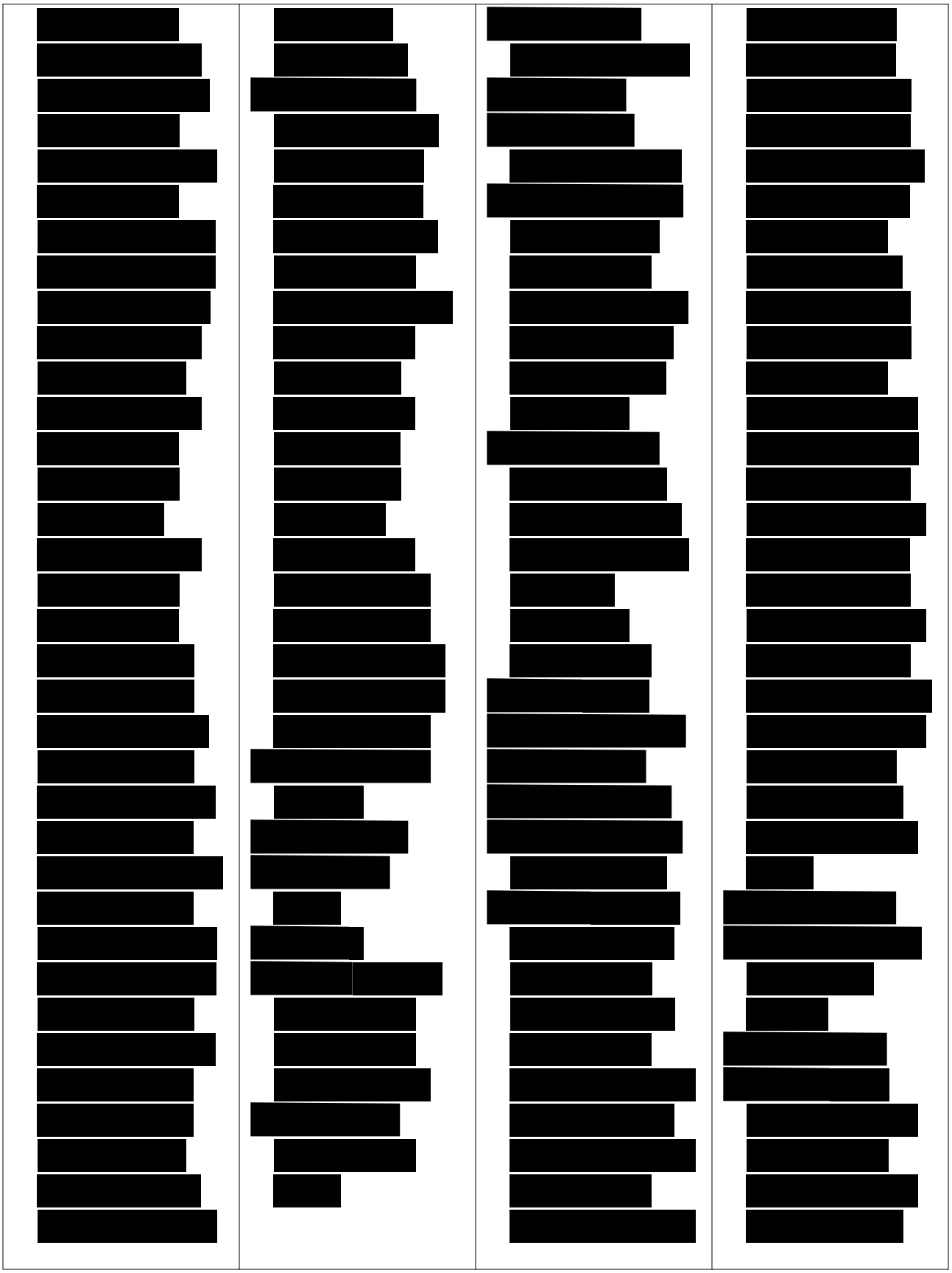
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[joint - layer]



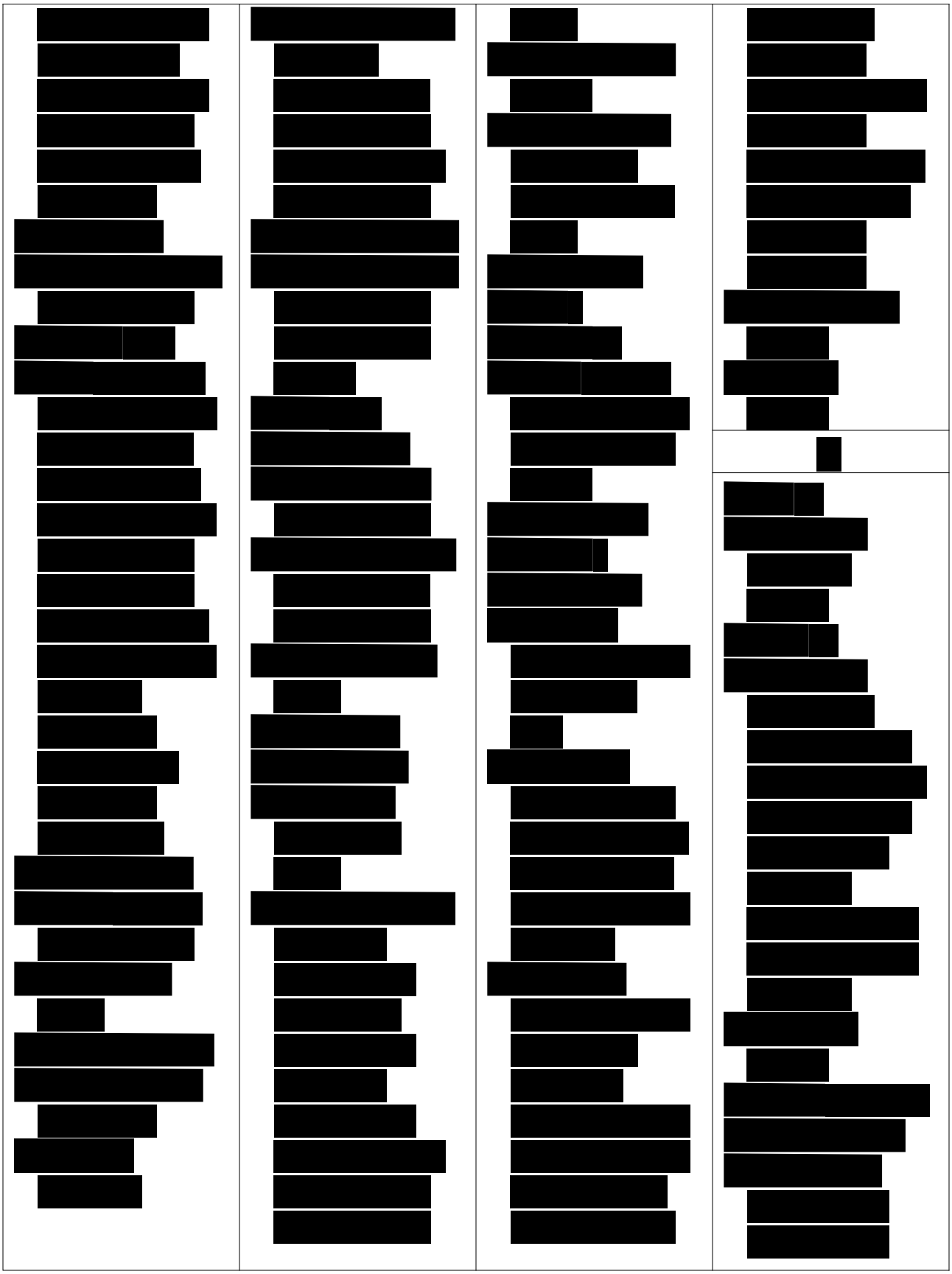
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[layer - line]



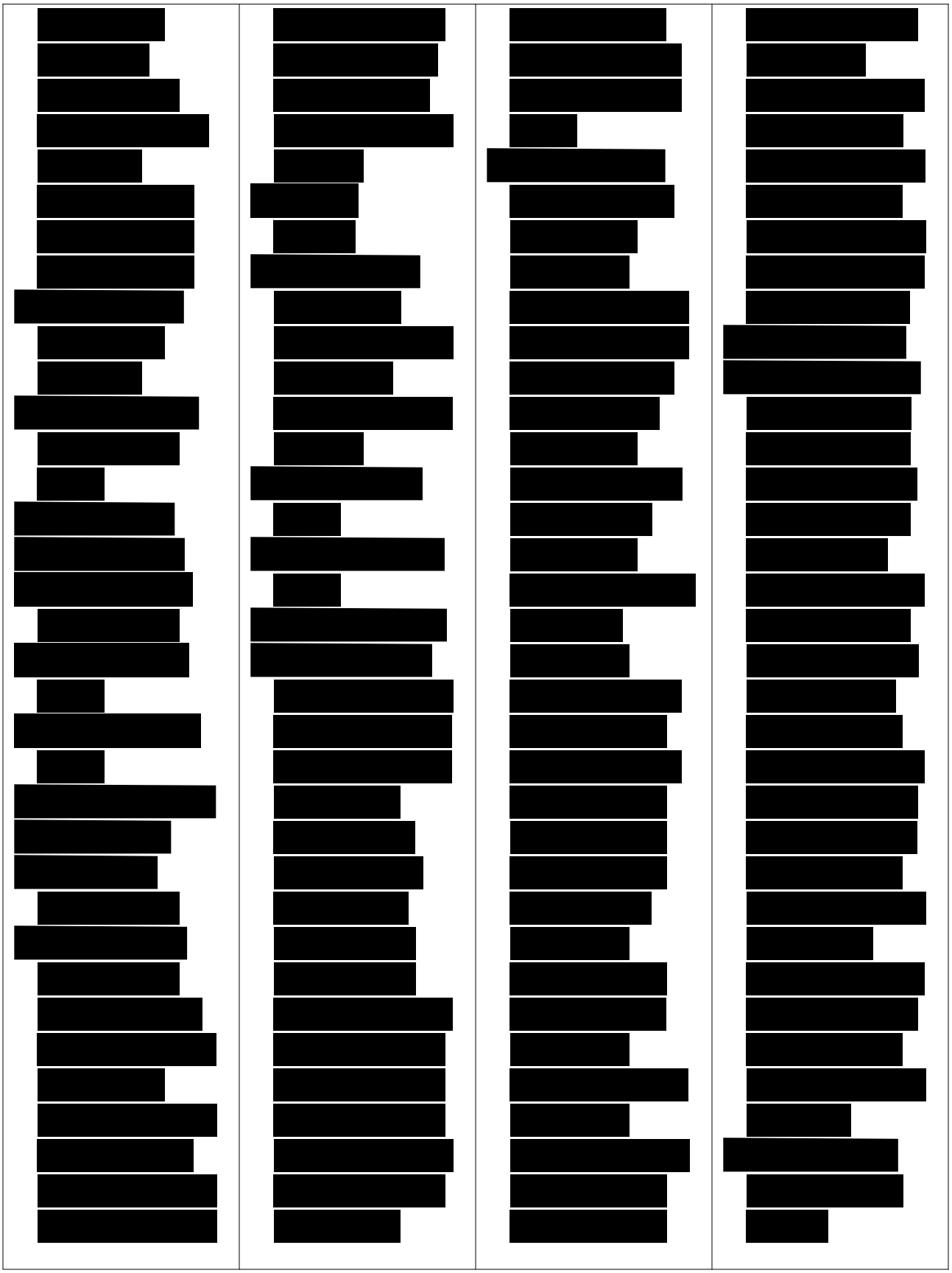
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[line - make]



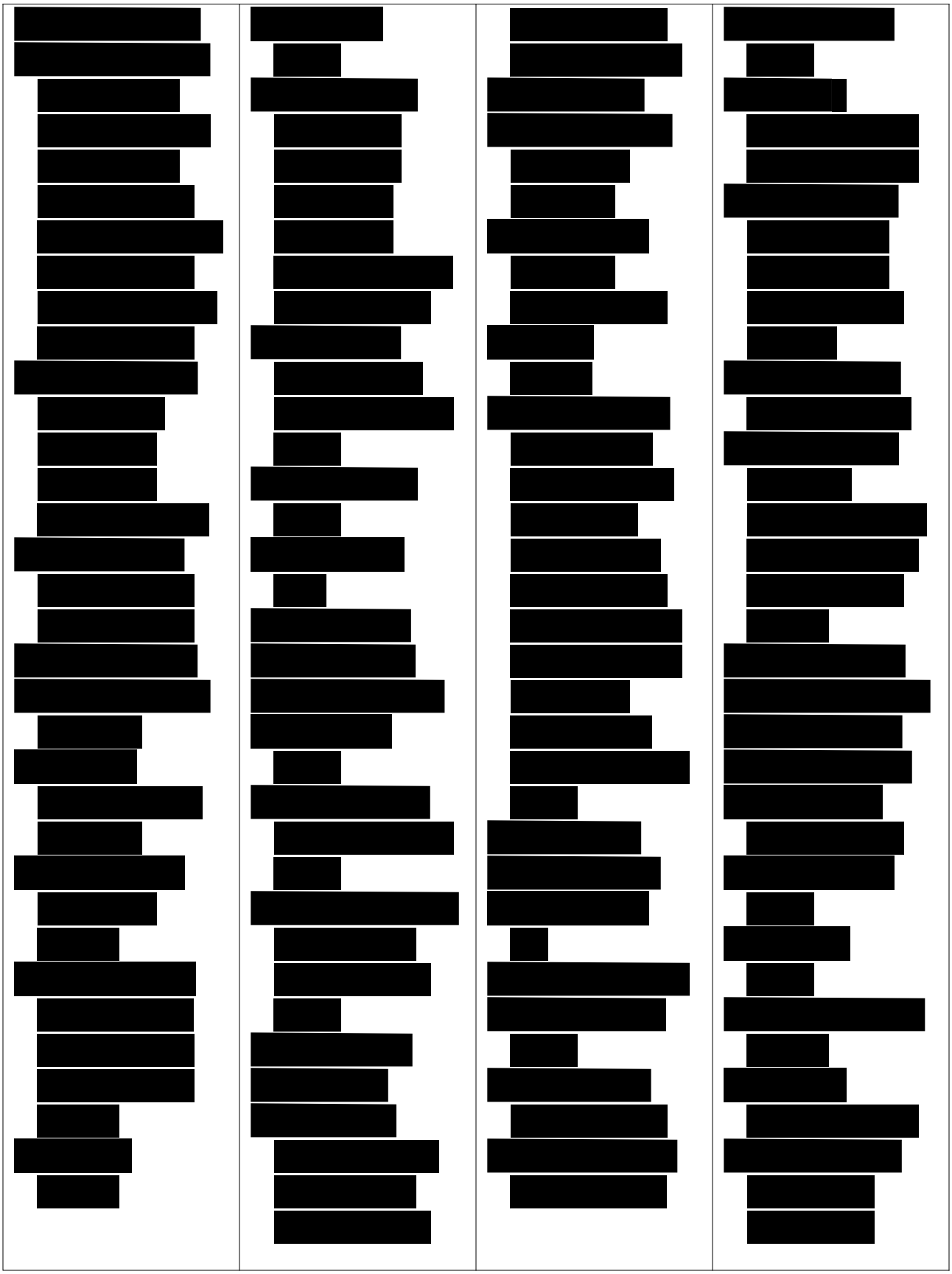
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[make - matter]



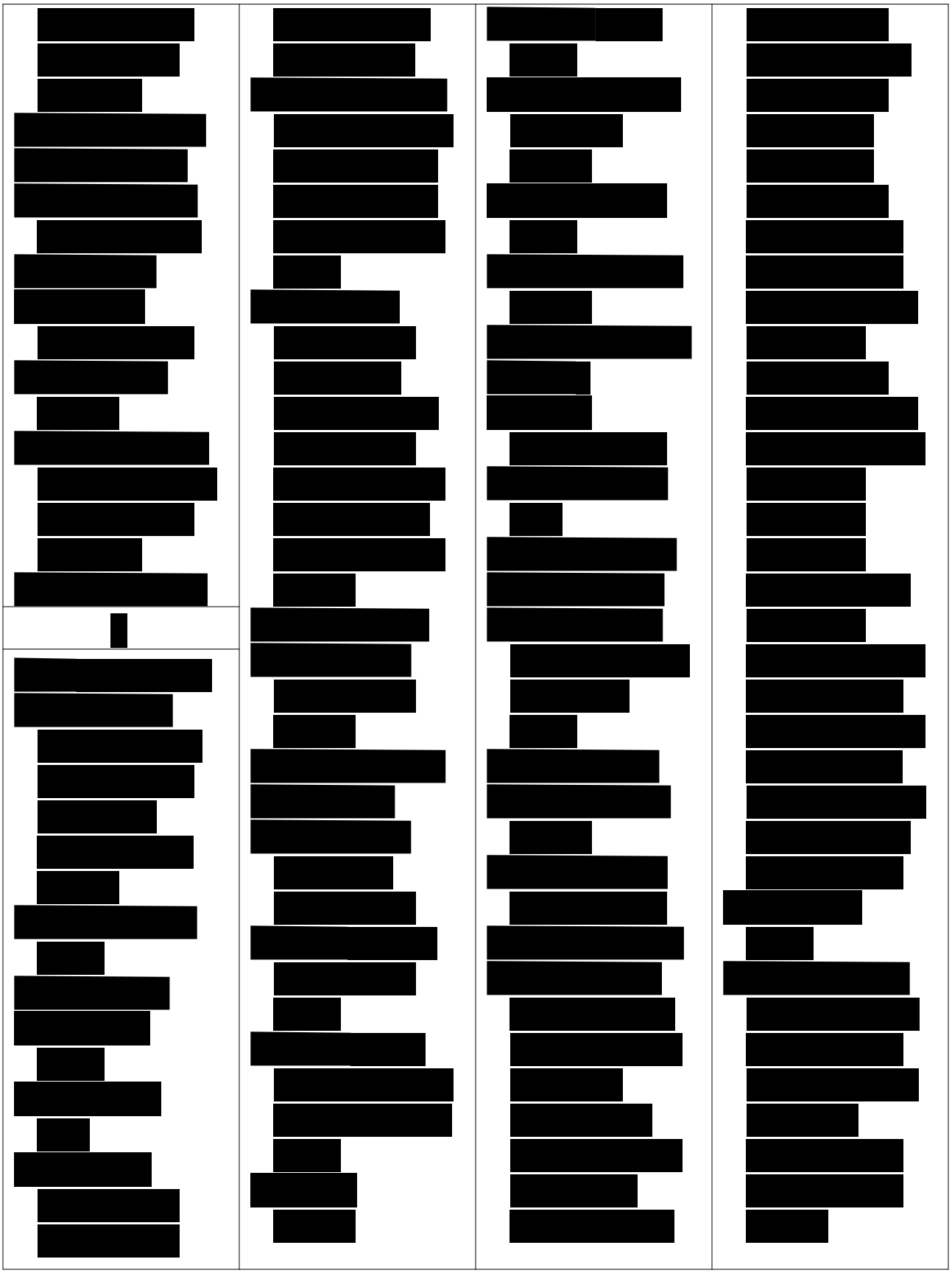
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[matters - moment]



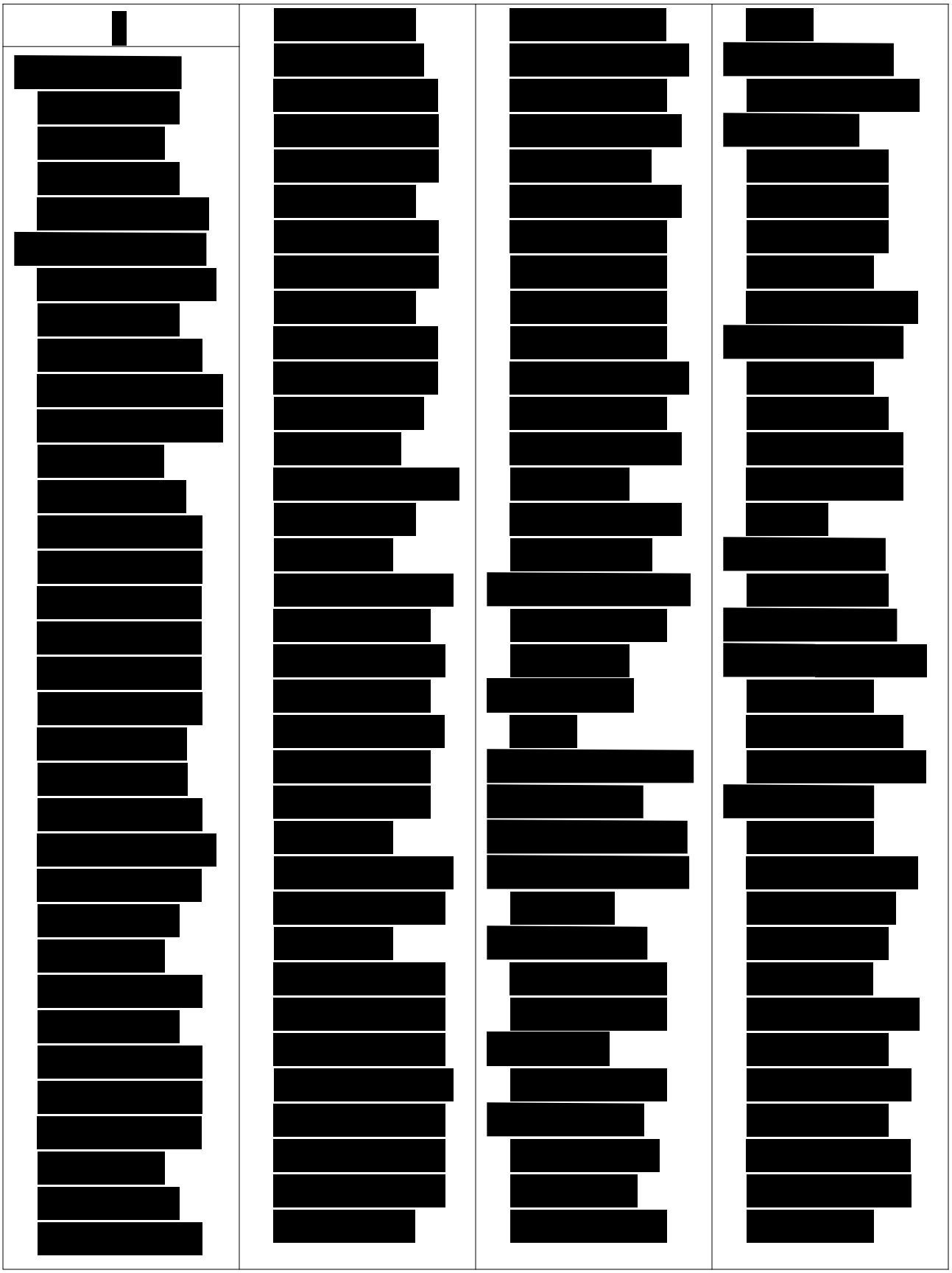
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[moment - numbers]



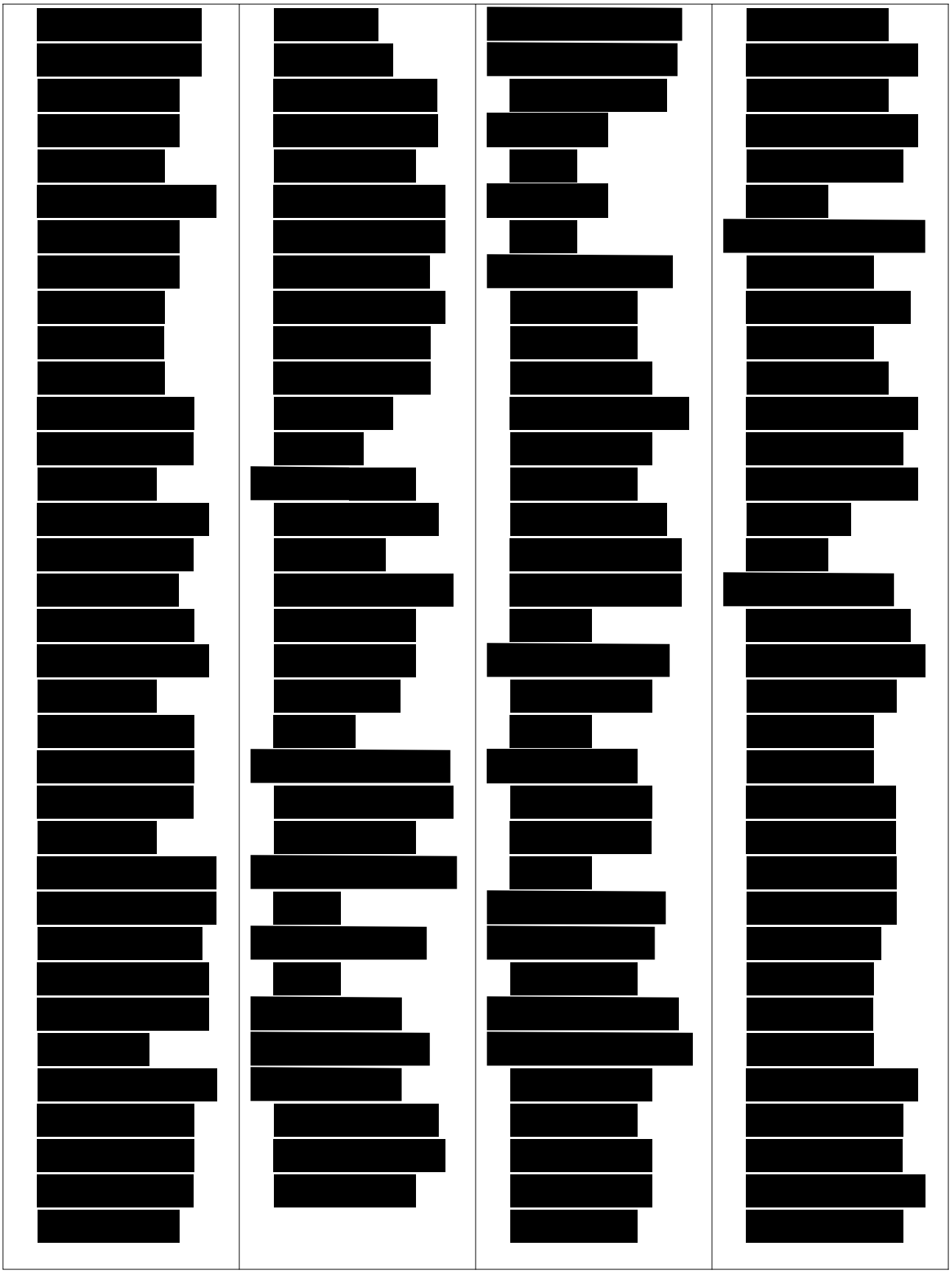
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[object - okay]



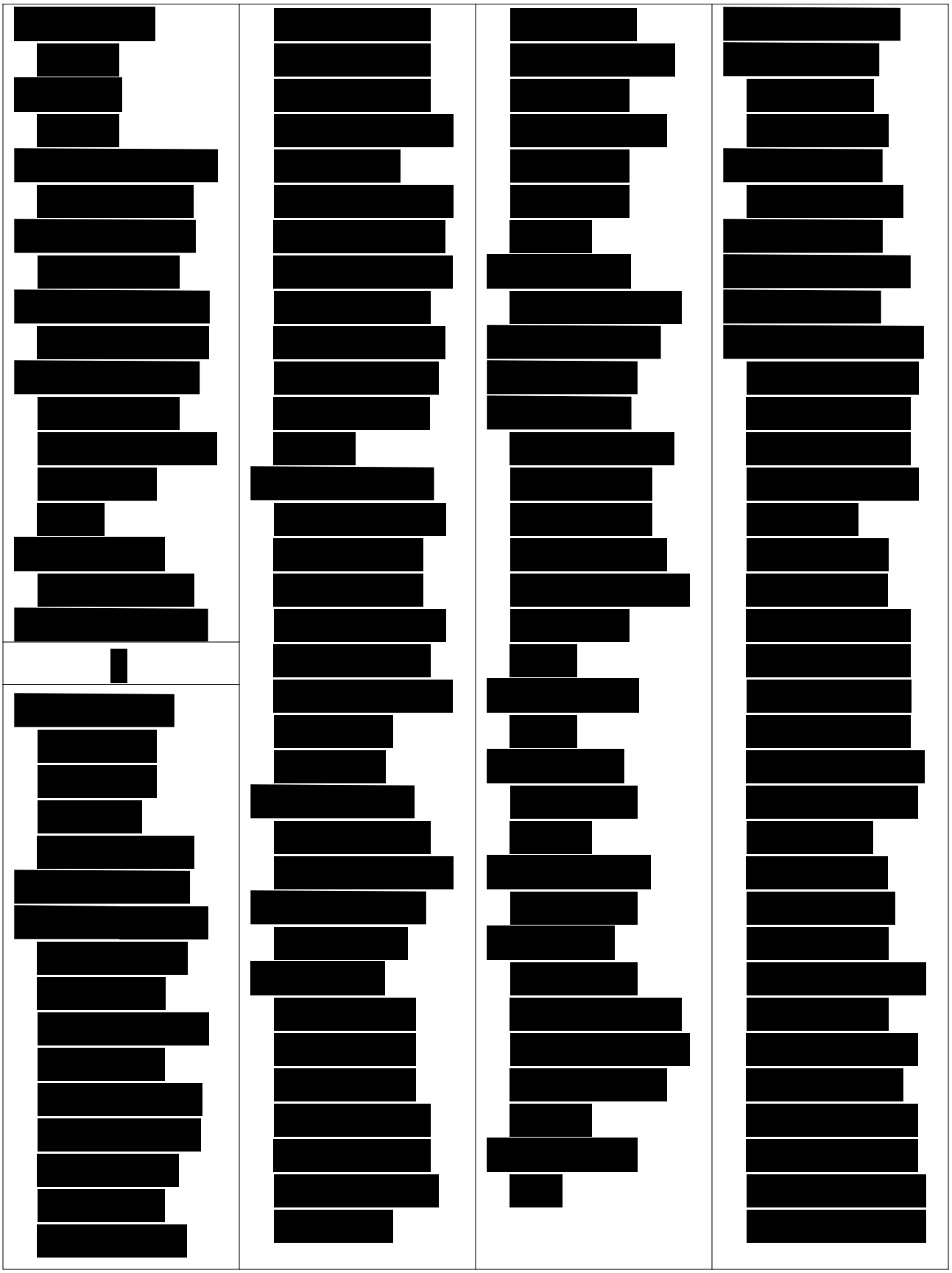
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[okay - organic]



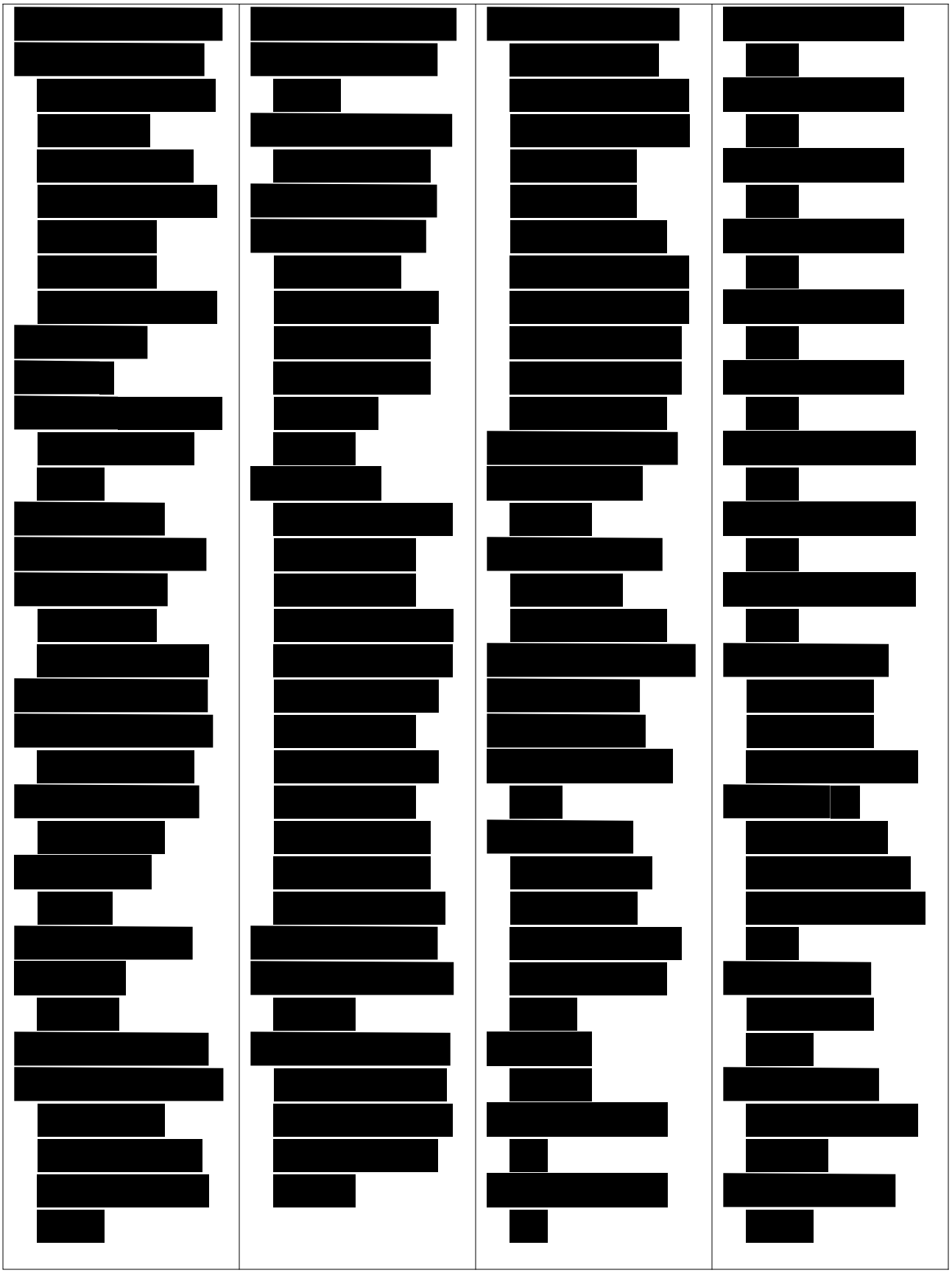
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[organically - patent]



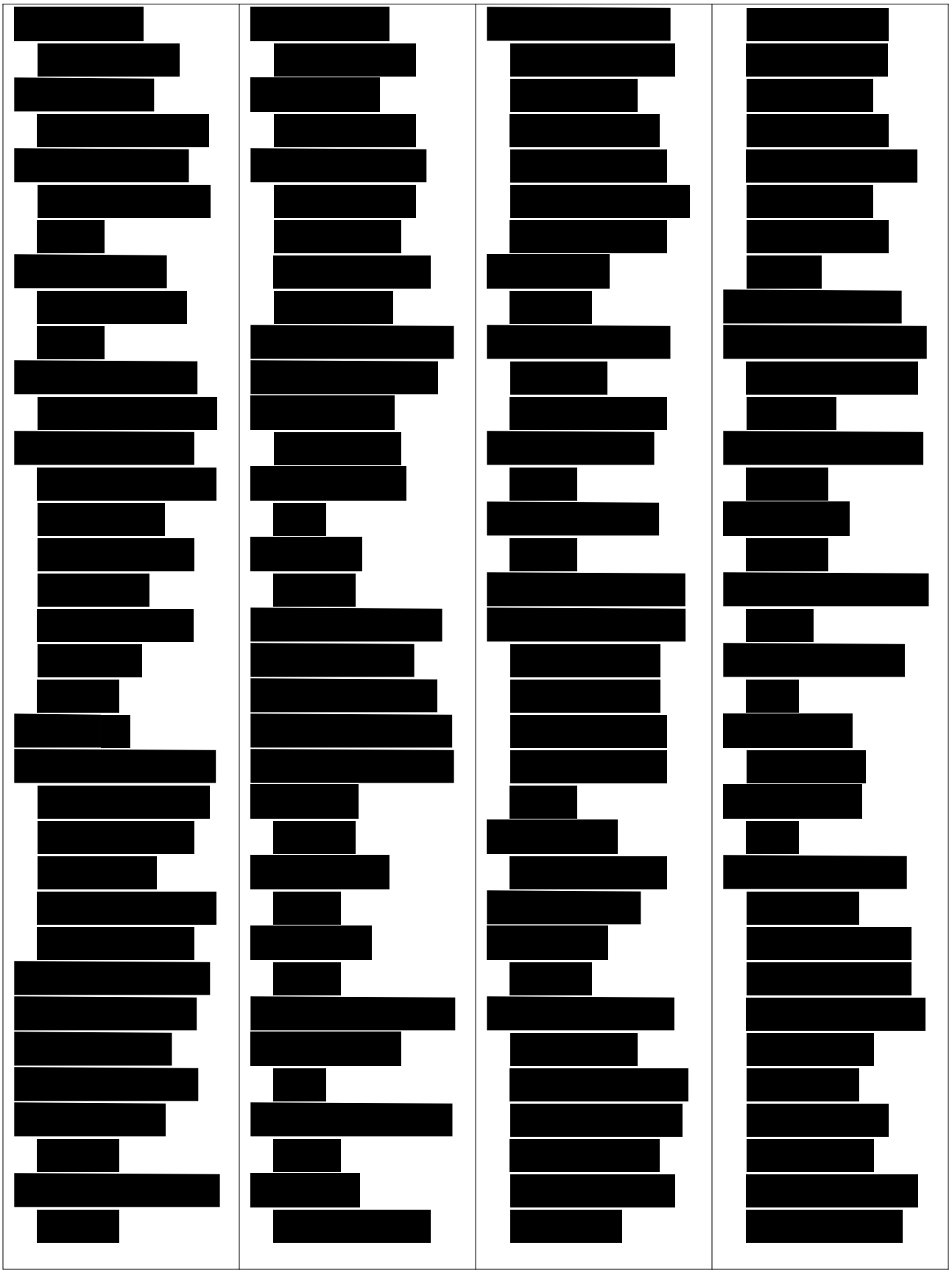
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[patentese - placed]



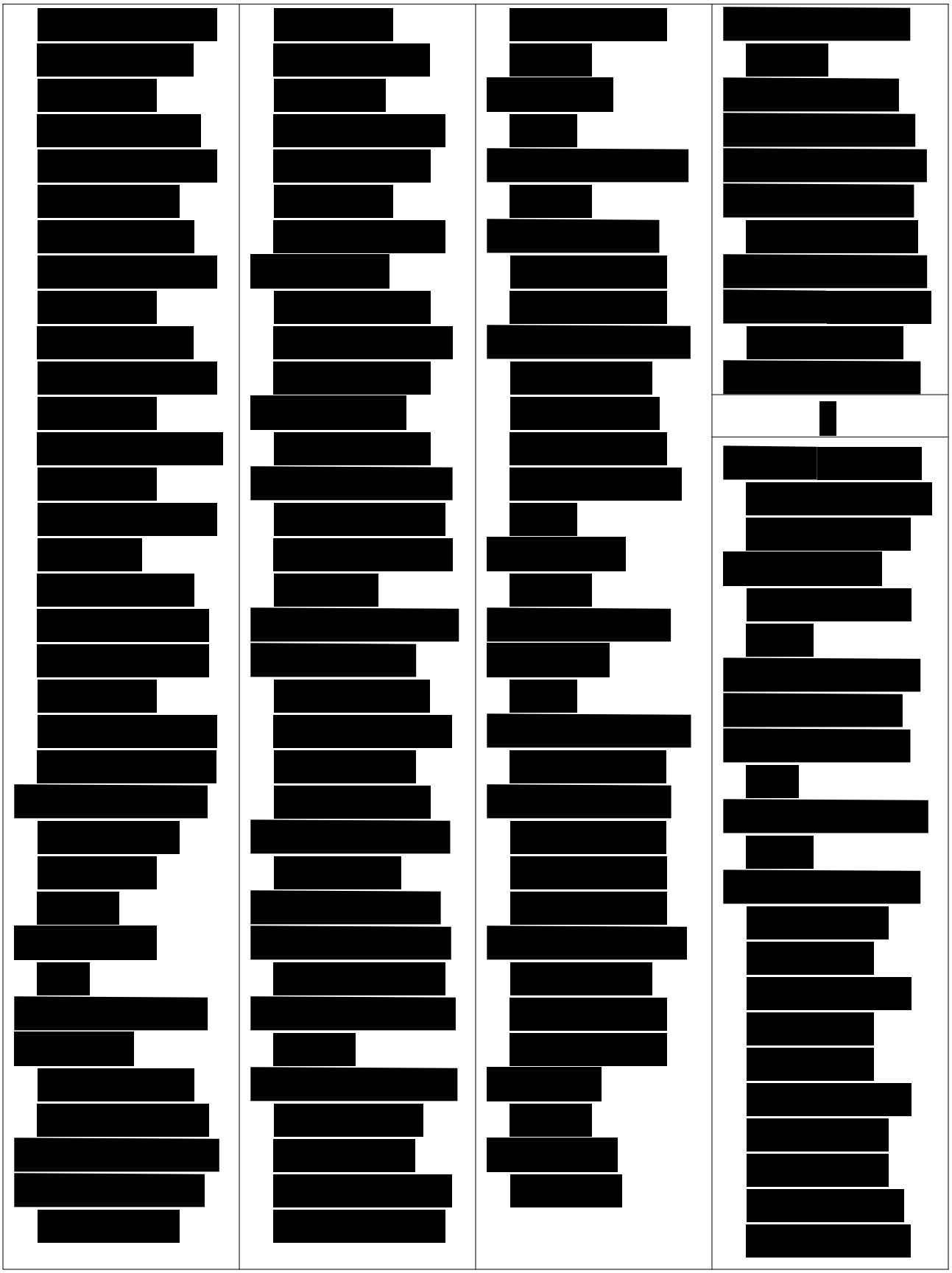
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[placement - process]



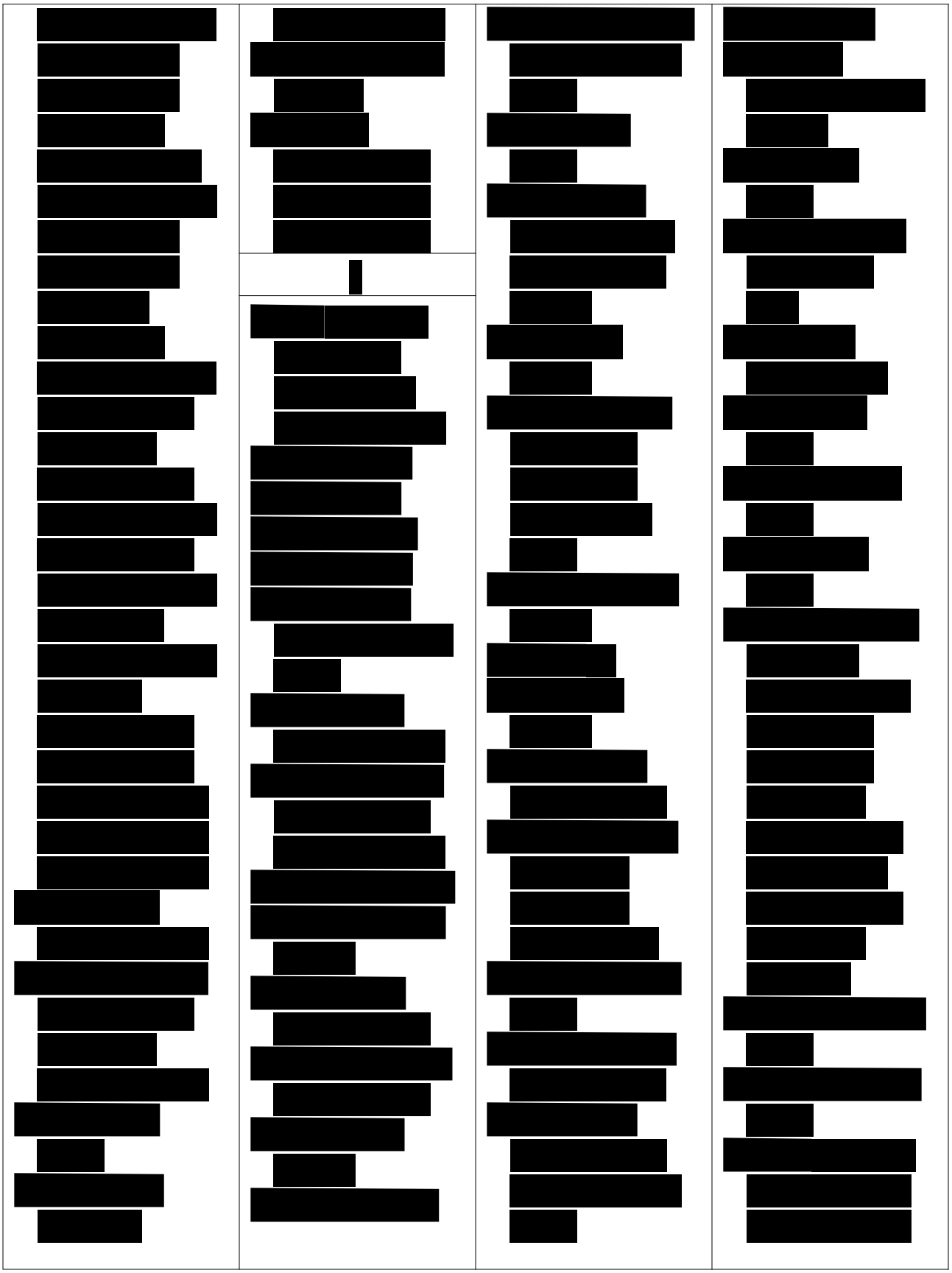
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[process - question]



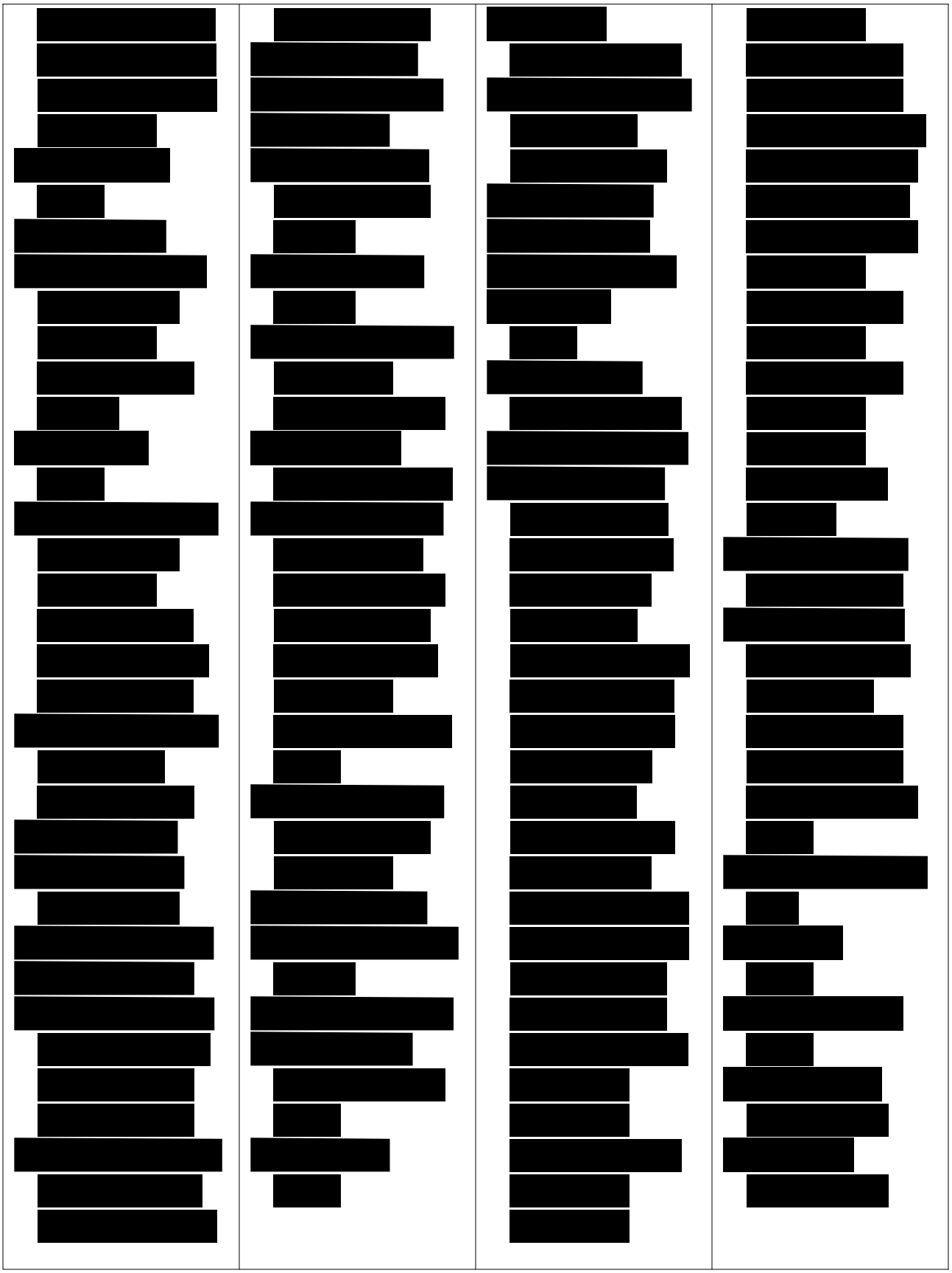
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[question - red]



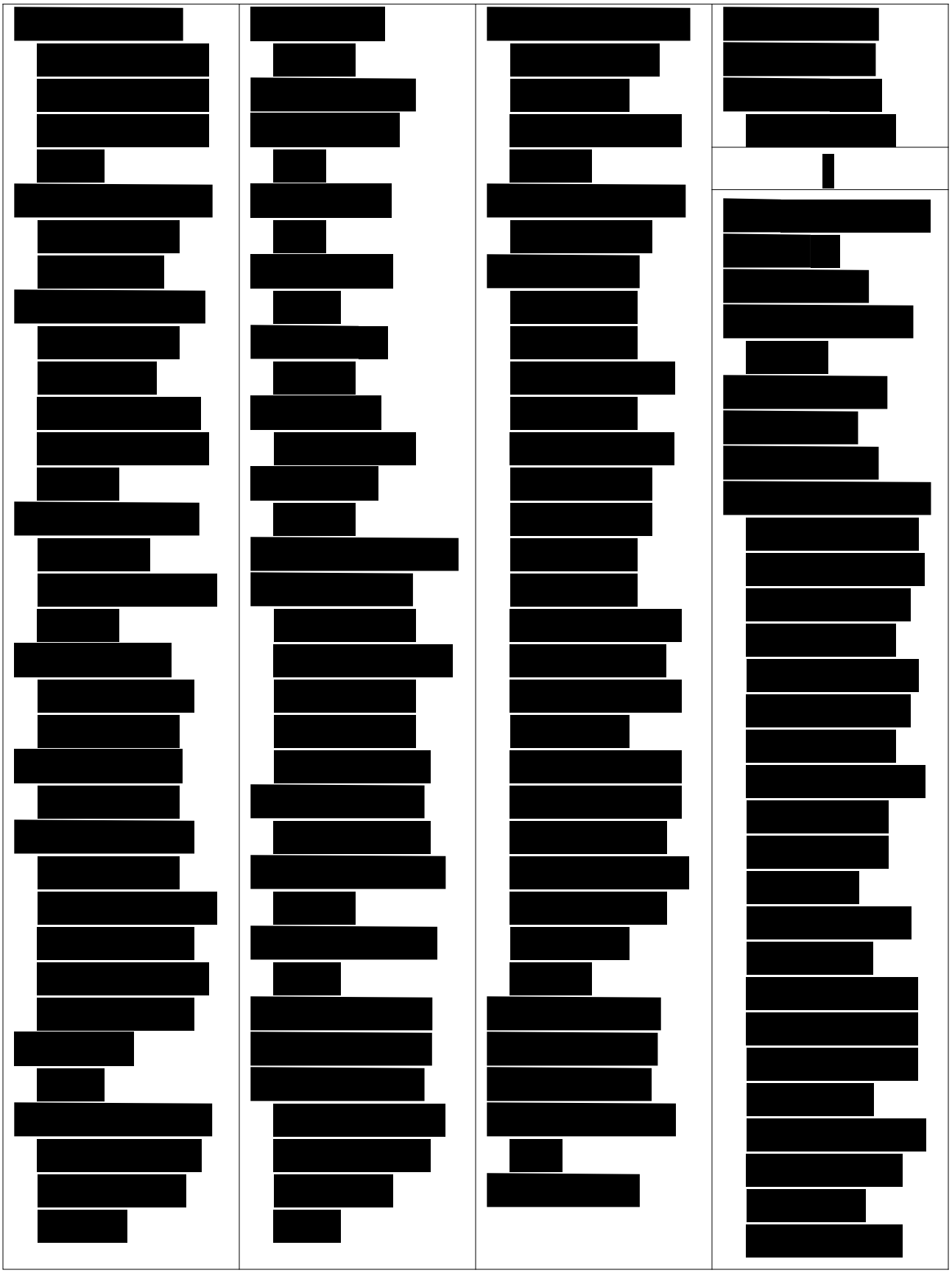
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[red - represents]



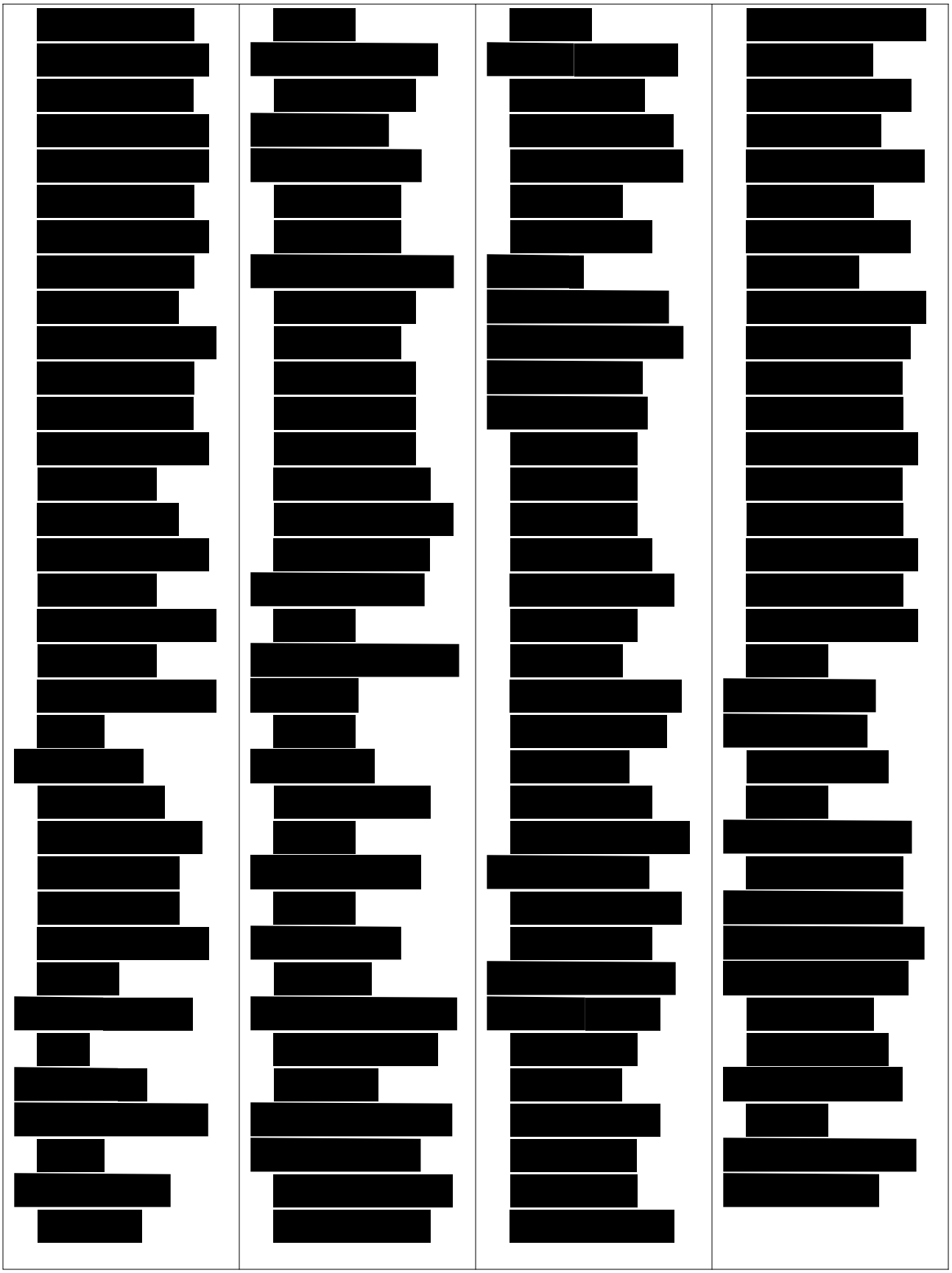
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[request - samsung]



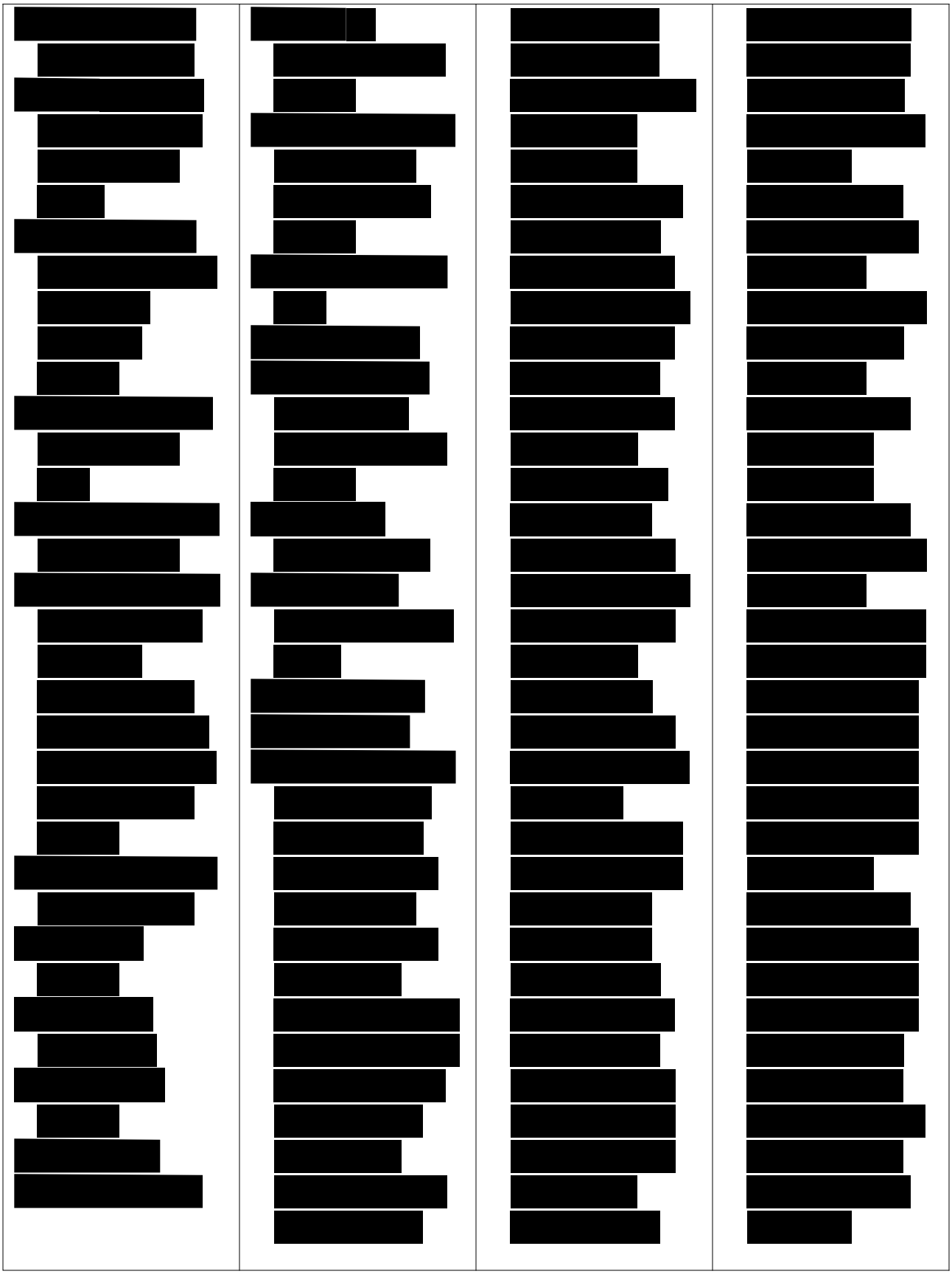
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[samsung - sent]



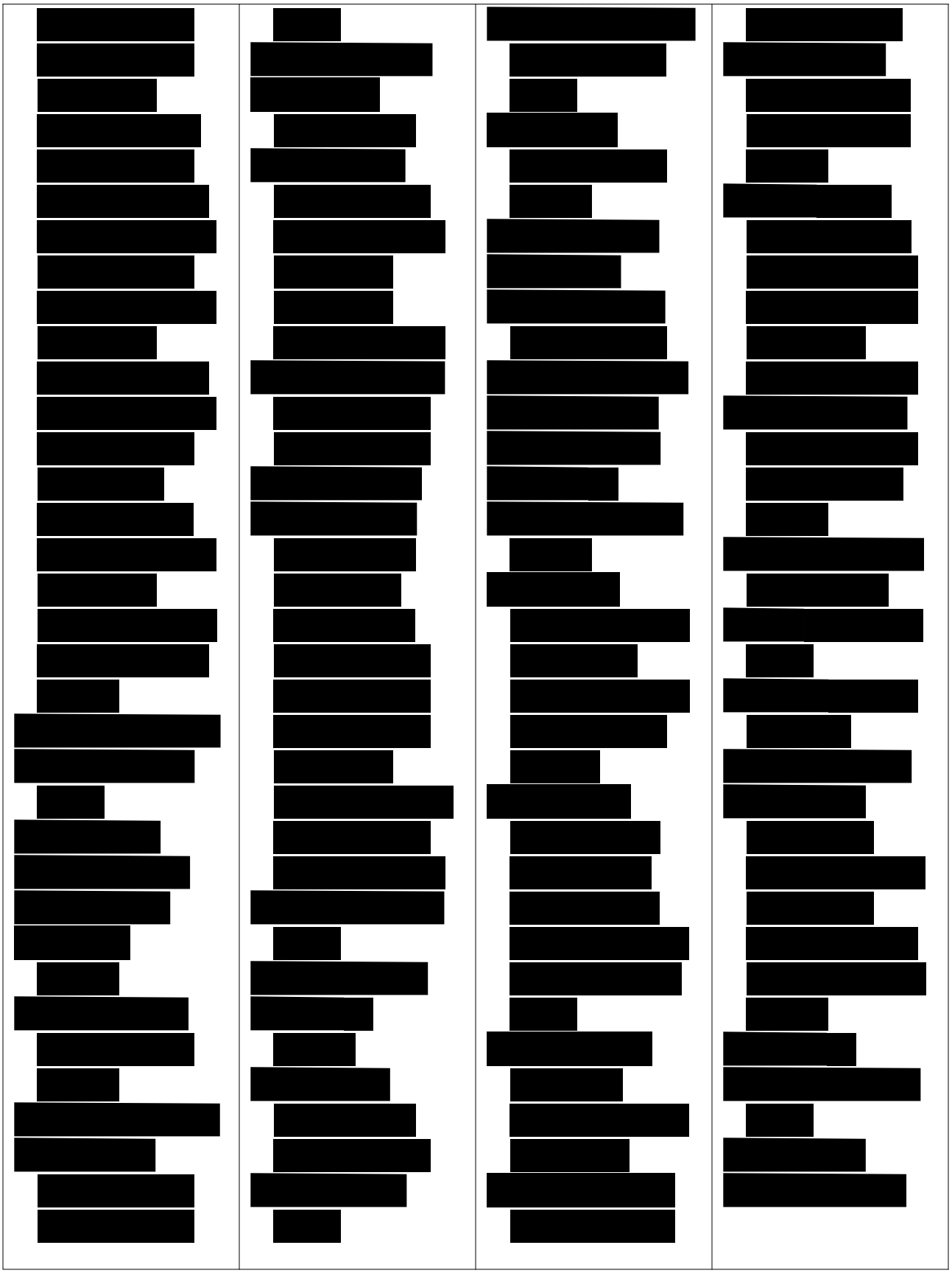
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[sentence - sheasby]



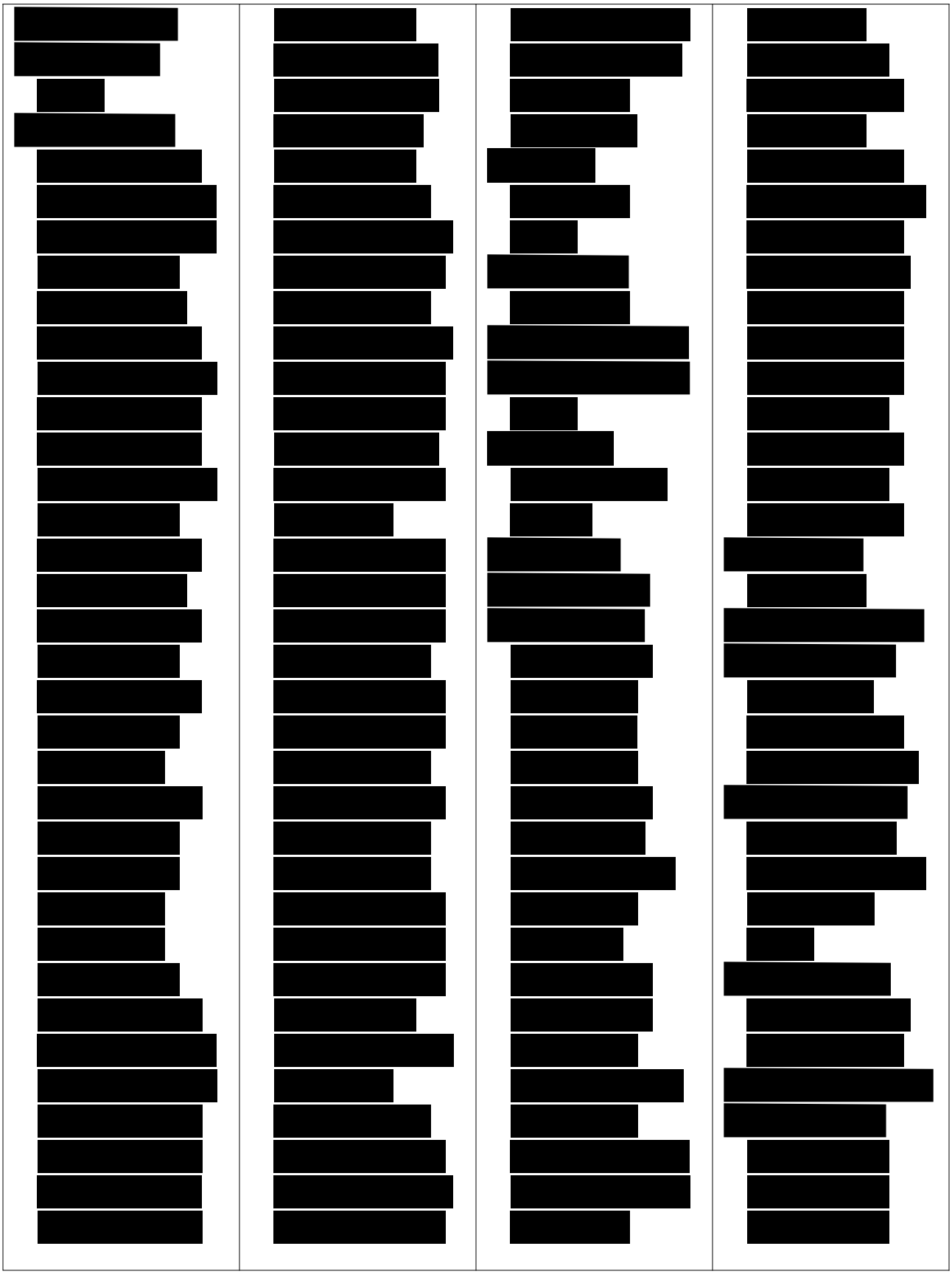
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[sheasby - smaller]



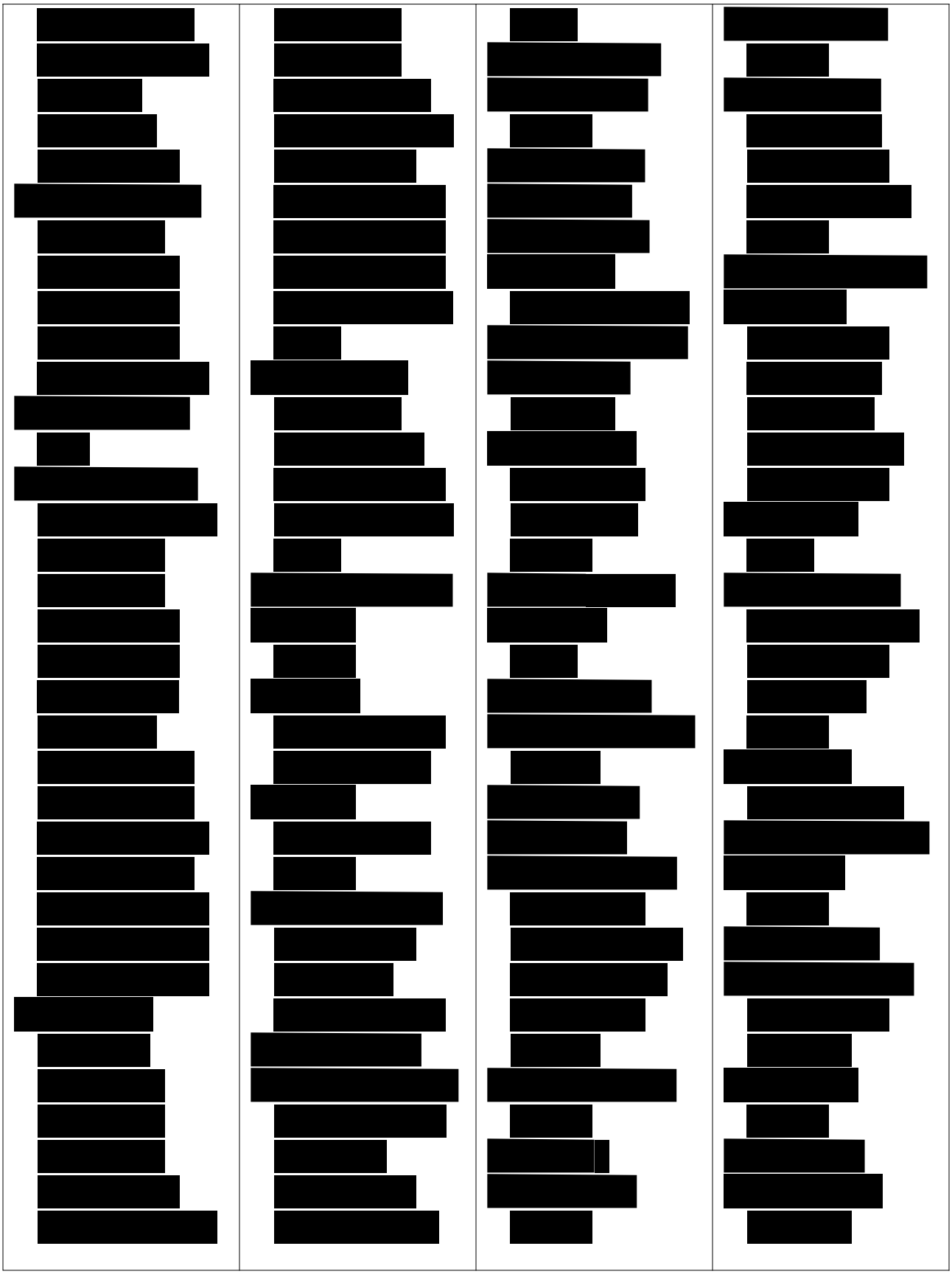
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[smart - speak]



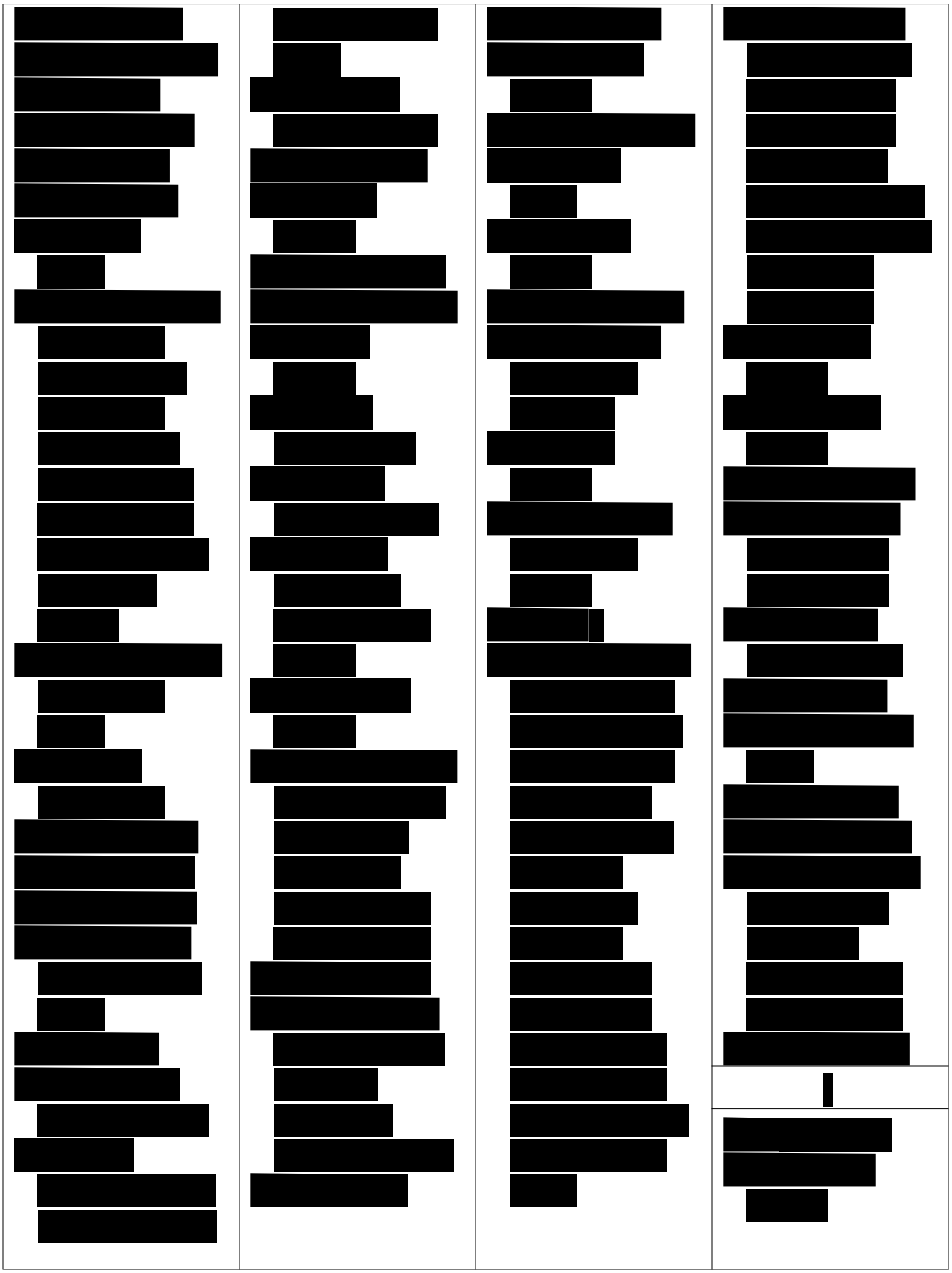
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[speak - stockholders]



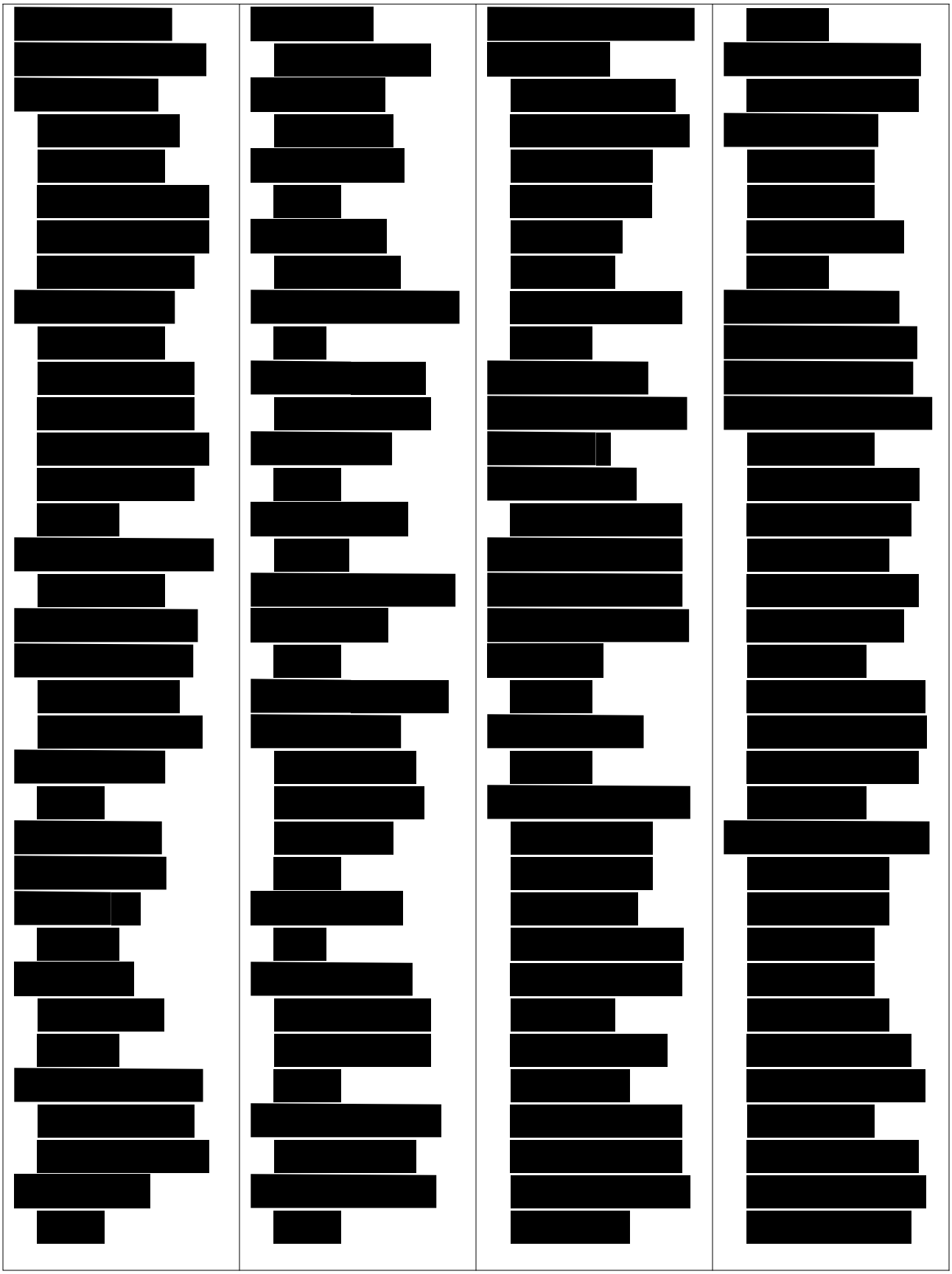
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[stored - table]



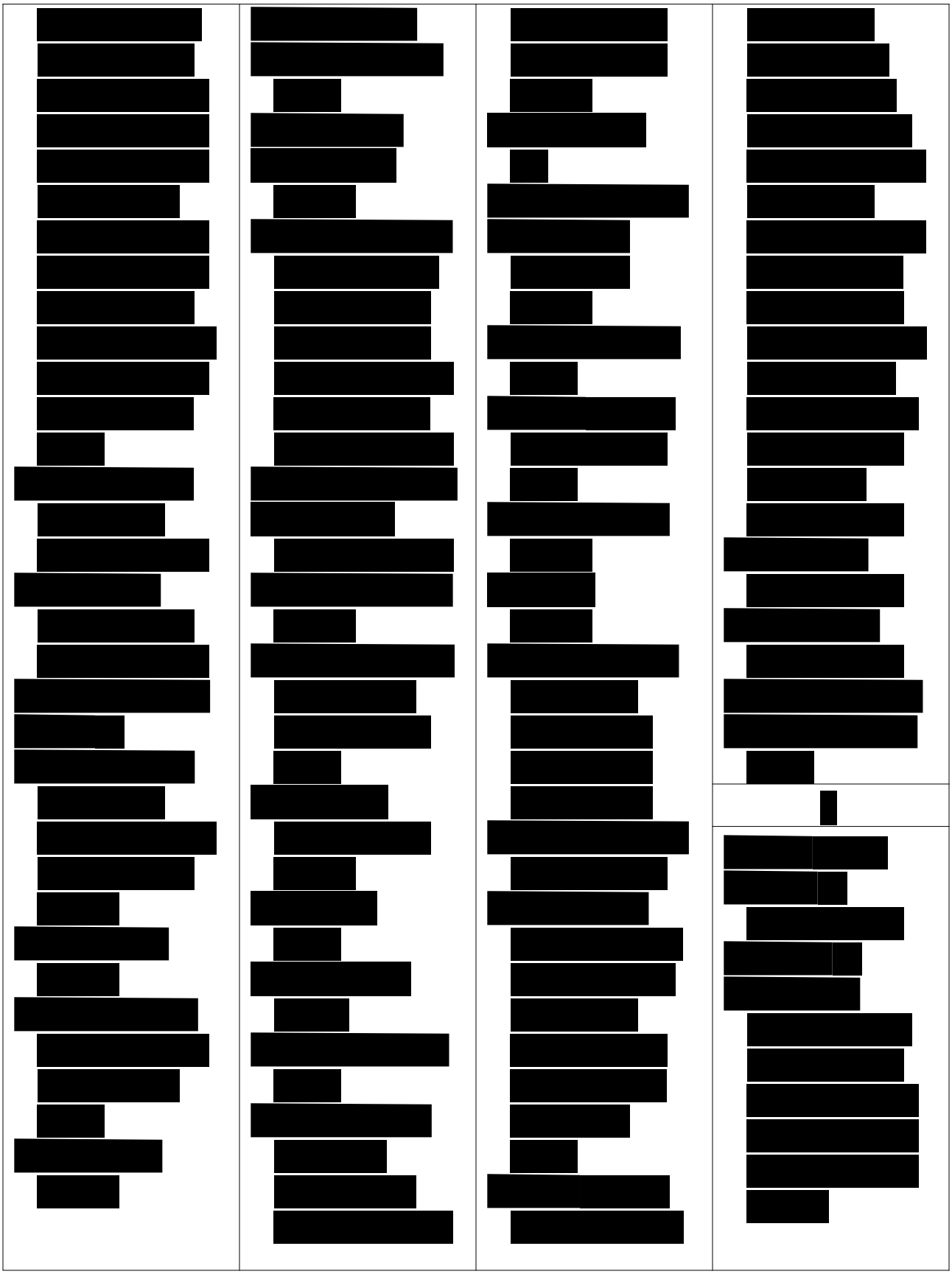
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[tabs - time]



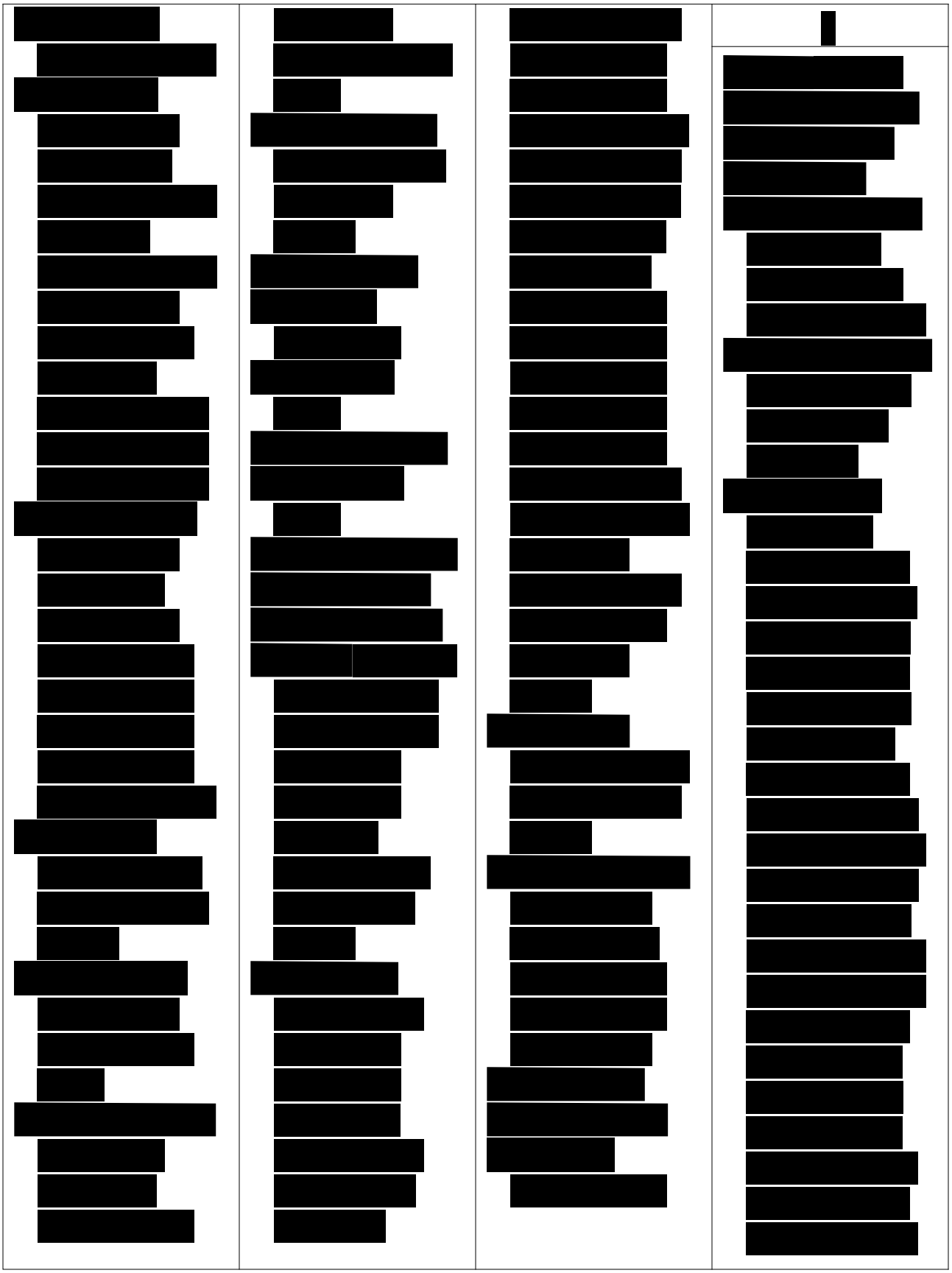
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[time - under]



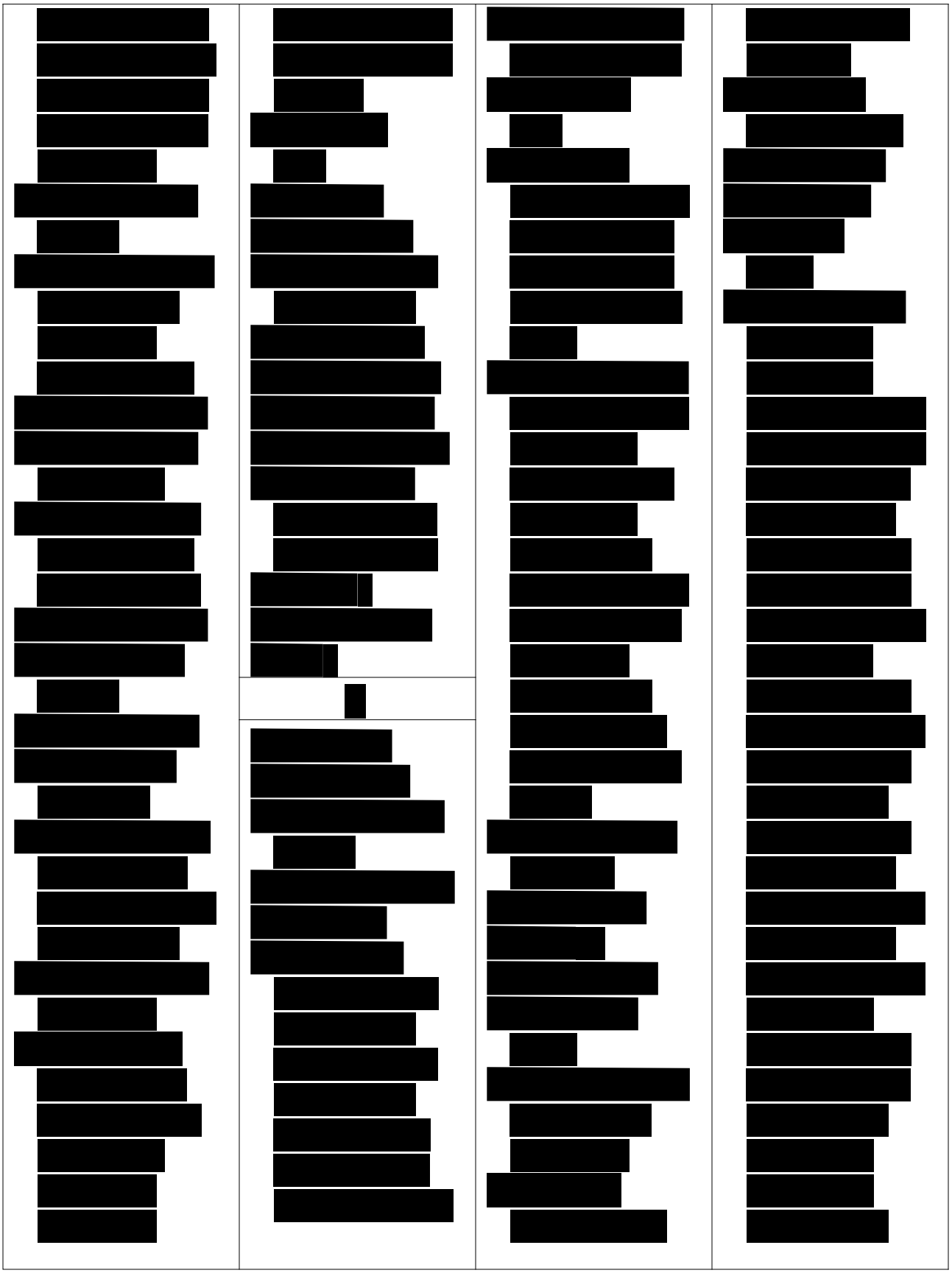
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[underneath - vaporization]



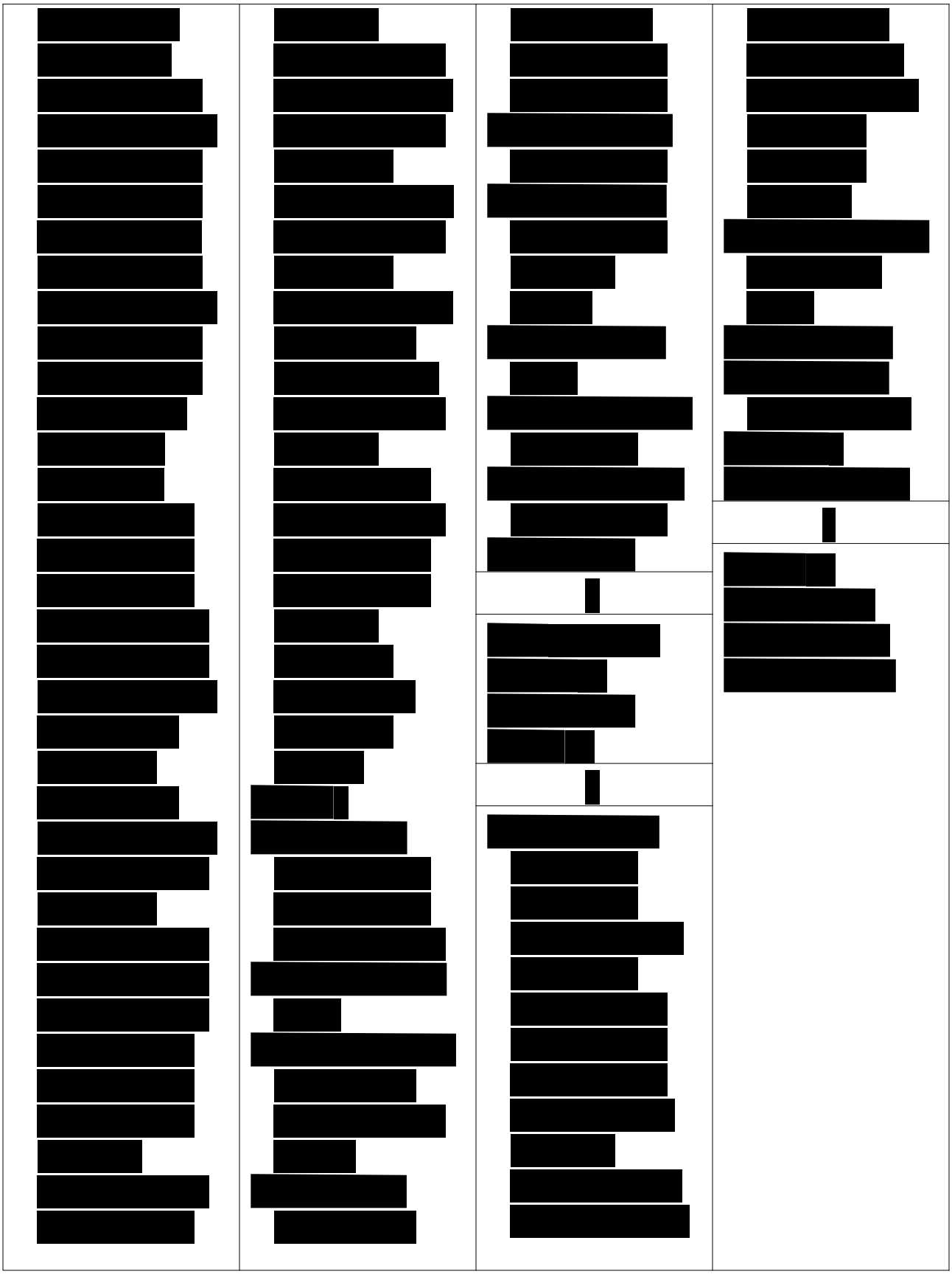
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[vaporization - witness]



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[witness - zoom]



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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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