

NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

PACIFIC GAS & ELECTRIC COMPANY

(Diablo Canyon Units 1 and 2)

Docket Nos. 50-275
50-323

Place - Avila Beach, California

Date - 15 February 1979

Pages 9940 - 10,182

Telephone:
(202) 347-3700

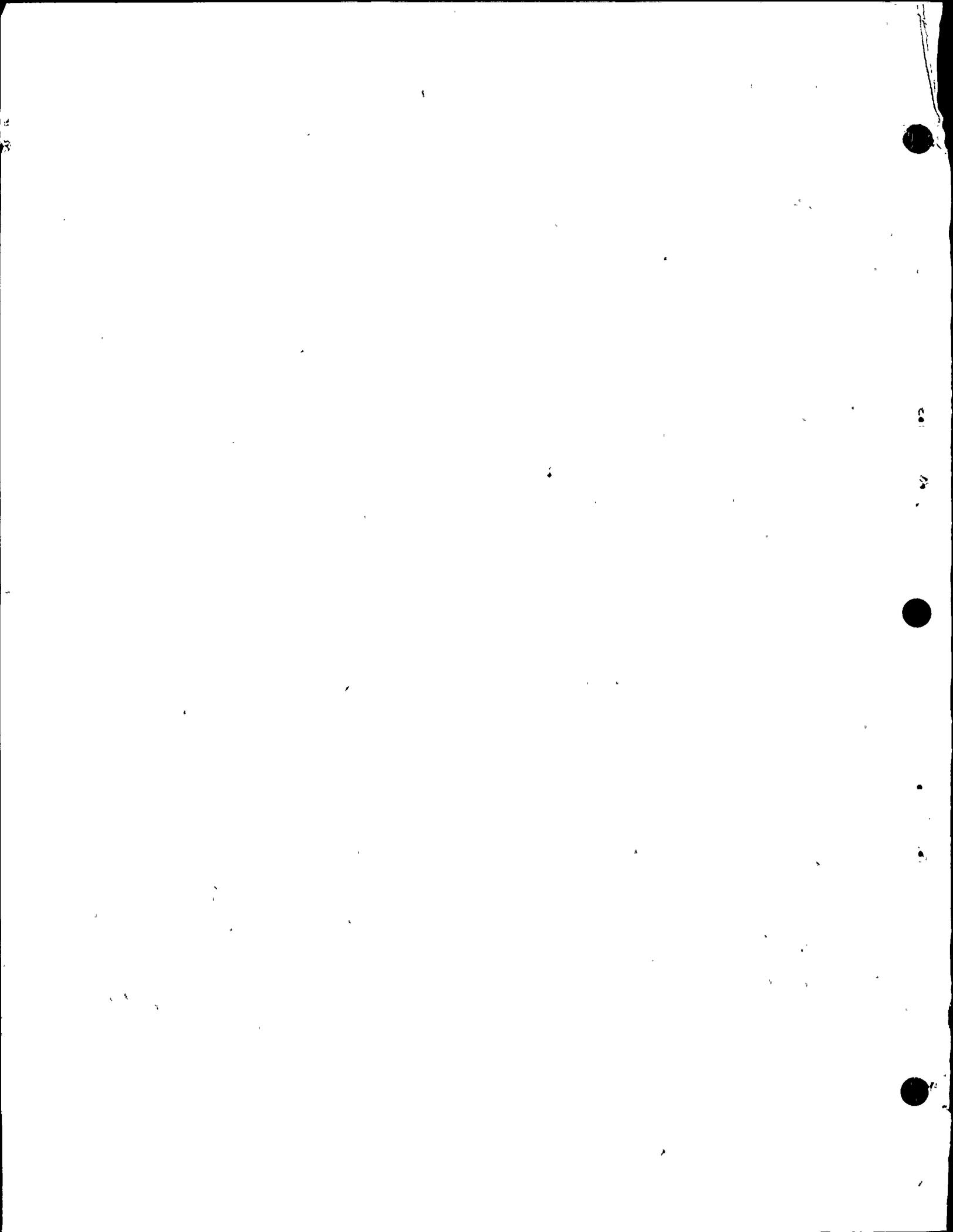
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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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PACIFIC GAS & ELECTRIC COMPANY : Docket Nos. 50-275
: 50-323
(Diablo Canyon Units 1 and 2) :
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: :

Cavalier Room,
San Luis Bay Inn,
Avila Beach, California

Thursday, 15 February 1979

The hearing in the above-entitled matter was reconvened, pursuant to adjournment, at 8:30 a.m.

BEFORE:

ELIZABETH BOWERS, Esq., Chairman,
Atomic Safety and Licensing Board.

DR. WILLIAM E. MARTIN, Member.

GLENN O. BRIGHT, Member.

APPEARANCES:

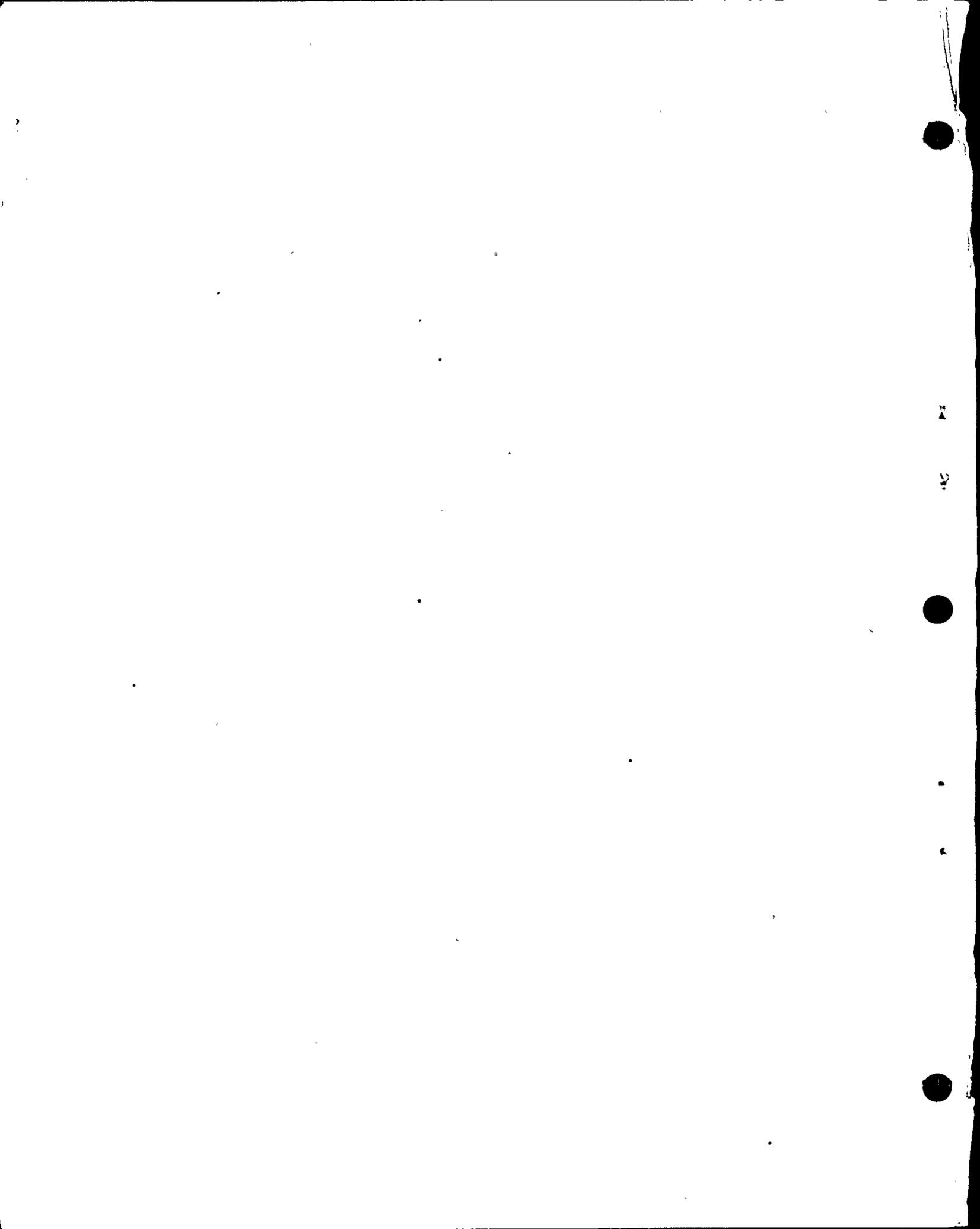
On behalf of Applicant, Pacific Gas & Electric Company:

BRUCE NORTON, Esq., 3216 No. Third Street,
Phoenix, Arizona 85012.

PHILIP CRANE, Esq., Legal Department, Pacific
Gas & Electric Company, 77 Beale Street,
San Francisco, California 94106.

MALCOLM H. FURBUSH, Esq., Legal Department,
Pacific Gas & Electric Company, 77 Beale Street,
San Francisco, California 94106.

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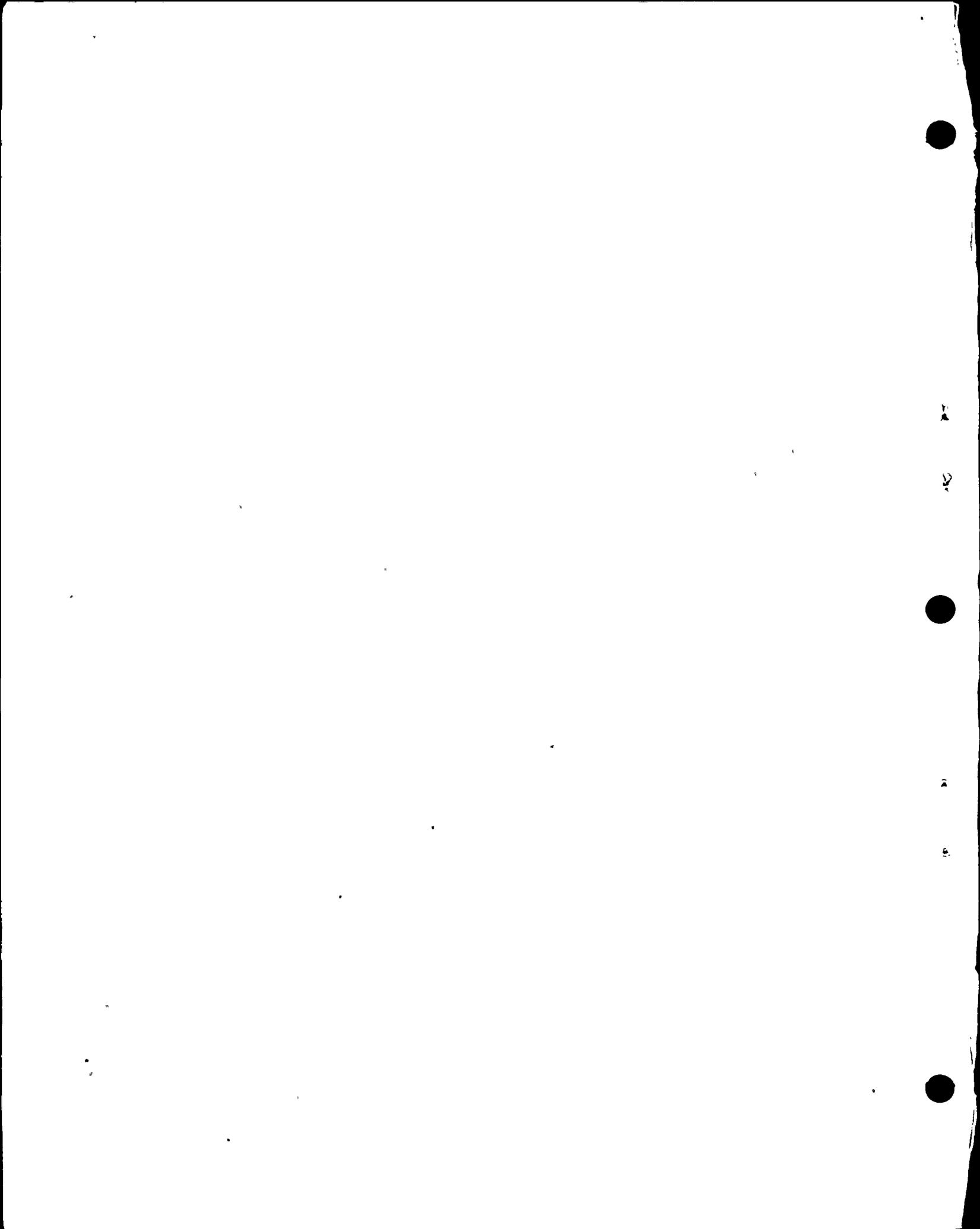
APPEARANCES: (Continued)

On behalf of Joint Intervenors:

DAVID S. FLEISCHAKER, Esq., Suite 602,
1025 15th Street, N.W., Washington, D.C.

On behalf of NRC Regulatory Staff:

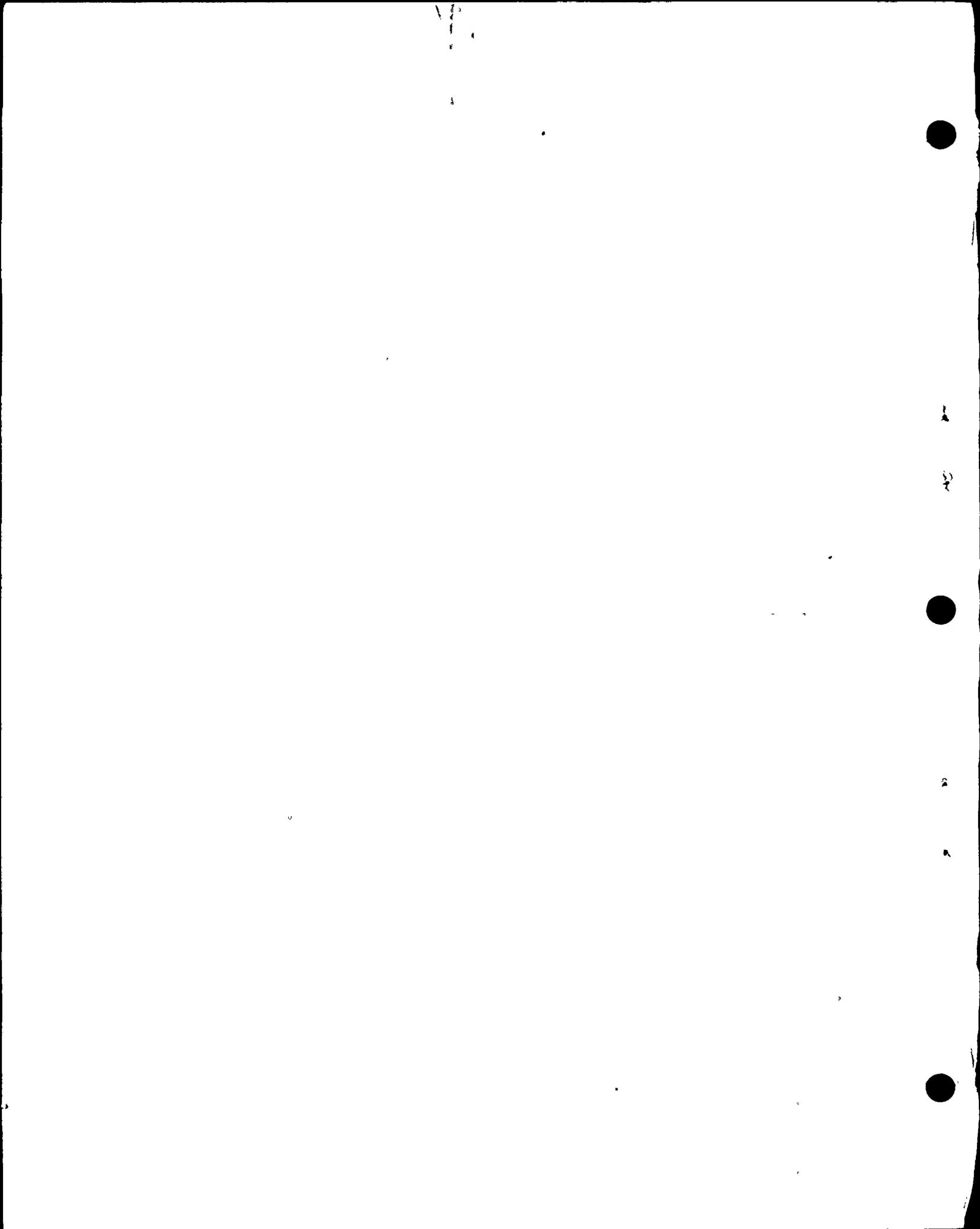
JAMES R. TOURTELLOTT, Esq., MARC STAENBERG, Esq.,
and EDWARD KETCHEN, Esq., Office of Executive
Legal Director, U.S. Nuclear Regulatory
Commission, Washington, D.C. 20555.



wel.

C O N T E N T S

	<u>Witnesses</u>	<u>Direct</u>	<u>Cross</u>	<u>Bd. Exam</u>	<u>CK. on Bd.Exam.</u>
1	Richard H. Jahns)				
2	Douglas H. Hamilton)	9954		10,050	10,052
3	C. Richard Willingham)			10,071	
4	(Recalled)				
5	James F. Devine			10,050	
6	John A. Blume)				
7	H. Bolton Seen)	10,083			
8	Gerald Frazier)				
9	Lincoln E. Malik)				
10	(Recalled)				
11	<u>Exhibits</u>			<u>Identified</u>	<u>Received</u>
12	J.I. 110				10,014
13	App. 46 thru 60 (Slides, Seismic Panel)	9957			10,100
14	App. 61,62,63 (Slides, Seed Presentation)	10,101			10,161
15	App. 64 (Slide, Seed Presentation)	10,160			10,161
16	App. 65 (Heterogeneity of Rock & Soil Formation)	10,162			10,172
17	Staff 13 (Aycock Professional Qual.)	10,176			
18	Staff 14 (Crocker Professional Qual.)	10,176			
19	Staff 15 (Affidavit of Aycock, Crocker and Allison re generic safety items)	10,176			
20	Staff 11 (NUREG-0371)			9946	
21	Staff 12 (NUREG-0471)			9946	
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P R O C E E D I N G S

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MRS. BOWERS: Are we ready to begin?

MR. KETCHEN: Yes.

Mrs. Bowers, I would like this morning if I could to go back to the generic items subject matter just for a few minutes. And at this time I would like to make a formal motion to the Board that the Board accept the affidavit and the supporting documentation into the record, and I would like the affidavit--

MRS. BOWERS: Mr. Ketchen, have you completed the other document you were working on?

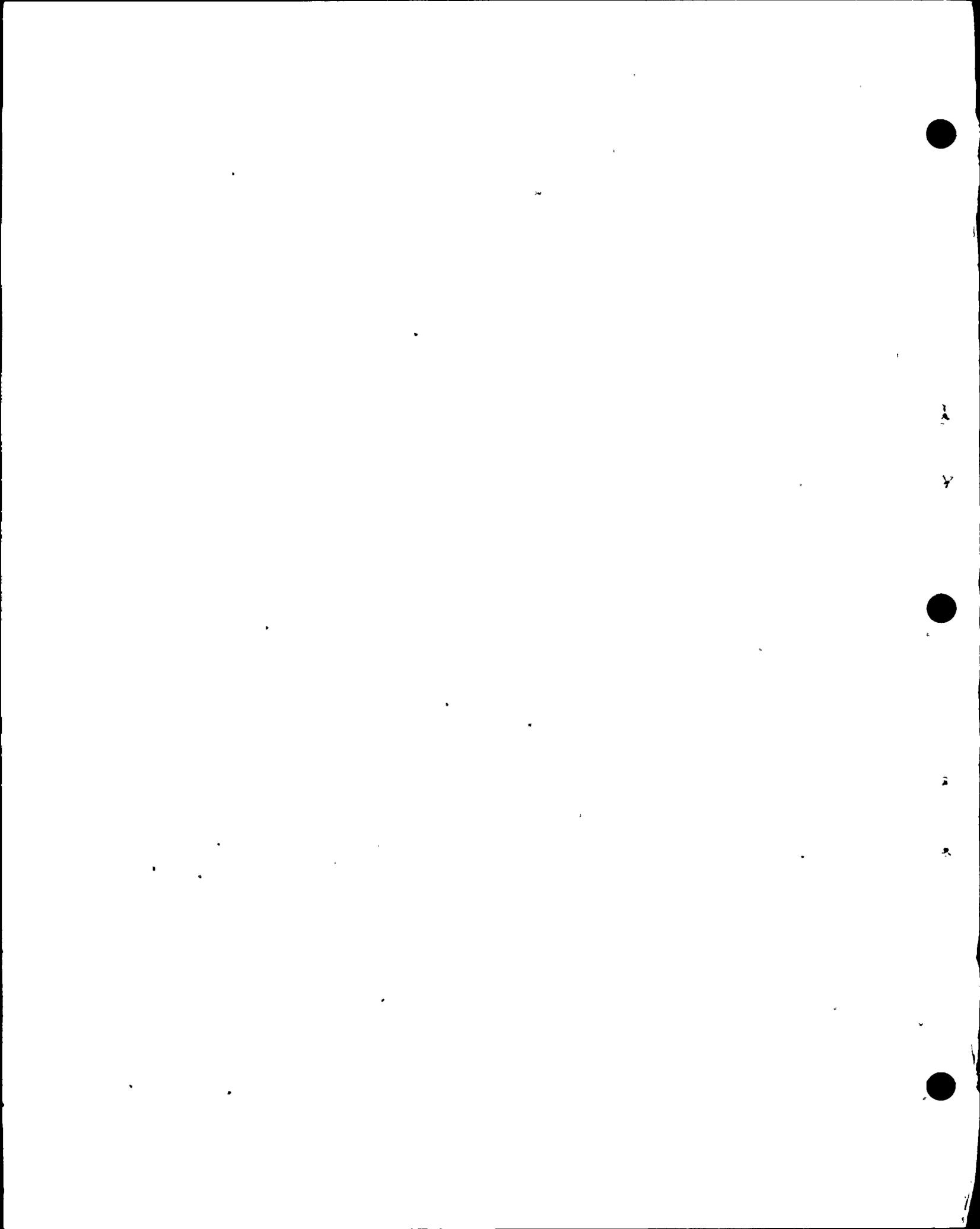
MR. KETCHEN: No, Ma'am. But it's a separate item that can be dealt with at a separate time.

MRS. BOWERS: Okay. Go ahead.

MR. KETCHEN: I'd like to move the admission of the affidavit of Messrs. Aycock, Michael B. Aycock, Lawrence P. Crocker and Dennis P. Allison relating to the status of NRC Staff activities regarding generic safety issues. I have provided the appropriate number of copies of that document to the Reporter.

In addition to that I would like to move the admission of the professional qualifications of Messr. Aycock Crocker, and I believe Mr. Allison's professional qualifications have been admitted previously in this proceeding.

Copies of these materials were passed out to the



WRB/wb2 1

parties I believe on Tuesday of this week.

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That completes the motion.

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In addition to that, however, Mr. Allison is available, not as a witness because we believe this can come in in affidavit form as documentary evidence, Mr. Allison is available, if necessary, for the limited purpose of describing how this document came into being.

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That completes my presentation on this matter.

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MRS. BOWERS: Mr. Fleischaker?

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MR. FLEISCHAKER: Let me state our position very succinctly.

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Mr. Hubbard and I have had a chance to talk this over, and we have three points that we would just like to state to the Board.

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First of all, we believe that the appropriate form for this submission to take is testimony. We think witnesses should be presented to sponsor the testimony and that the parties should have an opportunity to cross-examine if they feel that it's merited. At this point we don't know, we haven't had an opportunity to thoroughly review the materials. But generic safety items is an issue we have been concerned with. For over two years we have submitted various pleadings to the Board. The Board has ruled that the Intervenor could not sponsor a contention. But I think that there are Appeal Board decisions which

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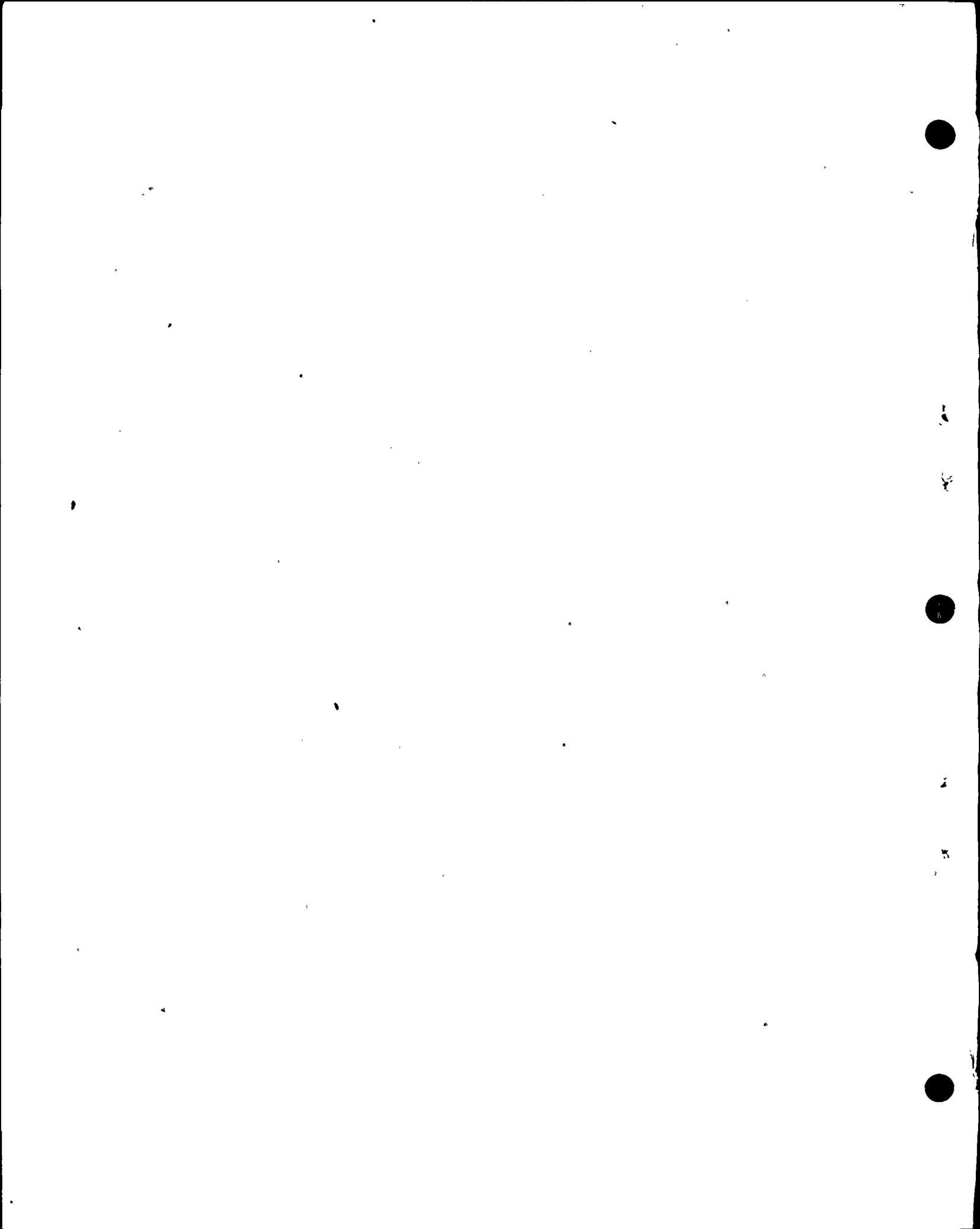
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2 stand for the proposition that even though there isn't a
3 contention existing that Intervenors have the right to
4 crossexamine on matters that are before the Board where
5 there is testimony submitted.

6 The third point is that although it would be
7 a convenience to counsel, and I would appreciate having
8 hearings in Washington, D.C., after having checked with
9 my clients I cannot accede to that. So if there are hear-
10 ings we would oppose holding hearings in Washington, D.C.
11 and would request that they be held in San Luis Obispo.

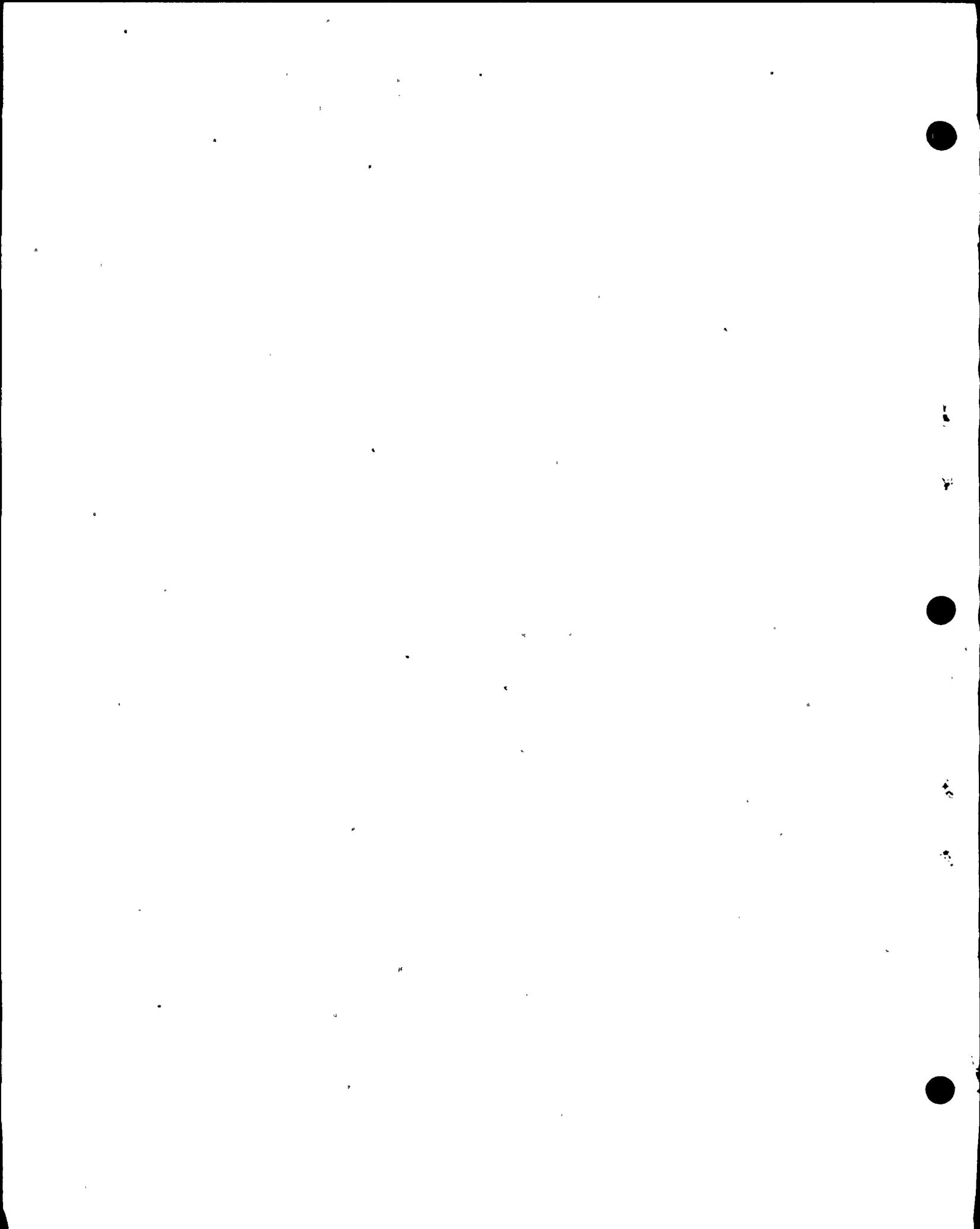
12 MRS. BOWERS: Mr. Geer?

13 MR. GEER: We have no objection to the Staff's
14 motion.

15 If the Board determines that hearings are
16 appropriate, we would like that the Board close the record
17 subject to having -- and establishing the schedules for
18 proposed findings of fact submittals at the close of this
19 hearing, and proceed with your hearing in Bethesda at a
20 later date.

21 MR. KETCHEN: Excuse me, Mrs. Bowers, if I may
22 go back just a moment:

23 My motion, in addition to the items that I
24 mentioned, that I have given to the Reporter to be bound
25 into the record, part of that package includes the Task
Action Plans for generic activities, NUREG 0371, and Generic



WRB/wb41

2 Task Problem Descriptions, Categories B, C and D Tasks,
3 NUREG 0471. Those documents I would add to my motion,
4 but I'm moving them into-- I would like them to come into
5 evidence as exhibits rather than having them bound into
6 the record.

7 MRS. BOWERS: Can you give them numbers now?

8 MR. KETCHEN: Mrs. Bowers, I'm going to have
9 to go back and find out where our sequence of numbering
10 left off.

11 MRS. BOWERS: I think the Applicant has been
12 keeping a running account.

13 MR. NORTON: The Staff left off with No. 10.

14 MR. KETCHEN: Thank you, Mr. Norton.

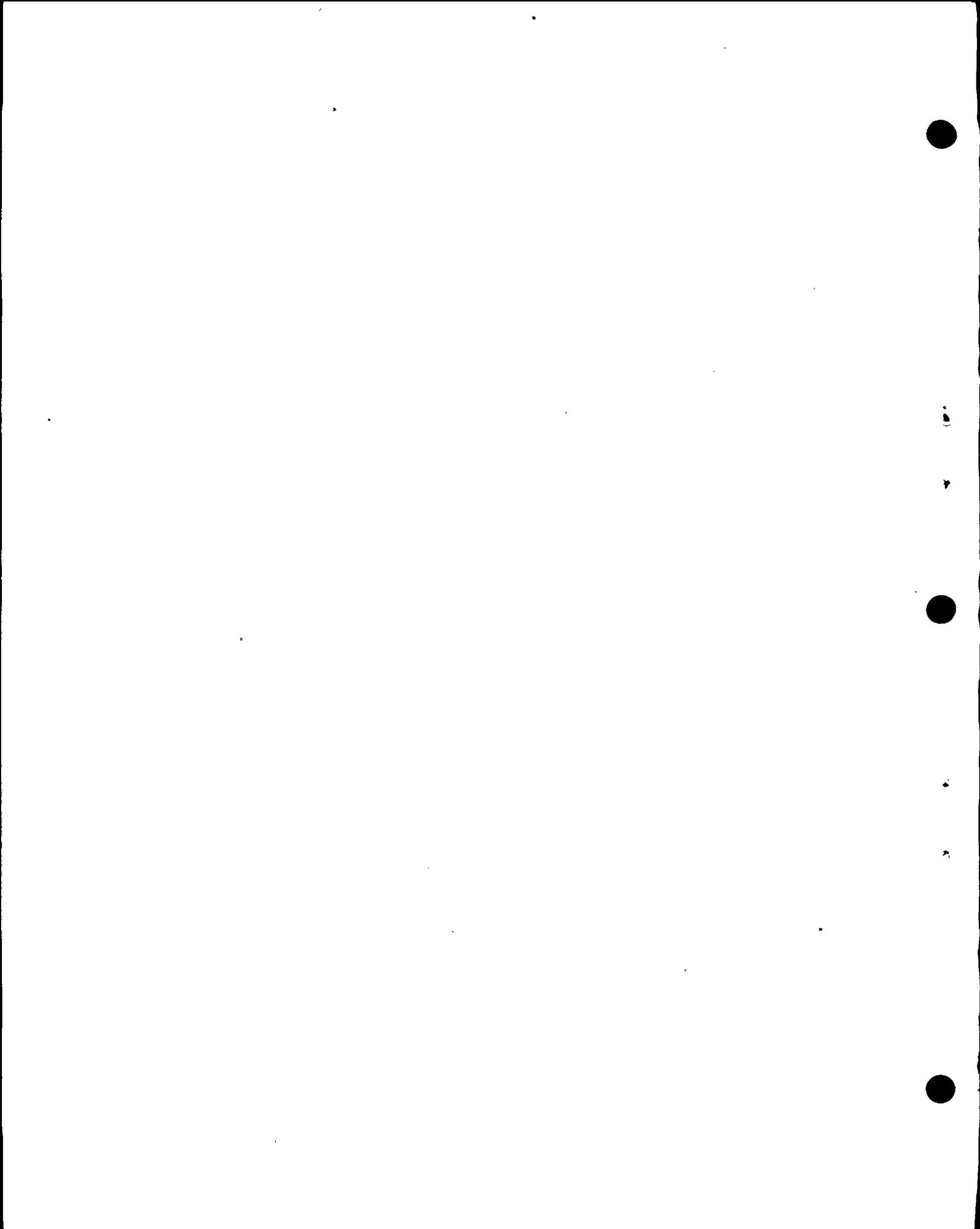
15 I would have marked for identification NUREG-0371
16 as Staff Exhibit No. 11, and have marked for identification
17 NUREG 0471 as Staff Exhibit No. 12.

18 (Whereupon the documents referred to
19 were marked for identification as
20 Staff Exhibits 11 and 12.)

21 MR. KETCHEN: I would request that the Board
22 receive these documents into evidence as part of the package
23 of evidence submitted pursuant to my motion.

24 I might, in addition to that, in brief response
25 to Mr. Fleischaker's position, just indicate that the Staff's
position was set forth yesterday evening, and we'll stand

KZKZKZ



1 with that position as we set it out.

WRB/wb5 2 MRS. BOWERS: Mr. Fleischaker, let me check
3 again with you. I made a note of your three points; that
4 you hadn't had sufficient time to thoroughly review the
5 documents, and that following that thorough review you
6 might request testimony at an evidentiary hearing; is
7 that correct?

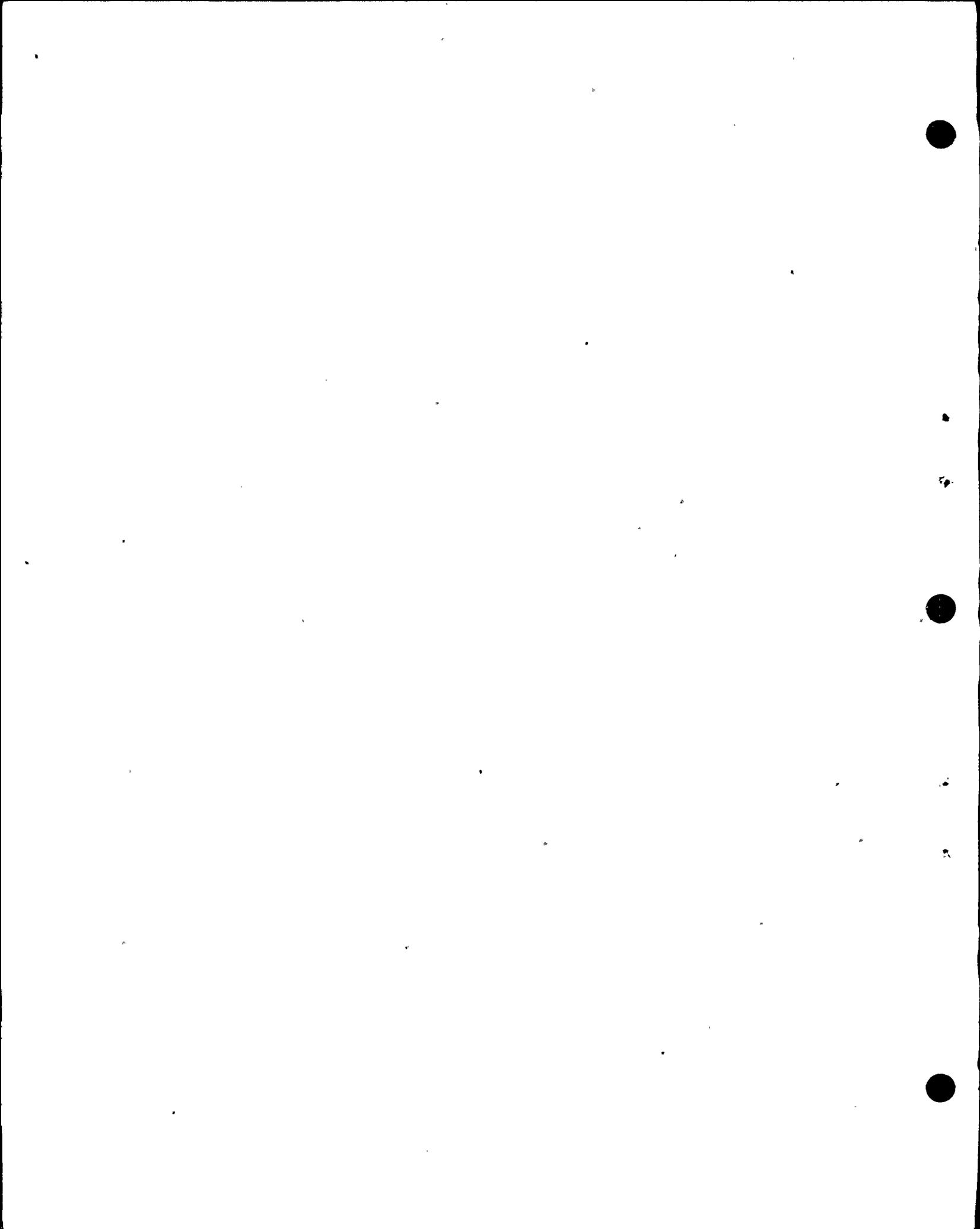
8 MR. FLEISCHAKER: No. Let me restate them then.

9 We think that in any case this should be
10 submitted in the form of testimony, to give all parties
11 an opportunity to cross-examination, as it was in Black
12 Fox, for example. We are opposed to submission of this
13 information by way of affidavit; we think it should come
14 in as testimony sponsored by witnesses.

15 The second point is, that would give all parties
16 the opportunity to cross-examine. I don't know at this
17 time how many questions, if any, we would have. I would
18 need to review. But I believe that the parties should be
19 permitted the opportunity to cross-examine. And upon
20 review of the materials we would know where we stood in
21 terms of our cross-examination.

22 The third point was location of the hearings.

23 MRS. BOWERS: Well, our problem is, to some
24 extent, the same as yours. We haven't had an opportunity
25 to thoroughly consider what has been submitted. And we



1 don't know what the Board's position will be as far as an
2 evidentiary hearing until that review is completed.

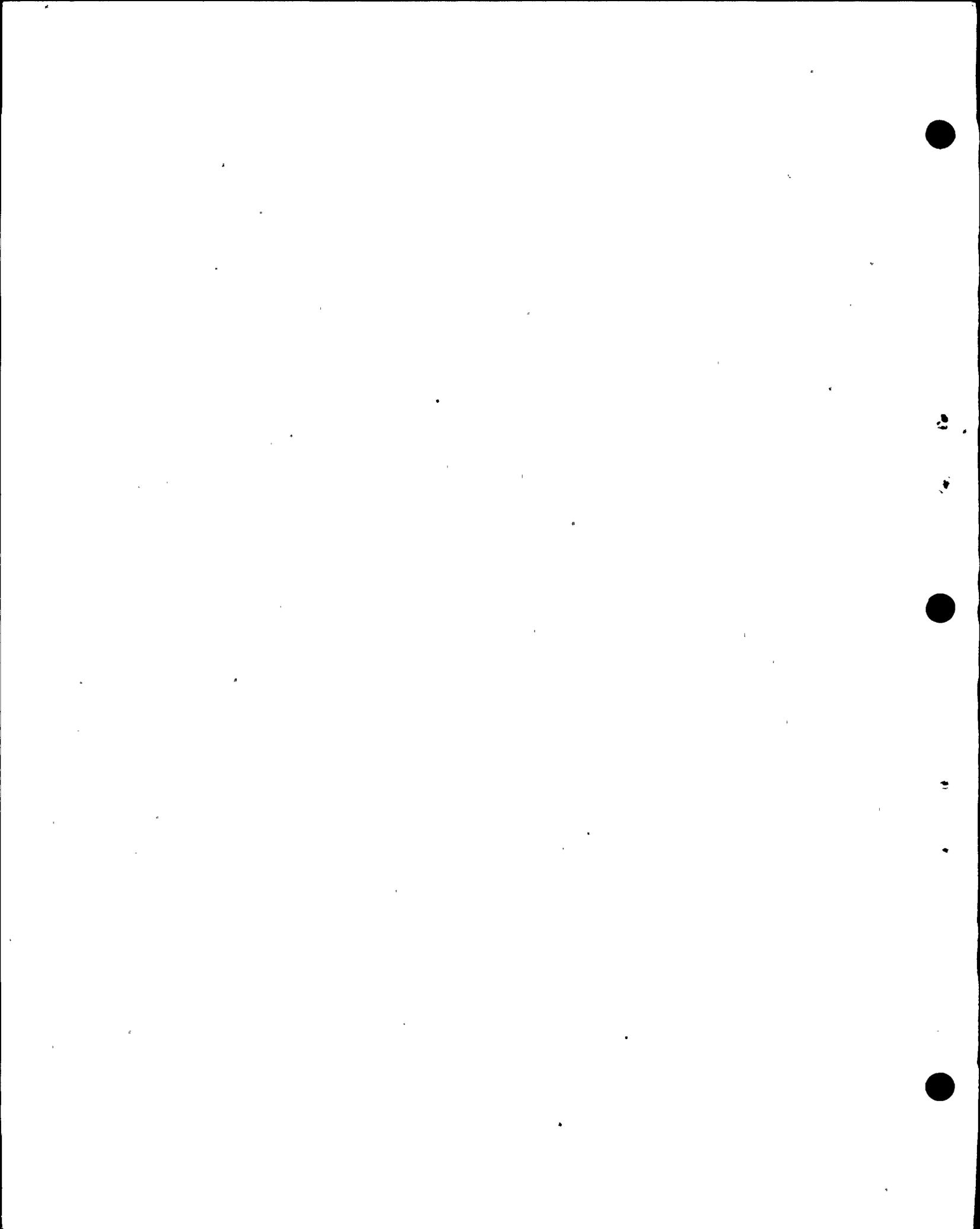
3 What we could do is accept them into the
4 record subject to motions from the parties or the Board on
5 its own initiative -- motions from the parties to request
6 an evidentiary hearing, or the Board on its own initiative
7 to determine that an evidentiary hearing is appropriate.
8 But until the Intervenors complete their review, as I under-
9 stand it, you really don't know to what extent you would be
10 wanting to pursue examination of witnesses.

11 MR. FLEISCHAKER: Let me clarify that.

12 When I say "review" -- and admittedly my state-
13 ment was unclear.... I checked with Mr. Hubbard just now,
14 and he is certain that we would have some questions for
15 cross-examination, but we don't know the extent of those
16 questions.

17 I think the reason Mr. Hubbard is in that
18 position is because he is somewhat familiar with the
19 material, material like this, because of his participation
20 in other cases, like Black Fox, where the generic safety
21 items issue has come up. And in that proceeding, as he
22 informs me, there are scheduled to be three to four days
23 of cross-examination. And he has done some initial work
24 getting prepared for that.

25 But, in any case, I think that our position is,



1 First of all, we object to the Board receiving information
2 into the record in the form of an affidavit. We think that
3 it should come in as testimony sponsored by witnesses.
4 We would cross-examine those witnesses: we don't know the
5 extent of that cross-examination.

6 Secondly, we think that the hearing should be
7 located here, although I understand it's to counsels' and
8 the Board's convenience to have it in Bethesda. But, as I
9 said, I discussed this matter with my clients and they
10 feel strongly about having the hearings here, if the Board
11 rules to have additional hearings on the matter.

12 MRS. BOWERS: Well what we'll do on this is to
13 defer our ruling until after the mid-morning break.

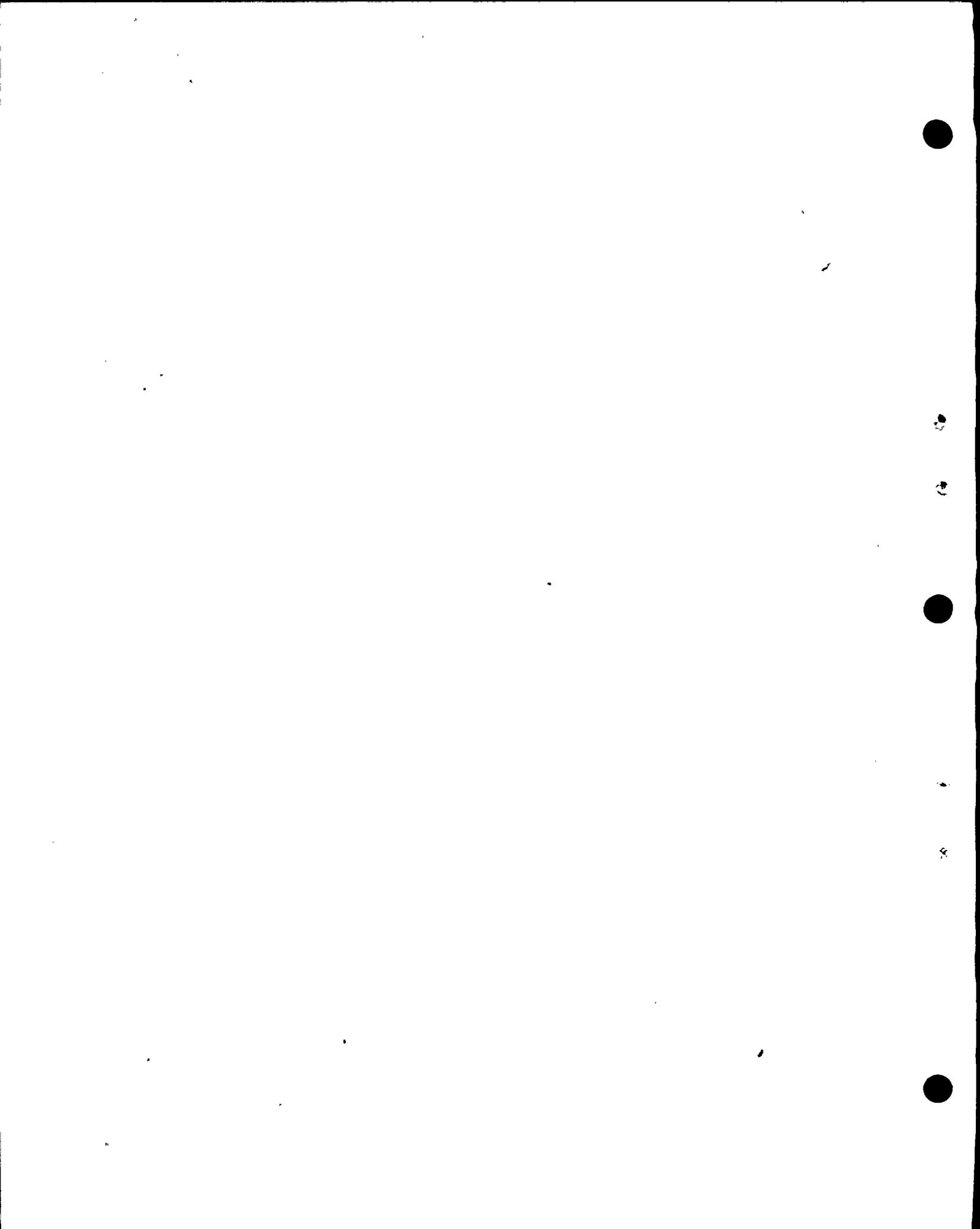
14 Did you have something further, Mr. Geer?

15 MR. GEER: Yes. Why don't we have the hearing
16 on Monday?

17 MRS. BOWERS: Well, we'll consider that.

18 MR. KETCHEN: Mrs. Bowers, I put our position
19 on the record yesterday. But I just want to try to be
20 clear about this.

21 Our position, again, is that this is similar,
22 or parallel to an SER, maybe, which is presented to a
23 Board, which has a lot of information in it that is not
24 subject to cross-examination in an operating licensing
25 hearing because it is not pertinent, or in the area of issues



1 that are in the proceeding. And so we just want to make
2 that point, that there is no broad-ranging right, we believe,
3 no broad-ranging right of opportunity to cross-examine
4 on the generic items that we're presenting in this docu-
5 mentation.

6 Thank you.

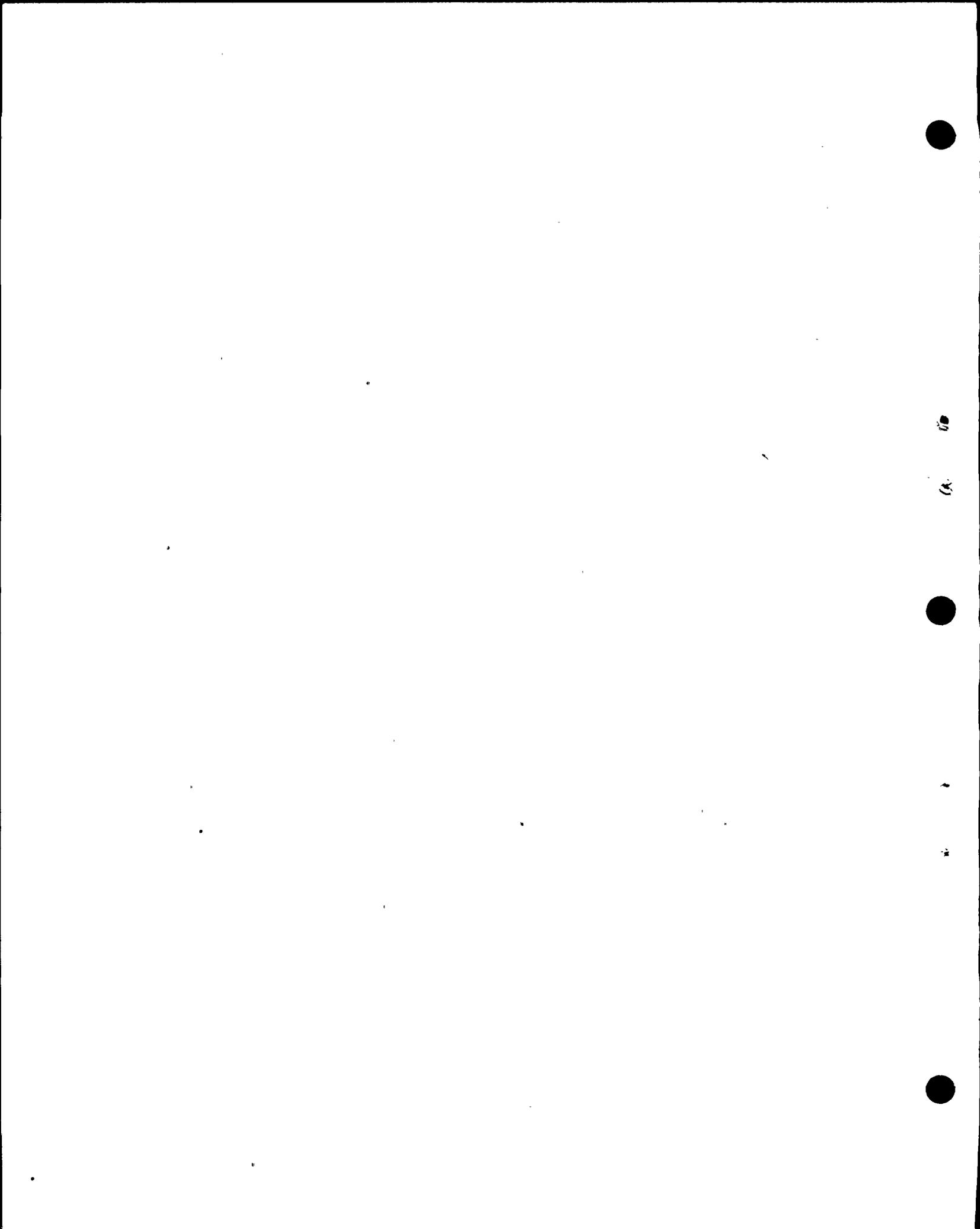
7 MRS. BOWERS: Well, but, when you sponsor an
8 SER you have a witness to sponsor that. And that witness
9 is available for cross-examination; isn't that correct?

10 MR. KETCHEN: No. He's available, in an SER
11 situation he would be available, in an operating license
12 hearing, available for cross-examination on the issues in
13 the proceeding, and any information in that documentation
14 that related to those issue. But not on every item in
15 the SER

16 We have a responsibility, the Director does,
17 beyond the hearing. So the SER serves another purpose in
18 an operating license hearing.

19 We would object to any questions asked of that
20 witness which went off into areas that were not intervenors'
21 contentions in the operating license proceeding.

22 In addition to that we would also indicate, as
23 a practical matter, when the Project Manager sponsors the
24 SER he usually indicates that it was prepared under his
25 supervision and direction. But in particular areas of subject



1 matter that have contentions involved we would present,
2 probably present, as a practical matter, other witnesses
3 other than the Project Manager on the detailed sections,
4 probably present the reviewer for cross-examination.

5 So that would be our position, that no, a
6 witness sponsoring a particular document like this is not
7 necessarily subject to cross-examination in an operating
8 license proceeding on all information in those documents.

9 MRS. BOWERS: Mr. Fleischaker, Black Fox is
10 a construction permit proceeding, isn't it?

11 MR. FLEISCHAKER: That's correct.

12 MRS. BOWERS: And of course the proceeding I
13 mentioned yesterday, Perkins, is also a construction permit
14 proceeding.

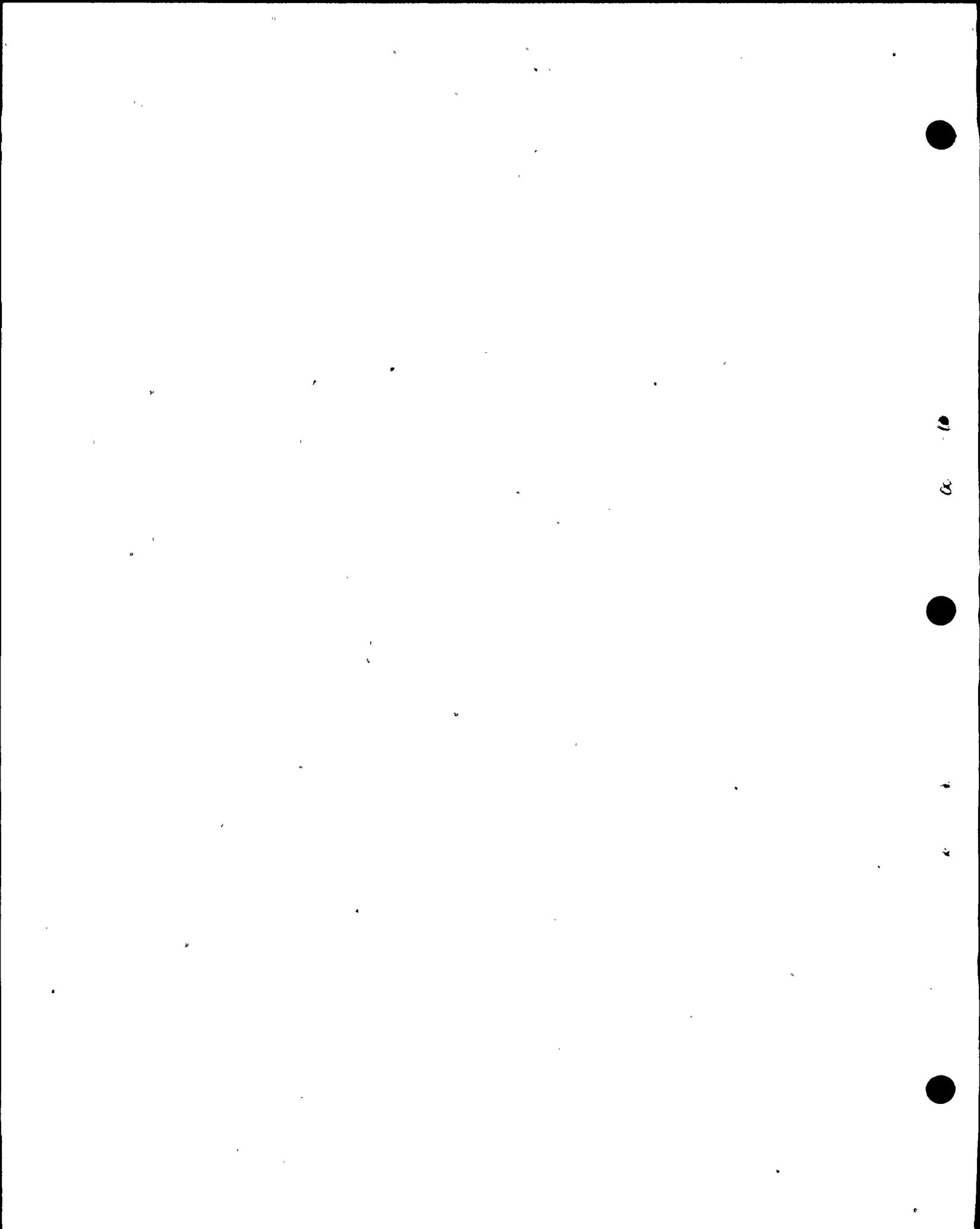
15 MR. FLEISCHAKER: I don't know. I don't have
16 any information on that.

17 MRS. BOWERS: Well, it is.

18 Mr. Geer, you mentioned yesterday the procedure
19 the Appeal Board followed in North Anna. We read the
20 North Anna decision when it came out. But, of course, it
21 has been some time since we reviewed it.

22 Would you mind briefly repeating your position
23 as far as what the Appeal Board -- how the Appeal Board
24 handled it in North Anna?

25 MR. GEER: I think the key to the way the



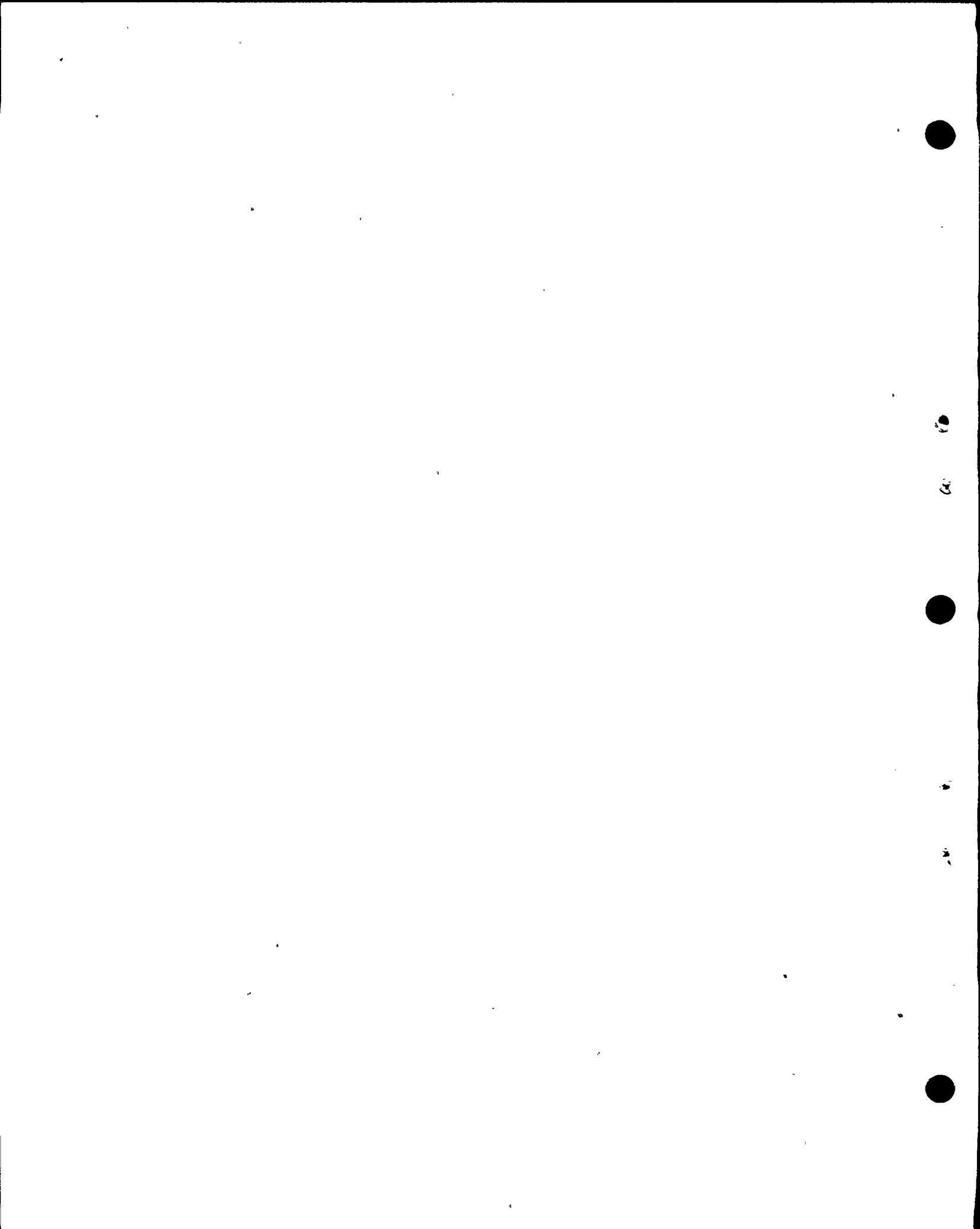
1 Appeal Board handled it was, they handled it as an
2 uncontested case. And in that situation they ruled that --
3 they determined that the submittal in affidavit form was
4 adequate form. And they made this ruling even though there
5 had been intervention in opposition before the ASLB below.
6 They did not return the matter to the ASLB for the taking of
7 evidence, but, rather, they went through the record them-
8 selves and then asked for the affidavit form of statements.

9 MRS. BOWERS: I think you mentioned yesterday
10 the intervenors had really withdrawn at the Appeal Board
11 level.

12 MR. GEER: Yes. It seemed to me the Appeal
13 Board had the option of not conducting the further
14 evidentiary proceedings before it, and it could have
15 returned. And I imagine the intervenors would still have
16 had an opportunity to participate. They chose not to do
17 so.

18 The Appeal Board made a determination not to
19 follow that practice.

20 MRS. BOWERS: Well, but going to -- carrying
21 it a little farther: in a construction permit proceeding
22 the intervenors participate on their contentions. And, of
23 course, if there are several parties, we know from Prairie
24 Island, they can participate on other contentions as well
25 as the Board's questions within their zone of interest.



1 So if it had been remanded-- Of course this was an operat-
2 ing license. But I thought you indicated a minute ago that
3 if it had been remanded to the Licensing Board that the
4 intervenors would have then had an opportunity to partici-
5 pate.

6 MR. GEER: At least they would have been able
7 to make the same argument Mr. Fleischaker is making, that
8 there are decisions that permit cross-examination in areas
9 in which they have not got contentions.

10 MR. KETCHEN: Mrs. Bowers, if the Board would
11 like, I have a copy of the North Anna Appeal Board decision
12 here if you would like to see it.

13 But, in addition to that, I might point out
14 one thing about that decision by the Appeal Board. They
15 went through the reasoning that Mr. Geer presented to us,
16 but, in addition to that, they recognized the significance
17 of an operating license proceeding. They also allowed the
18 parties an opportunity to comment, and gave that opportunity
19 during that proceeding.

20 I just wanted to present that to you, because,
21 as I recall yesterday, that was your suggested way to
22 proceed. And I just wanted to get that in.

23 MRS. BOWERS: Well we would like to borrow
24 a copy of it. We may defer our ruling until after the
25 luncheon break.



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1 Now can we go on to other matters?

2 MR. NORTON: Mrs. Bowers, at this time for
3 rebuttal testimony we'd like to recall Dr. Jahns and
4 Messrs. Hamilton and Willingham.

5 MRS. BOWERS: And they've all been previously
6 sworn.

7 Whereupon.

8 RICHARD H. JAHNS

9 DOUGLAS H. HAMILTON

10 and

11 C. RICHARD WILLINGHAM

12 resumed the stand as rebuttal witnesses for and on behalf
13 of the Applicant and, having been previously duly sworn,
14 were examined and testified further as follows:

15 MR. NORTON: Mrs. Bowers, the way we'd like
16 to proceed on this is, we're not going to take a great deal
17 of the Board's time. Geology was discussed in the beginning
18 and I guess it's only appropriate at the end.

19 The way I would like to proceed, Mrs. Bowers,
20 is to ask a few questions about the testimony they heard
21 from Dr. Silver, Graham and Sso on.

22 DIRECT EXAMINATION

23 BY MR. NORTON:

24 Q Mr. Hamilton, you were here, were you not, for
25 all of the testimony of Dr. Silver and Dr. Graham and



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1 Dr. Hall; is that correct?

2 A (Witness Hamilton) Yes, that's true.

3 Q And you were personally in the room and
4 heard it all; is that right?

5 A That's right.

6 Q All right.

7 And, Dr. Jahns, you have reviewed the transcripts
8 of that testimony; is that correct?

9 A (Witness Jahns) Yes, that's correct.

10 Q And Mr. Willingham, I take it you're a combina-
11 tion of both: you heard I believe almost all of it, and
12 what you did not hear you reviewed in the transcript; is
13 that correct?

14 A (Witness Willingham) Correct.

15 Q Mr. Hamilton, rather than ask you specific ques-
16 tions, I would ask you at this time to give us a presenta-
17 tion, or a summarization of your opinions regarding those
18 opinions expressed by Drs. Graham, Silver and Hall, if you
19 would. And I understand you're going to be using some slides,
20 and you will also be referring -- or asking Mr. Willingham
21 to answer some questions or to make some statements, too.

22 A (Witness Hamilton) Yes, that's true.



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(Slide.)

2 A (Witness Hamilton) If I could just briefly set
3 the stage, I would like to make some responses to some of
4 the comments that have been made regarding some of our
5 geological opinions that we presented over the course of
6 this hearing, and also comment on some of the opinions that
7 have been presented by Dr. Graham and Dr. Hall and Dr. Silver.
8 In a way, we're going to proceed geographically, because I'd
9 like to essentially start at the north end of the area being
10 discussed, which is around the San Gregorio Fault, and that
11 automatically takes me to the area covered by Dr. Graham.
12 There's one point made by Dr. Silver in that area that I'd
13 also like to cover.

14 And then I'll work south as quickly as possible
15 to the Hosgri Fault.

16 Q Mr. Hamilton, before you continue, please identify,
17 if you would -- I believe this slide that we're now looking
18 at was previously in the record, and it should be identified
19 as to where it was.

20 A Yes. This first slide is going to be used for
21 general reference purposes. I believe that this is Joint
22 Interveners' Number 13, and it was used in response to cross-
23 examination by myself earlier.

24 I think I'd like to go up to the screen now and
25 refer to this slide, and following it we have some new slides



wel 2

1 that we also want to use in this response, and we have
2 copies of those that can be passed out.

3 MR. NORTON: Mrs. Bowers, we have previously
4 marked all of these slides -- the new ones that will be
5 shown -- and, rather than to interrupt the presentation,
6 Mr. Williamson will simply pass them around after they're
7 put up on the screen, giving the appropriate number to the
8 Reporter, and so on.

9 They have already been marked, including the
10 copies that you will receive, as PG&E Exhibits, starting
11 with Exhibit 46.

12 The witness can refer to them as 46, et cetera.

13 So, rather than ask that each one be marked as
14 we go along, they have all been marked in consecutive order,
15 in the order they're to be presented.

16 (The documents referred to were
17 marked for identification as
18 Applicant's Exhibits 46 through
19 60.)

20 MRS. BOWERS: Do you have a pointer for Mr.
21 Hamilton?

22 MR. NORTON: We have a USGS pointer in the crowd.

23 (Laughter.)

24 (Pointer handed to Witness Hamilton.)

25 WITNESS HAMILTON: I've relied on the USGS for
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wel 1 many things, and I find that they generally come through
2 with satisfactory assistance.

3 The first slide that I am going to refer to
4 is one that we used earlier, and it shows the region of the
5 San Andreas Fault and the intersection of that fault with the
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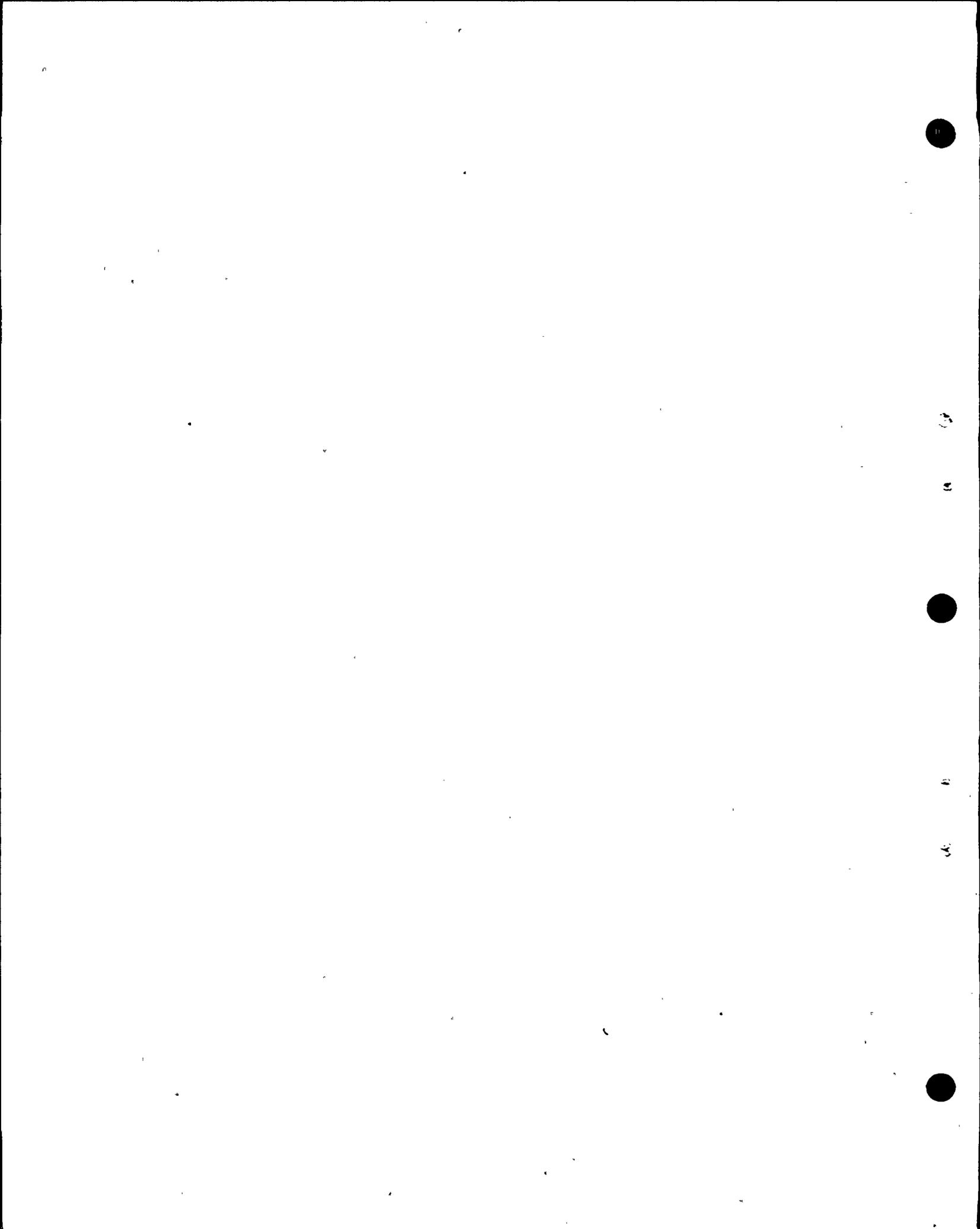
1 San Gregorio Fault, in the area from Monterey Bay to north
2 of San Francisco Bay.

3 It's based on work done mainly by Hoskins and
4 Griffiths and published in their paper in 1971, and it also
5 incorporates some on-land geological data from the published
6 literature.

7 This map covers the four main elements of evidence
8 that we described earlier in response to cross-examination,
9 indicating why, in the opinion of Mr. Willingham and myself,
10 we felt that there were constraints that limited the maximum
11 slip along the San Gregorio Fault -- at least during the
12 last 20 million years to not more than about 20 kilometers
13 of right slip distance.

14 Dr. Graham's discussion yesterday first centered
15 on the four elements of evidence that we had described, and
16 then proceeded on to essentially a defense of the seven
17 elements of evidence that he used to suggest a much larger
18 amount of right slip on that fault.

19 So the first of the -- well, to simply review what
20 those four elements of evidence that we felt limited the
21 possibility of slip are, they were, first, the existence of
22 a Oligocene-Lower Miocene basalt sequence underlying the
23 Monterey formation and younger rocks that exist in the Santa
24 Cruz Mountains and in the offshore outer Santa Cruz Basin,
25 essentially directly across the San Gregorio Fault, as



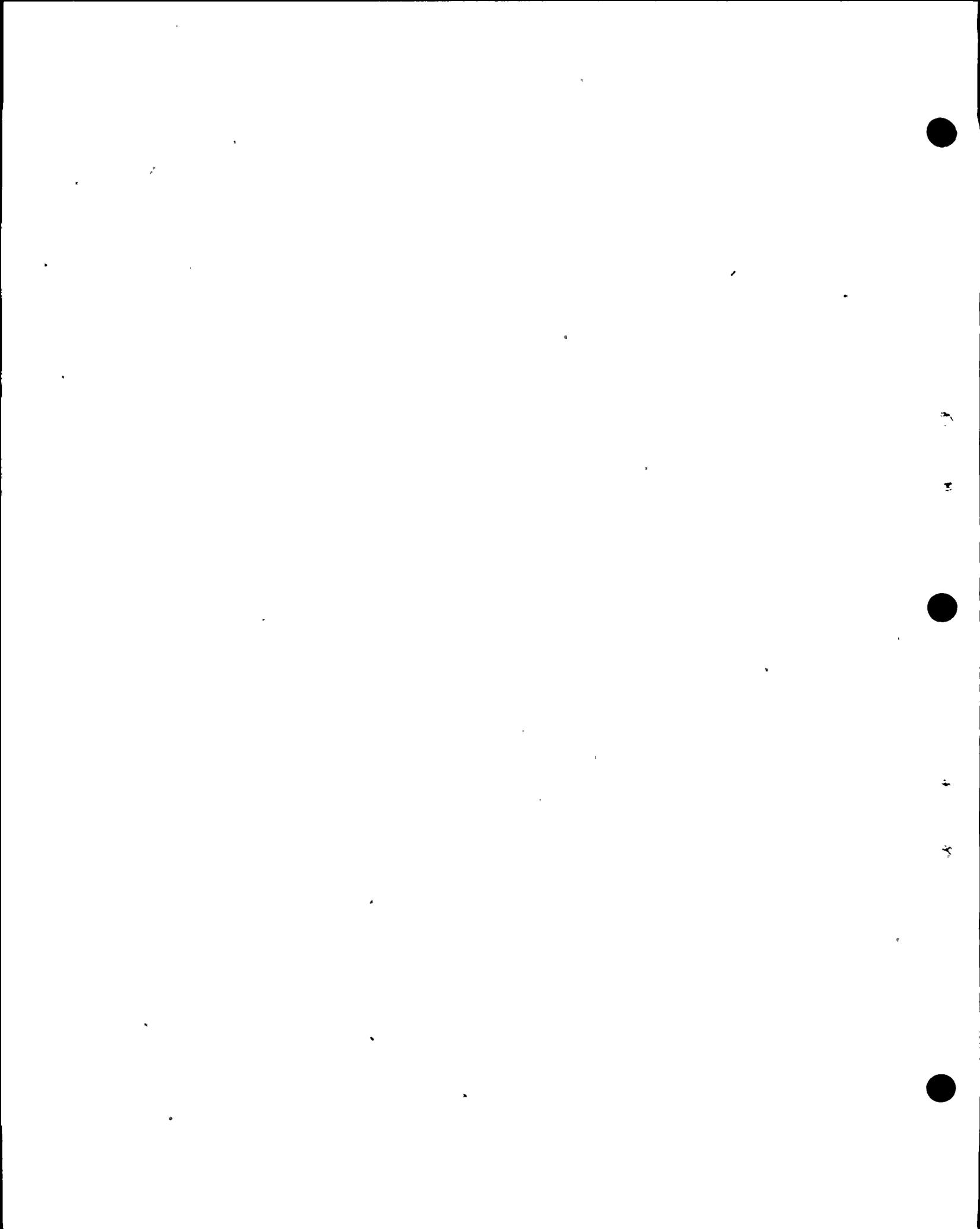
1 indicated on this slide.

2 The second of those elements of evidence -- and
3 I might add, and also the absence of such rocks near Point
4 Reyes -- the second of those elements of evidence had to
5 do with the distinctive gravity anomaly pattern in the area
6 that falls from San Francisco Bay south along the trace of
7 the fault.

8 The third had to do with the essential lack of
9 any deviation of the Monterey submarine canyon coming out of
10 Monterey Bay and extending directly across the San Gregorio
11 Fault.

12 And the fourth of those elements had to do with
13 the existence of a distinctive accumulation of sedimentary
14 rocks of Upper Miocene age in the area immediately west of
15 the Sur Fault, which has been indicated as the possible
16 southerly extension of the San Gregorio Fault, across from
17 a source terrain that has the distinctive same set of rocks
18 in it.

19 --To speak first to the matter of the distinctive
20 Lower Miocene basalts that Dr. Graham made several points
21 about, I think maybe the most significant one was simply
22 that shown by this slide, which is that the basalts do exist
23 in the area east of the San Gregorio Fault and in the area
24 west of it, and they don't exist in the area where these
25 rocks east of the fault purportedly would have to have been



wel 5

1 moved had this very large amount of offset been an actual
2 fact.

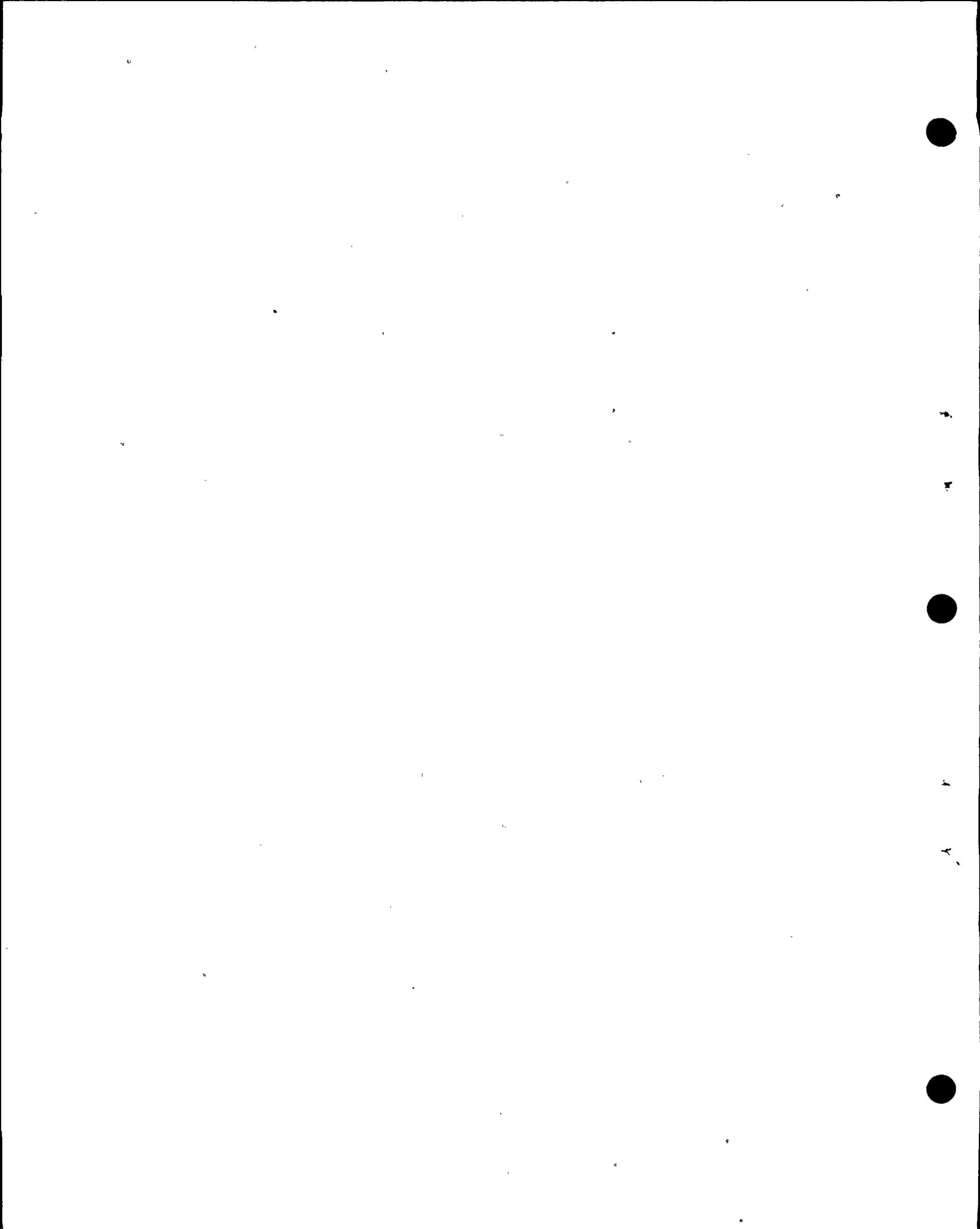
3 Dr. Graham made several other points. One of
4 them had to do with the rather widespread distribution of
5 these rocks at other points.

6 It's true that there are basalts like this, for
7 example, at Point Arena. However, at Point Arena they're
8 called the Iveson basalt, and they're in a rather somewhat
9 different sequence of rocks than exist in either the area
10 of Ben Lomond Mountain or the outer Santa Cruz Basin, and
11 these rocks exist at points farther south, actually beyond
12 this map area.

13 Again, the significant thing I feel is that they
14 are present in the two areas that are claimed as being offset,
15 in a non-offset relationship.

16 Dr. Graham made a couple of other points. One
17 of them was that there were basalts thought to be unlike
18 those in the mountains that were located immediately west
19 of the San Gregorio Fault on land. I mapped one of those
20 back in about 1971, and it appears to be actually intruded
21 into the fault plain, and it's quite unlike the widespread
22 essentially deposits of volcanic rocks that are, I feel, the
23 correlative features.

24 The other point that Dr. Graham made was that
25 there was a suggestion that the rocks in the Santa Cruz

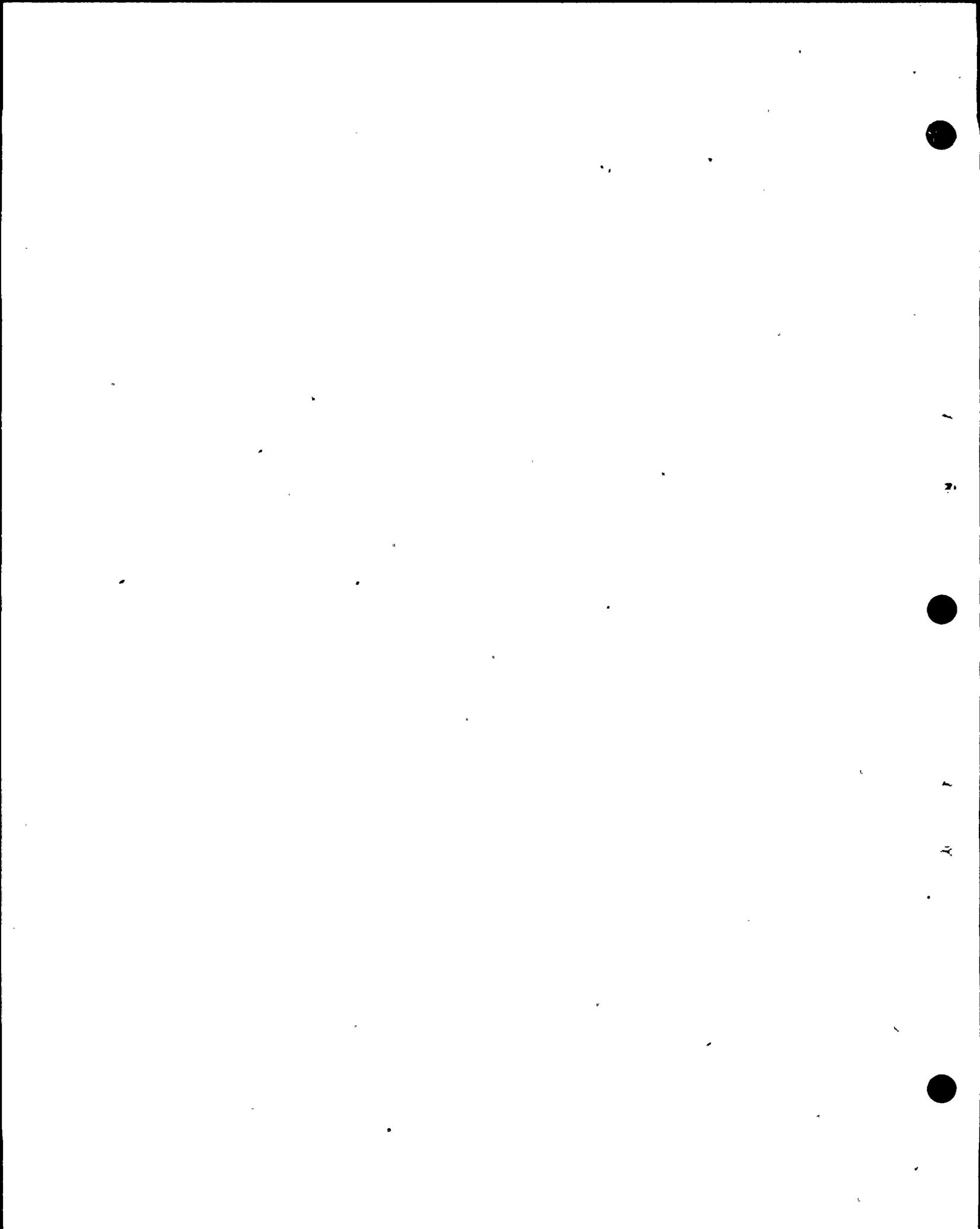


wel 6 1 Mountains area came from a single eruptive source, and they
2 thinned away from a maximum thickness at a particular point
3 there, and that, therefore, you wouldn't expect these rocks
4 to have some relationship to ones located farther away.

5 I would just call upon the general geologic
6 situation, where it's a rare occurrence, I think, to find
7 one single volcanic eruptive center at any place. If you
8 consider like the Mount Lassen area, or Mount Shasta in
9 California, or the rocks in the areas farther north in the
10 volcanic province of the Cascades, they're generally a
11 sequence of volcanoes that are fairly closely grouped in
12 space, and certainly they're no farther apart in those areas
13 than in the two areas that we're referring to here.

14 One last point about Dr. Graham's testimony was
15 that he remarked on the unreliability of relying on only two
16 six-inch bore holes. In fact, these two six-inch bore holes
17 cover an area that has been quite thoroughly examined by
18 seismic reflection profiling, its stratigraphy is well known,
19 and I would submit that those two bore holes passing through
20 essentially an intact basin sequence, really give a much
21 better idea of what the stratigraphy should be than in the
22 disrupted rocks that one can see in the narrow strip of
23 ground actually adjacent to the fault.

24 The second point that Dr. Graham made had to do
25 with the gravity pattern in this area, and his point was that



wel 7

1 the gravity is essentially non-diagnostic so far as making
2 an evaluation of the fault offset goes.

3 This, of course, is somewhat in contrast to one
4 of the points that he relied upon, which was Dr. Silver's
5 opinion published earlier that a gravity high in this area
6 was correlative with one located south of Monterey Bay as
7 one of the points of evidence supporting the large offset.

8 I'd like, however, to now turn to Mr. Willingham
9 to give a discussion of the gravity work that was actually
10 done here, and what its significance really should be.

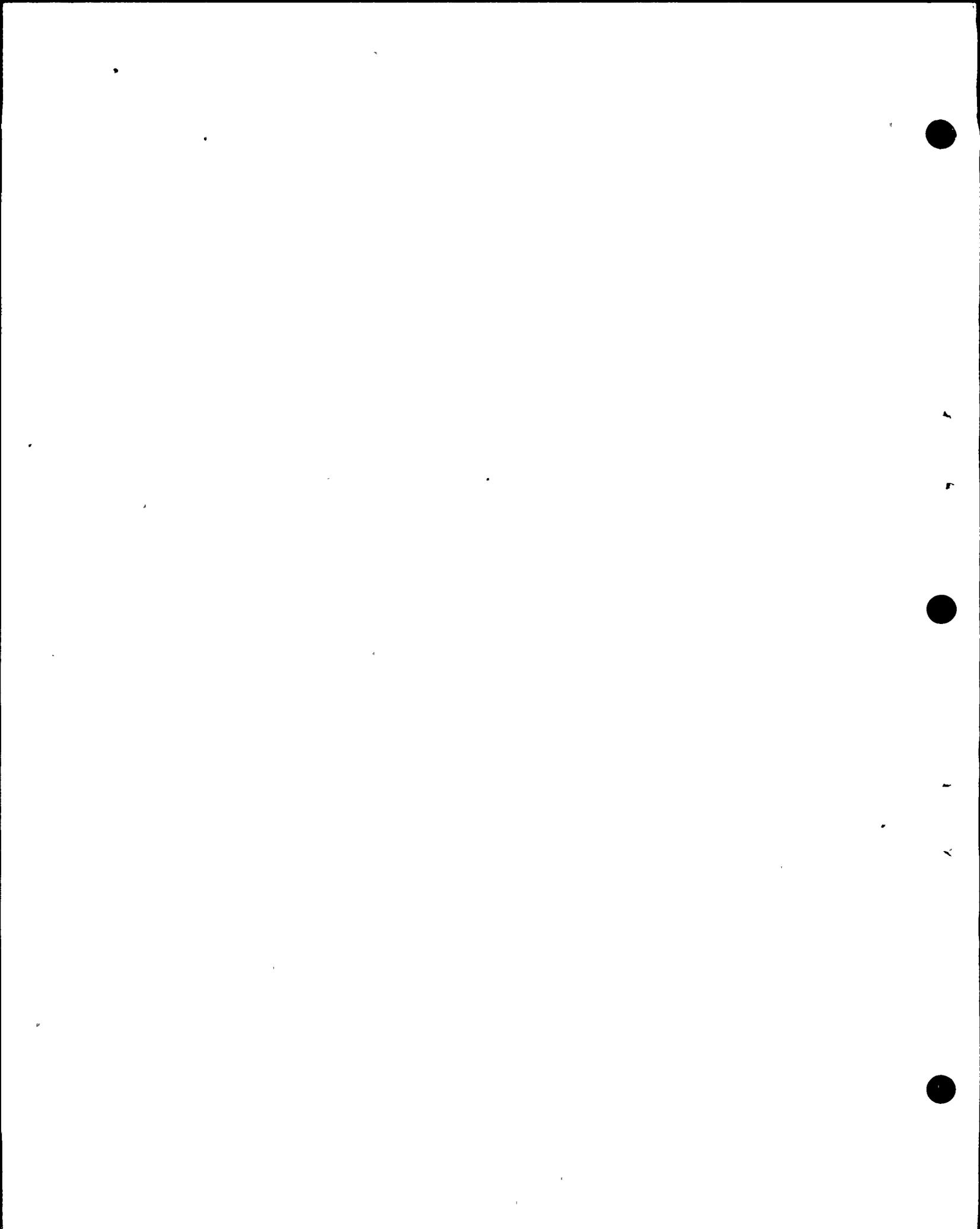
11 BY MR. NORTON:

12 Q Mr. Hamilton, before you do that, was it Dr.
13 Graham that said that the gravity data isn't much good
14 because, I think he said, "One bullseye looks like another
15 bullseye." I think that was the expression.

16 A (Witness Hamilton) I believe that he used that
17 word. "Non-unique solutions" was the phrase that I wrote
18 down, but I think he elaborated on that some.

19 Q And in fact, one of his seven matching points
20 were some theoretical bullseyes of Dr. Silver's, isn't that
21 right?

22 A Yes. Although I believe in his deposition that
23 actually Dr. Graham said that he and Dr. Dickinson had
24 somewhat relocated the assumed gravity high that Dr. Silver
25 used on the east side of the fault. So they made that



wel 8 1 readjustment to change Dr. Silver's 90 kilometers of offset
2 to agree with their proposed 110 kilometers of offset. That
3 certainly was one of their points.

4 MR. FLEISCHAKER: I'm going to object to that.
5 I'm going to ask that the last part of that answer which
6 refers to language in the deposition be struck, on the
7 basis --

8 MR. NORTON: I agree. We should not have any
9 reference to the deposition, and I'll rephrase the question.

10 BY MR. NORTON:

11 Q Have you ever heard Dr. Graham say that they
12 moved Dr. Silver's bullseyes to conform from 90 to 115, at
13 any time?

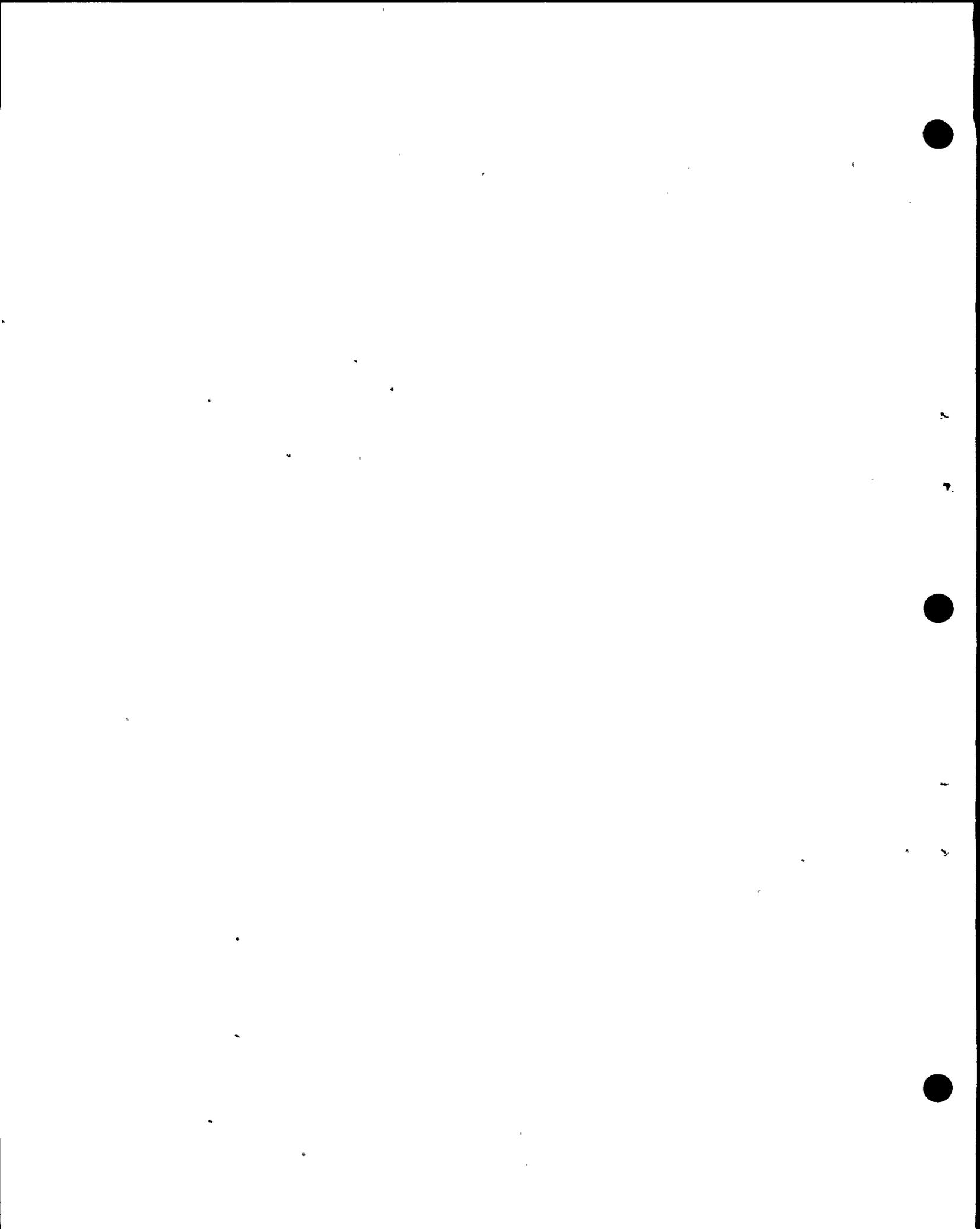
14 A (Witness Hamilton) I believe that point was made
15 during the depositions.

16 Q No, no. Excuse me. Have you ever heard him say
17 that, yes or no?

18 A Well, I haven't reviewed the deposition recently,
19 so I'm going to have to not be able to respond to that
20 directly.

21 (Laughter.)

22 Q No. My question is: Have you heard him say, at
23 any place, whether it be in a deposition or on the street or
24 here in this hearing room, or anyplace else, have you heard
25 him say that?



wel 9 1

2 answered. We're getting into use of the deposition, it's
3 quite clear from this witness' testimony, and that's an
4 inappropriate use of the deposition. The deposition should
5 not be entered into evidence in this way, which is simply
6 a way to sidestep and subvert the rules governing the use
7 of depositions in the agreement between counsel..

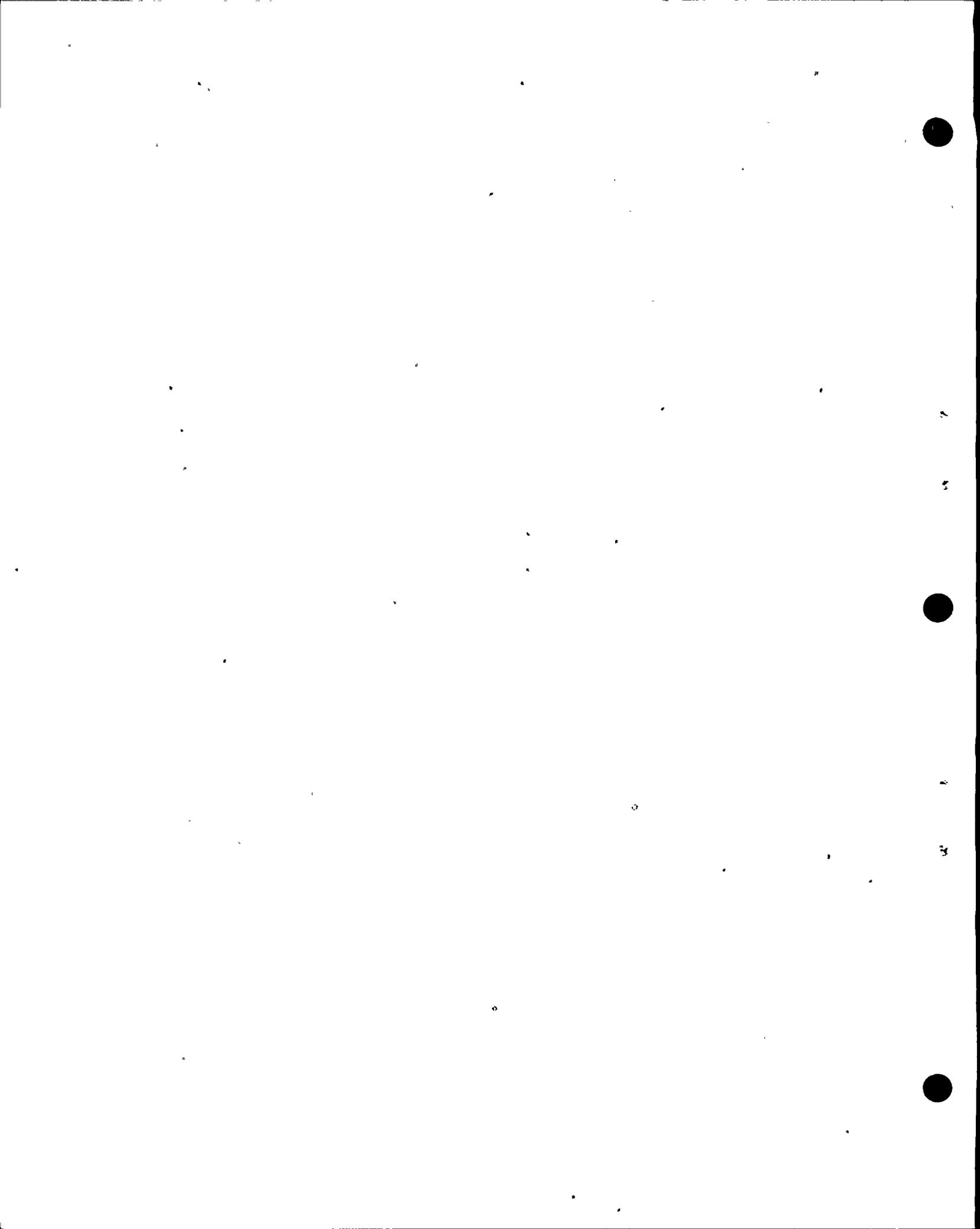
8 Therefore, I request that the prior mention of
9 Dr. Graham's testimony be stricken, and that there be no
10 further questions on this.

11 Dr. Graham is not here to respond to questions
12 about what may or may not have been said in the deposition.

13 MR. NORTON: Excuse me, Mrs. Bowers. I just
14 totally disagree with that.

15 I agree that it's probably not a proper use to
16 put into evidence what he said in the deposition, but if
17 this witness heard him say something, he certainly can use
18 that for rebuttal. And that's been done, my gosh, I don't
19 know how many times we've had one witness say, well, so-and-so
20 told me. In fact, all of Dr. Silver's that we're talking
21 about, the Weber and Majoey studies, and they said, well,
22 I talked with Weber and Weber told me this -- lots of
23 evidence like that has come in.

24 Now, if Dr. Graham has said something in Mr.
25 Hamilton's presence, Mr. Hamilton can certainly relate what



wel 10 1 he said.

2 The fact that it occurred in a deposition is
3 incidental to the fact that Dr. Graham said this in Mr.
4 Hamilton's presence. And on that basis, he can say it.

5 Now, if he can't recall what he said, then he
6 can't recall what he said, and I would agree that we cannot
7 sit here and read the deposition, and that's not what I'm
8 trying to do.

9 MR. FLEISCHAKER: Well, --

10 MRS. BOWERS: Well, the witness answered that
11 he hadn't reviewed the deposition. That answer, to me,
12 means no recall, unless he were to review that deposition.

13 Is that correct, Mr. Hamilton?

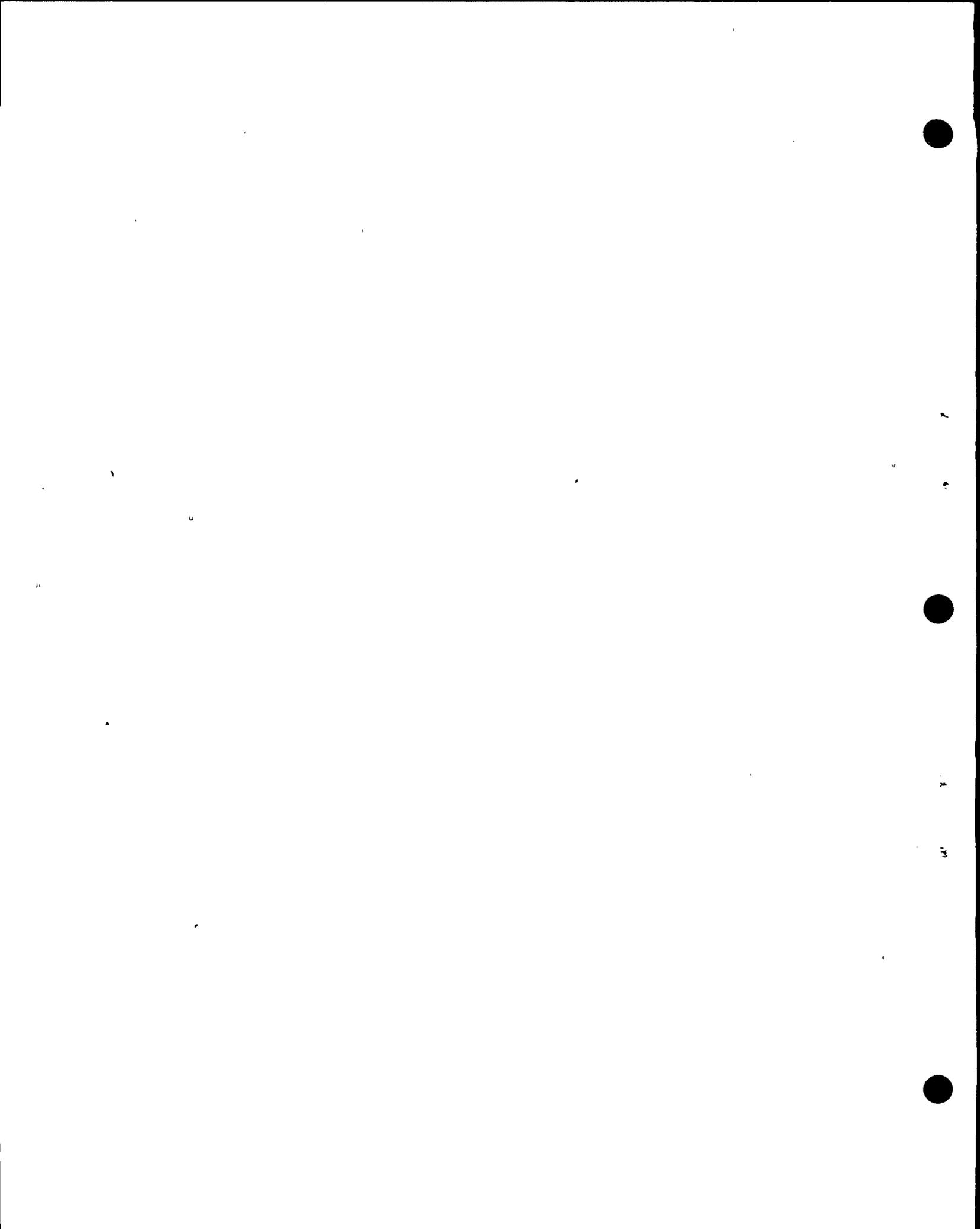
14 WITNESS HAMILTON: Well, it's my present recollection
15 that I did hear Dr. Graham say that.

16 MR. NORTON: And what you don't recall is whether
17 it was at the deposition or at some other place, is that
18 correct?

19 WITNESS HAMILTON: That's true, yes.

20 MR. FLEISCHAKER: Well, I think that conflicts
21 with his earlier testimony, and I would request that all
22 of those references be struck.

23 Dr. Graham was here yesterday. If there was
24 going to be cross-examination of Dr. Graham on the statements
25 he made in the deposition, it should have been done at that



wel 11

1 time.

2 This is unreliable evidence, and I don't think
3 that -- well, to permit the Applicant to proceed in this
4 manner is to permit him to clearly subvert the rules
5 governing the use of the deposition.

6 MRS. BOWERS: Mr. Staenberg, does the Staff have
7 a position on this?

8 MR. STAENBERG: There doesn't appear to be much
9 disagreement between the Applicant and the Intervenors
10 regarding the proper or improper use of the deposition, and
11 on that issue the Staff agrees.

12 If Mr. Fleischaker wishes to have struck the
13 previous comments of this witness, then it seems to the
14 Staff that Applicant is free, with a clean slate, to ask
15 the question again and to elicit responses from this witness
16 that would not run afoul of the problem that Intervenors
17 raise.

18 So we can't have it both ways. We can't have
19 the -- if the questions and answers are struck, and then
20 not allow Applicant to ask in more proper form and the
21 witness to answer those same questions.

22 MRS. BOWERS: Do you want to respond to that,
23 Mr. Norton?

24 MR. NORTON: That's basically what I said in
25 different words. I agree that we can't sit here and read



Y
187

wel 12

1 Dr. Graham's deposition, and that wasn't the intent at all.
2 It was simply that Mr. Hamilton said he believed he heard
3 Dr. Graham say, and, unfortunately he said, "...in his
4 deposition." If he hadn't used those three words, there
5 wouldn't have been any objection.

6 We're not using the deposition. We're using
7 Dr. Hamilton's memory of what he heard Dr. Graham say.

8 MRS. BOWERS: The motion to strike is granted,
9 and you can begin again.

10 BY MR. NORTON:

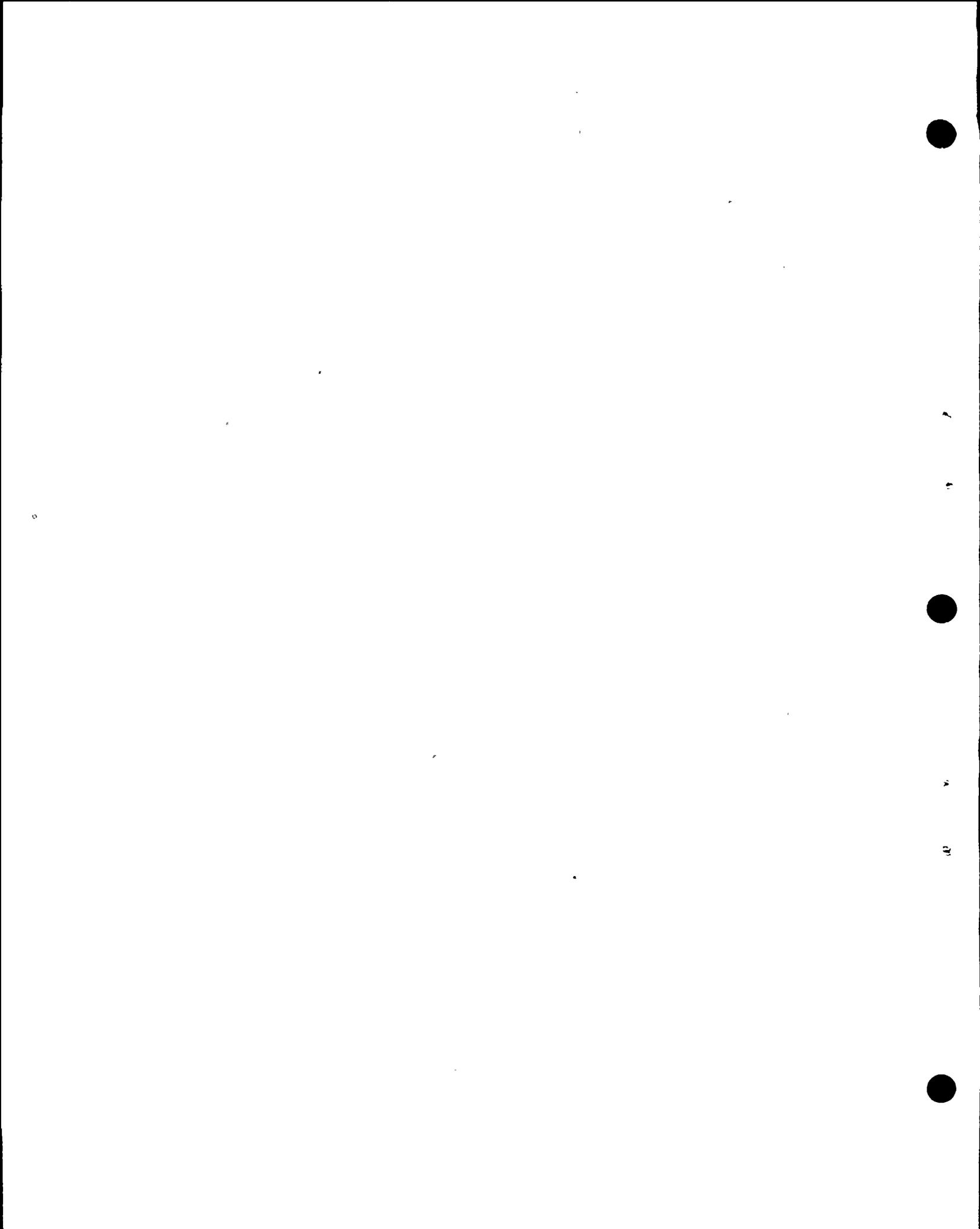
11 Q Mr. Hamilton, did you hear Dr. Graham, at any
12 time in recent months, say how he used the gravity offsets
13 of Dr. Silver? Yes or no?

14 A (Witness Hamilton) It's my present recollection
15 that I did.

16 Q All right. And what did he say?

17 A It's my recollection that he said that he and
18 Dr. Dickinson made essentially another choice of where to
19 place the presumed matching gravity high in the area around
20 Big Sur with the gravity high that's associated with the
21 Pigeon Point high, in order to get a more compatible amount
22 of offset with the other features that were being matched
23 across the San Gregorio Fault.

24 Q And as I understand it Mr. Willingham is going
25 to discuss some of that gravity data, is that correct?



wel 13

1 A (Witness Willingham) Correct.

2 Q All right, please proceed.

3 A Before actually beginning with the data, I'd like
4 to request the Board's indulgence for a minute, and I'd like
5 to just outline some of the fundamentals of the gravity
6 interpretation procedures so that you can perhaps better
7 understand this term "ambiguity" which has popped up many
8 times in relation to this.

9 MRS. BOWERS: If this is going to take a few
10 minutes, let's have the lights on. This business of sitting
11 in a partially darkened room . . .

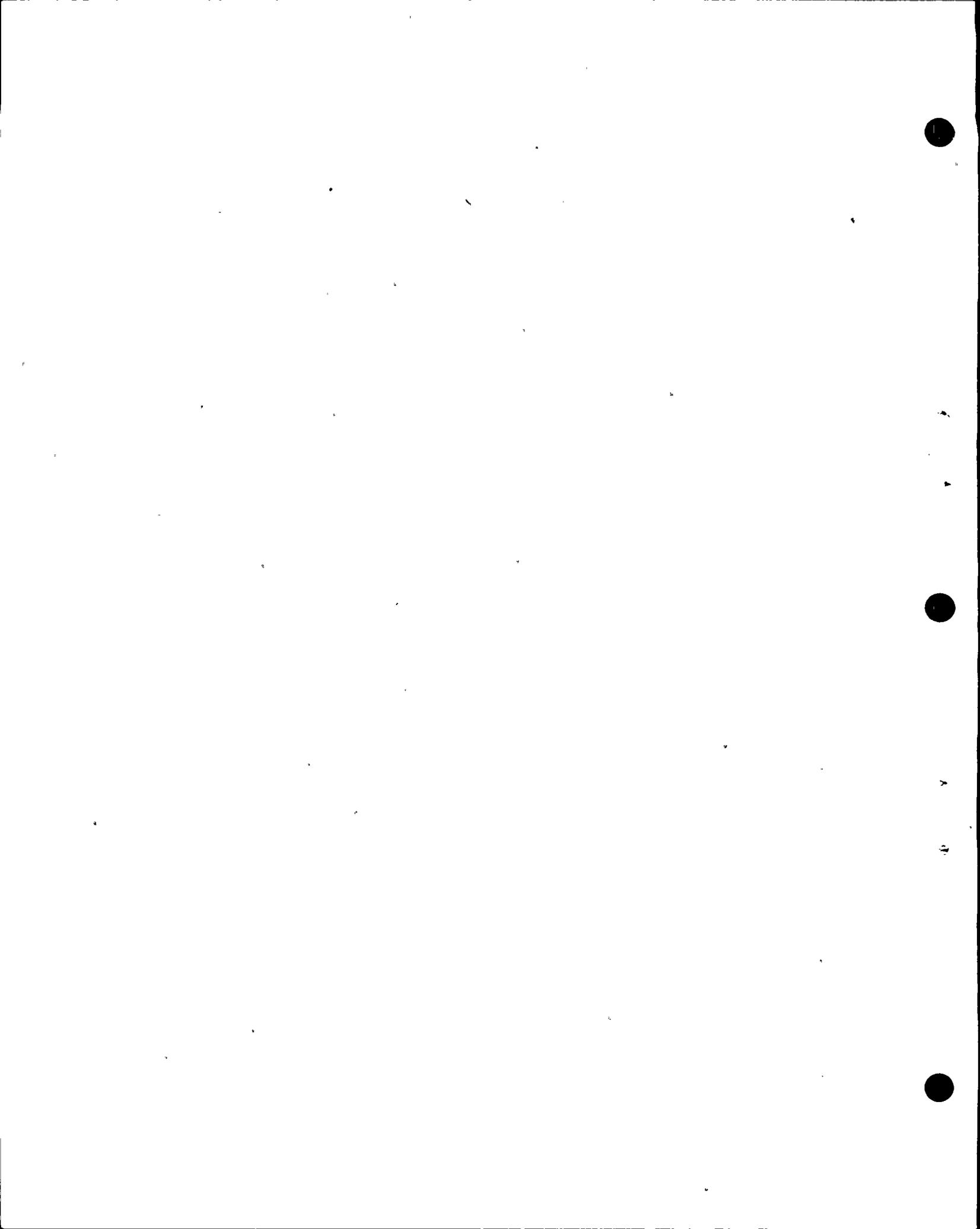
12 WITNESS WILLINGHAM: First of all, as has been
13 brought out many times in this hearing, there is an intrinsic
14 ambiguity in gravity interpretation for the following reason:

15 The source of a gravity field depends upon two
16 parameters:

17 The geometry of that source, and the density of
18 the material making up that source.

19 So that the resulting gravity field is the product
20 of two things, and we can vary either one of those two things
21 in a complementary fashion and still get the same end
22 product.

23 Fortunately, in a normal geologic circumstance,
24 the geometry is constrained. We have some basic ideas from
25 the past several hundred years of geologic exploration as



wel 14

1 to what subsurface structures tend to look like.

2 In the case of the offshore area here we have
3 fault boundaries for most of our basins, so we can actually
4 put a good deal of constraint on one of the variables in our
5 gravity equation. That removes a lot of -the ambiguity.

6 So, though there is always a bit of residual
7 uncertainty in the exact source, the shape of the source or
8 the density, we can make some general comments which have
9 very little ambiguity in them at all. And the kinds of
10 comments that we'll be making here today fall in that
11 category. We're making generalizations on the sources of
12 the gravity fields that we can state with a very high
13 degree of confidence.

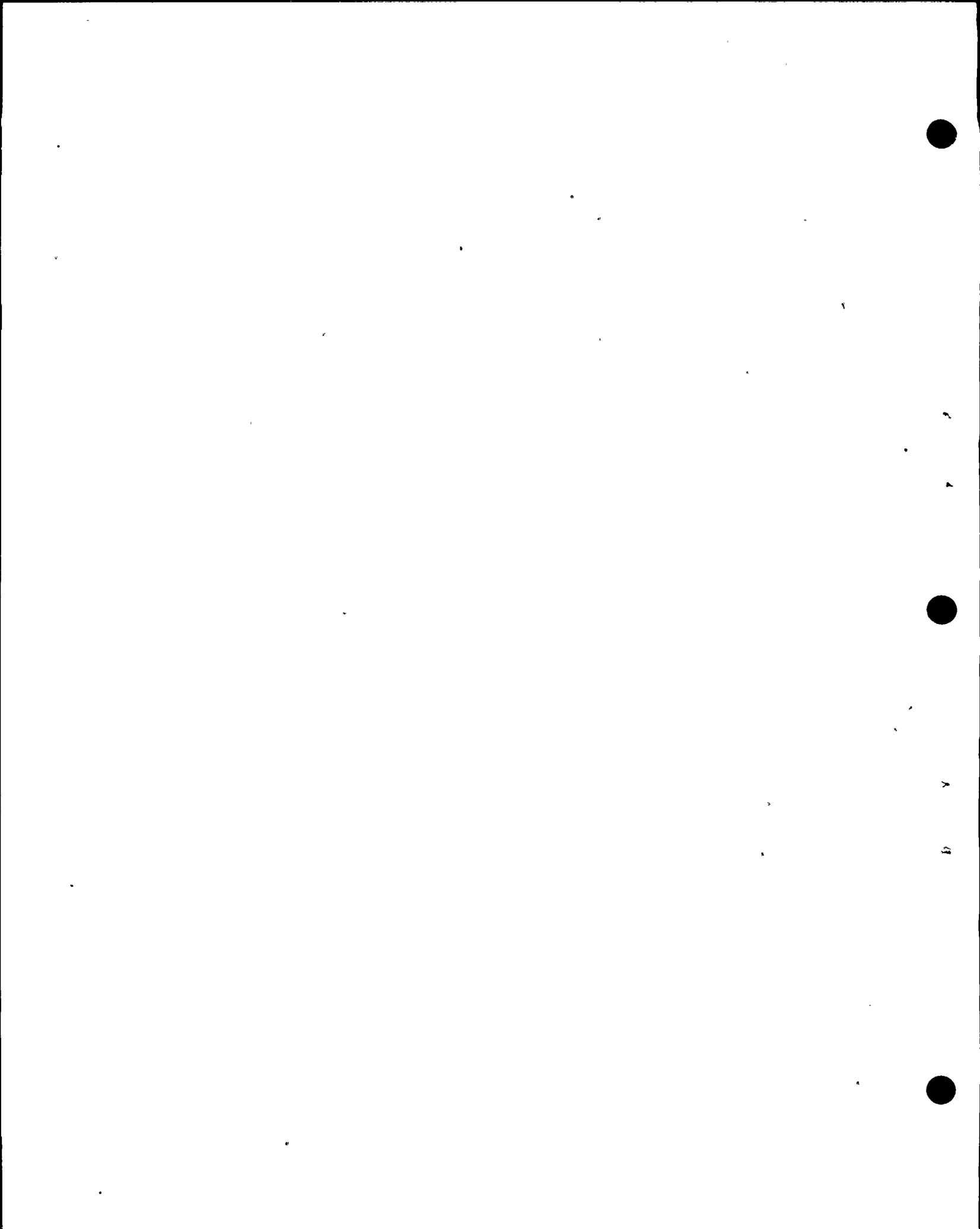
14 Can we have the first slide?

15 (Slide.)

16 BY MR. NORTON:

17 Q Excuse me, Mr. Willingham. While you're getting
18 up there and getting started, I will identify this as
19 Applicant's Exhibit 46. The copies that are being passed
20 out are so marked. And each new slide that goes up will be
21 consecutively numbered, from 46, and Mr. Williamson will
22 pass them out as he's doing with this one.

23 MRS. BOWERS: Before Mr. Willingham starts,
24 perhaps the record would be made a little more clear by
25 checking with Mr. Hamilton:



wel 15 1

2 You were concentrating on those two hatched areas
3 on that slide, weren't you?

4 WITNESS HAMILTON: Yes, that's true. Those are
5 the areas meant to represent the Oligocene-Lower Miocene
6 basalts.

7 MR. NORTON: These are colored slides, and they
8 are colored in the record. They would be the brown hatched
9 areas. I guess there are no other hatched areas, in any
10 event. But they are brown.

11 WITNESS WILLINGHAM: Here we see a gravity map
12 of the California coastal area from approximately the
13 latitude of San Francisco Bay at the extreme north end of
14 the slide, all the way down to the latitude of Estero Bay
15 at the southern end of the slide.

16 In an east-west extent, we're going from the
17 Pacific Ocean to an on-land area, with the shoreline falling
18 roughly on a diagonal passing from the northwestern or upper
19 left-hand corner of the slide, down to the southeastern
20 portion of the slide.

21 We have some coloration on the slide. The
22 reddish or orangish colors represent gravity highs, and the
23 darker, greenish-blue colors represent gravity lows.

24 The area of most interest is in the vicinity of
25 a spot located at the intersection of latitude 37 and
longitude 122. This is approximately the northern edge of



"

"

2

4



4

4



wel 16

1 Monterey Bay.

2 This slide is shown to give an overview of the
3 entire gravity field, and in just a minute we'll see two
4 other slides which show an expansion of the area just
5 mentioned.

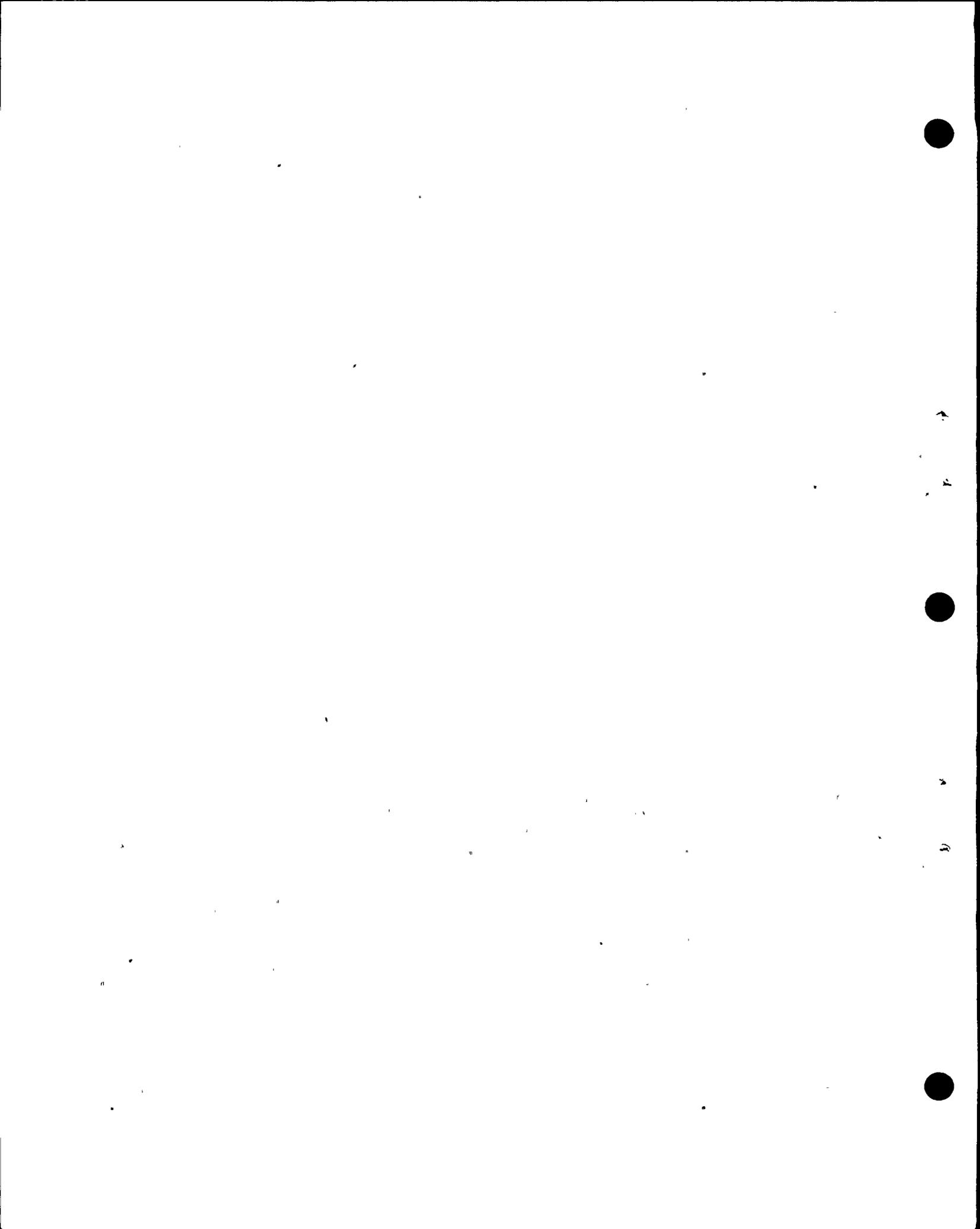
6 The northernmost gravity low, the northernmost
7 dark green band, represents the southern extension of the
8 offshore Bodega Basin. It is a gravity low because it's
9 filled up with sedimentary rocks which have less density,
10 and, therefore, less of a gravitational attraction, than
11 the granitic or Franciscan crustal rocks that occur in
12 other areas.

13 So these sediments within the basin generate the
14 low.

15 Once we pass the shoreline, which is indicated as
16 a faint red line, we cross into a small onshore extension of
17 that basin sandwiched between the Ziante and Pilarcitos faults.

18 Now, going south of this gravity low, we come
19 to a long northwest trending gravity high. This gravity high
20 consists of the Fallon Ridge, which is, for the most part,
21 a granitic high, and then immediately offshore -- it's
22 commonly identified as the Pigeon Point high, and onshore as
23 the Ben Lomond granite.

24 This is a gravity high because it's an area without
25 the low-density sediments. It consists of dense materials;



wel 17

1 therefore, gravity high.

2 So the south of that, we come to another low. This
3 low is a very major structural feature in California. It is
4 called the outer Santa Cruz basin. It is another one of
5 these offshore depressions that has been filled in with
6 sediments; ergo, the low.

7 It has an onshore extension which continues through
8 Monterey Bay, and links up with the Salinas Valley, a major
9 geomorphic feature of California, that also is a sedimentary
10 basin filled up with low-density sediments.

11 The remainder of the coloration on the slide will
12 not be referenced in this discussion.

13 Can we have the next slide?

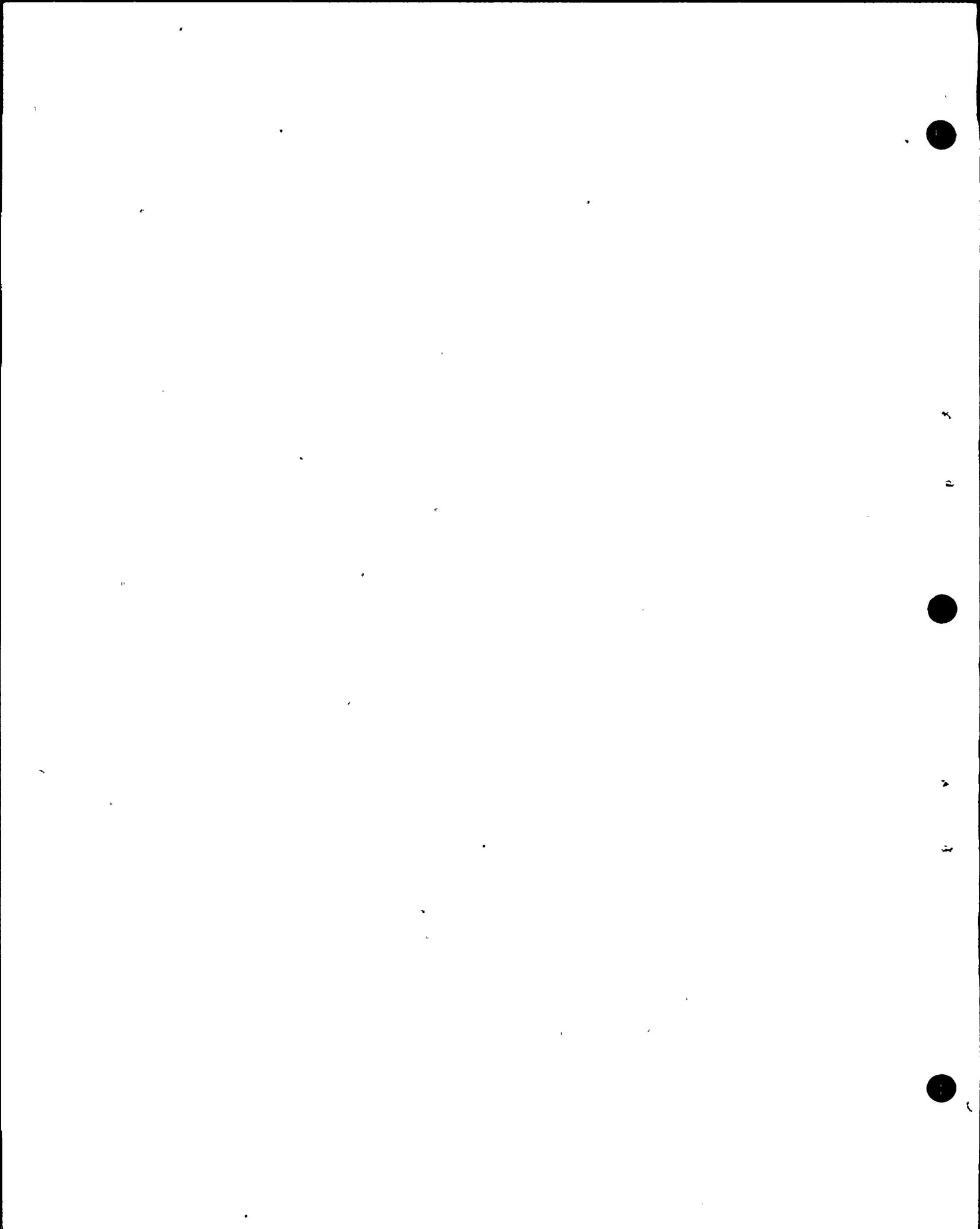
14 (Slide.) (Applicant's Exhibit 47).

15 Now, here we have an expansion of that area we
16 just mentioned, centered upon latitude 37, longitude 122.

17 Here we can plainly see in more detail the
18 structure of the gravity lows and highs. The lows and highs
19 of concern here have been shaded a light gray.

20 The very broad straight line crossing the slide
21 is a schematic representation of the San Gregorio Fault. It's
22 the best straightline representation that I could fit to the
23 actual trace of the fault, and in just a minute you'll see
24 why it is a straight line.

25 Mr. Graham, or Dr. Graham yesterday said that you



wel 18

1 really can't tell the difference between one bullseye and
2 another.

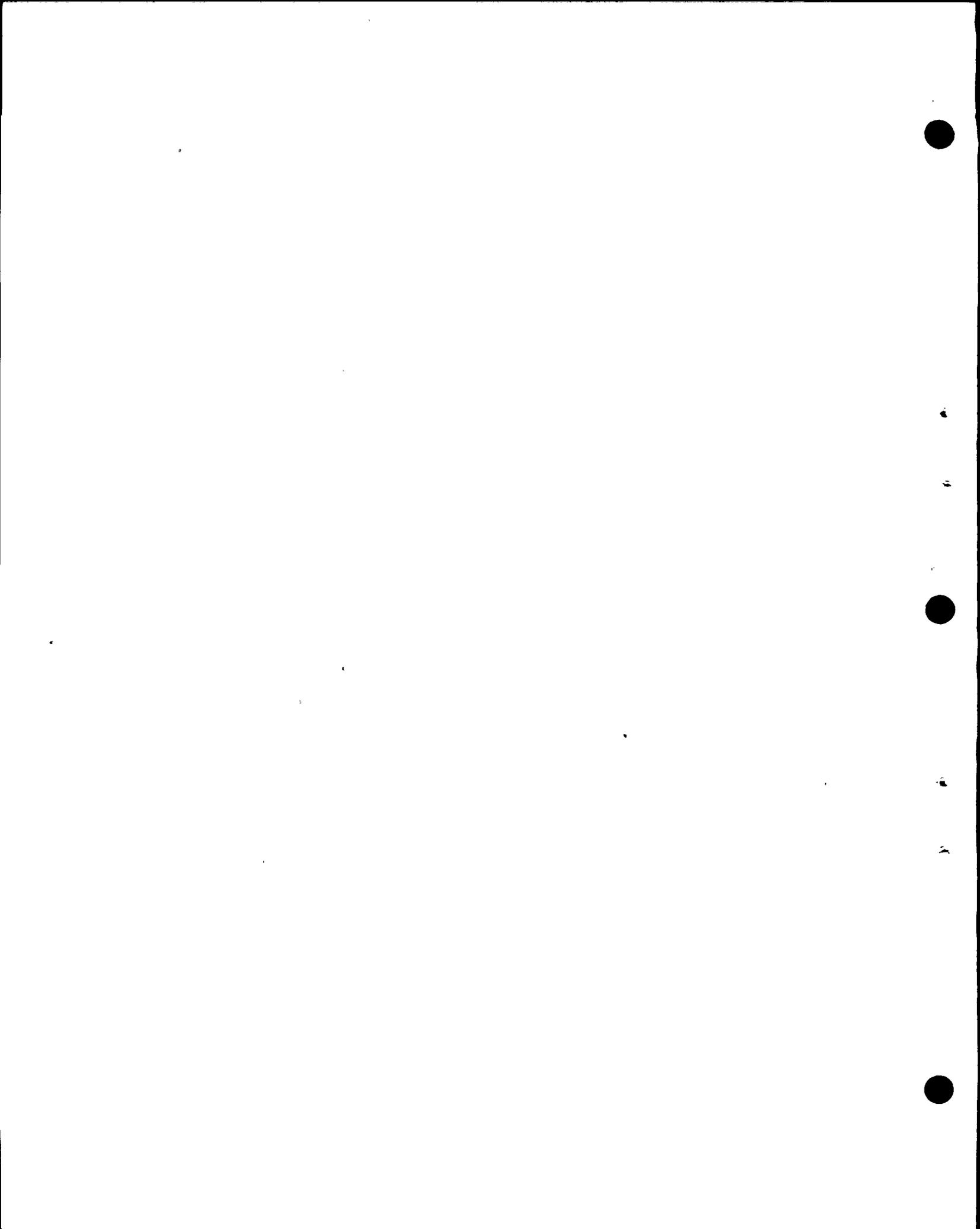
3 Well, that might be true in some circumstances,
4 but I think we would all admit that if two bullseyes were
5 exactly the same size and had some other unique features about
6 them, we might consider that they were more related than if
7 they were greatly different size and had absolutely no
8 features that were identical.

9 Here we have -- although they're not actually
10 bullseyes, but they are contour lines, and I think as we go
11 through this discussion we'll see they have a great deal of
12 similarity to one another.

13 First of all, let's take the gravity low associated
14 with the southern extension of the Bodega Basin. We see it
15 extending down from the northwest corner of this slide. It
16 is the first of the light gray colored zones that we encounter
17 coming from the north of the slide southward.

18 We see the axis of the gravity low, roughly
19 parallel to, or roughly coincident with, the zero milligal
20 gravity anomaly line, and see that there is an extension of
21 it on the other side of the fault.

22 If we look at the dashed lines here -- backing
23 up for a second, the contour intervals on this map are
24 10 milligals -- a milligal simply being a unit of gravity
25 measure, and the dashed lines represent 5-milligal lines.



wel 19

1 We can see the axis of the offshore Bodega Basin
2 coming down here, and then once we hop the San Gregorio Fault
3 we see the 5-milligal line matching very nicely with the
4 5-milligal line on the other side.

5 So we have a gravity low, and the amplitude of the
6 low on either side of the fault is nearly the same.

7 Now that, in itself, could be a coincidence.

8 But let's go on.

9 Just south of this low we have a gravity high,
10 a very pronounced high. If we count the contour lines, we're
11 up to the 10, 20, 30-milligal line, and we see that the high
12 peaks out at 35 milligals.

13 Now, we see an indentation which is partially
14 covered by the dark line -- perhaps we could go back to the
15 previous slide.

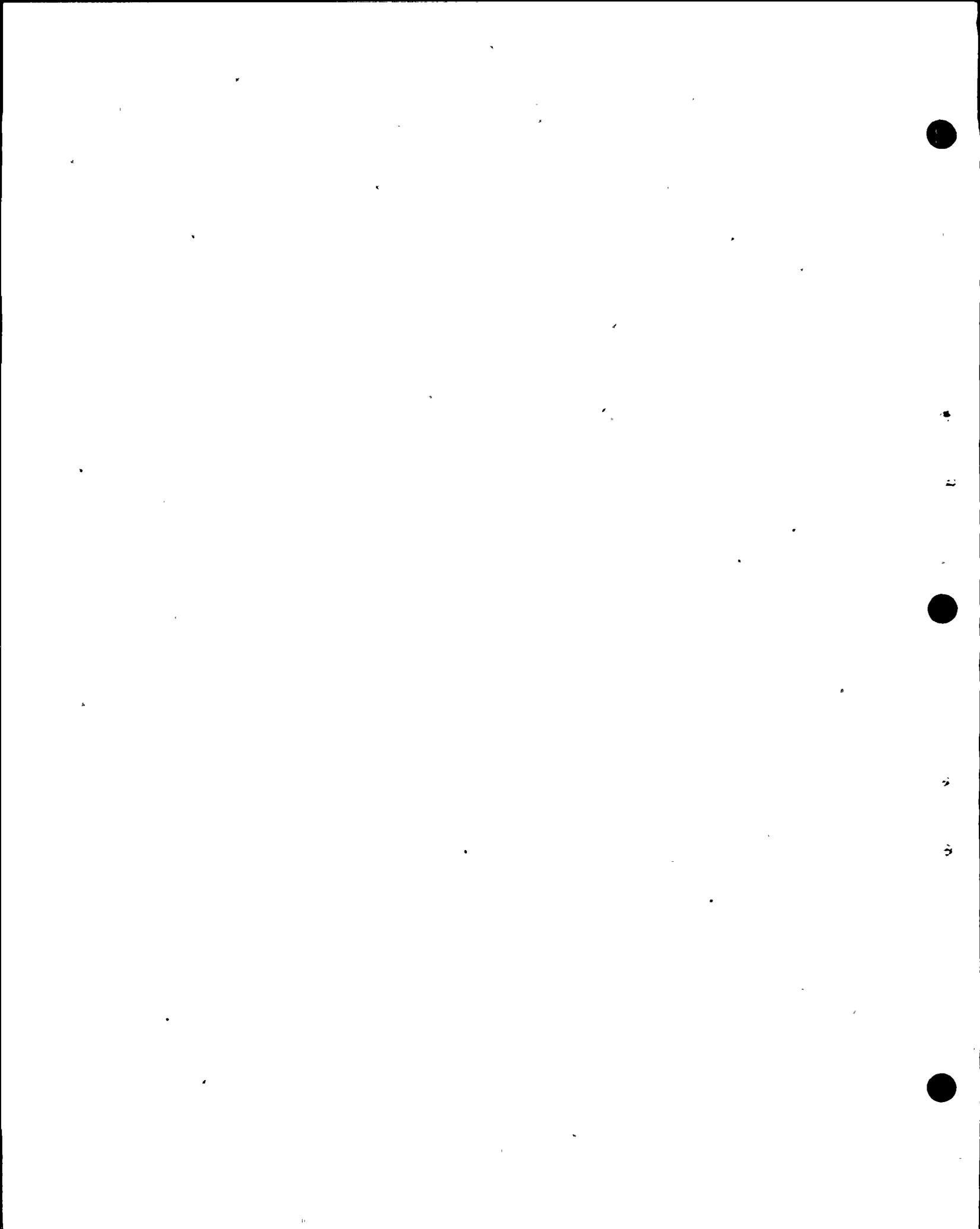
16 (Slide.) (Applicant's Exhibit 46.)

17 Looking again, very near the -- well, just
18 slightly north of the intersection of latitude 137 and
19 longitude 122 --

20 BY MR. NORTON:

21 Q Excuse me. I think it's latitude 37, not 137.

22 A (Witness Willingham) Excuse me. You're correct.
23 Latitude 37, longitude 122, we again see our gravity high
24 coming through here, and perhaps we can see that there is
25 an indentation in that high. If we consider the high to be



wel 29

1 continuous across the fault zone, there's a small notch at
2 the north side and a small notch at the south side, which
3 approximately follows the trace of the fault.

4 Back to the other slide.

5 (Slide.) (Applicant's Exhibit 47)

6 Okay. Here we see that again. This notch is
7 caused by fracturing of the rocks within the fault zone
8 itself. So we see the fault zone manifest very plainly.

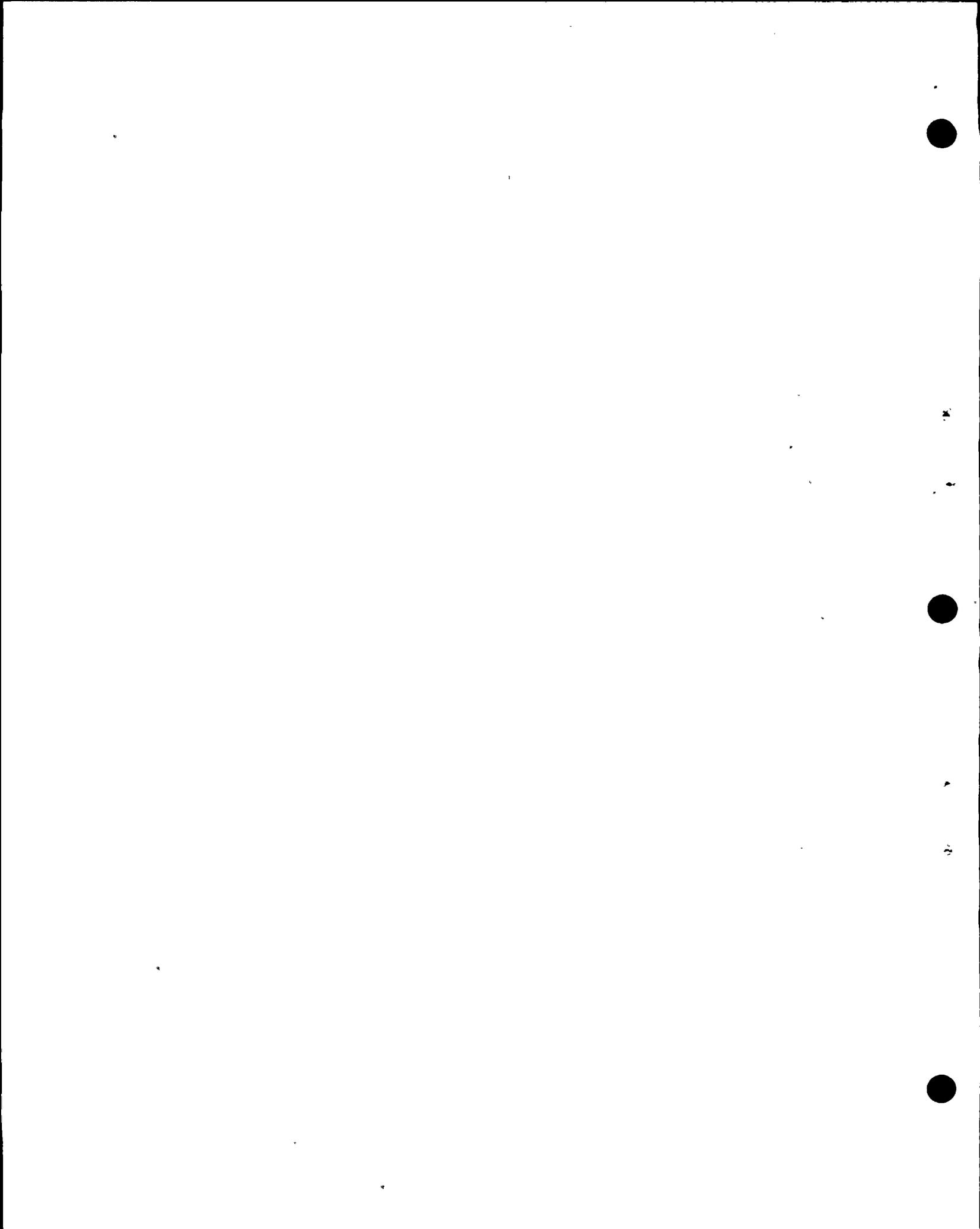
9 The fracturing of the rocks lowers their density,
10 and, therefore, lowers the gravitational attraction in that
11 area.

12 Now, let's take a look at the amplitude of the
13 high and the shape of the high. It comes up to 35 milligals.
14 We've jumped the fault, and we're on the other side, and
15 we're at 35 milligals.

16 As soon as we get out of that notch, that zone
17 of depressed gravity, we're back up at 35 milligals for the
18 high.

19 The 20-milligal line matches right straight across
20 the fault -- 20 milligals matches 20 milligals.

21 Well, now our bullseyes are beginning to take on
22 a lot of similarity. The amplitudes are the same, the form
23 as they approach one side of the fault appears to be very
24 similar to the form as we approach the other side of the
25 fault.



wel 21 1

2 Now, going down, leaving this high, this gravity
3 high, going down to the next gravity low farther to the
4 south, we again have the same kind of match. We find that
5 the plus 10-milligal line lines up very nicely with the plus
6 10 on the other side of the fault.

7 The low does, indeed, point directly across the
8 fault into another low. We can see the zero milligal lines
9 are looking very closely at one another, and, again, our
10 bullseyes are taking on a bit of similarity.

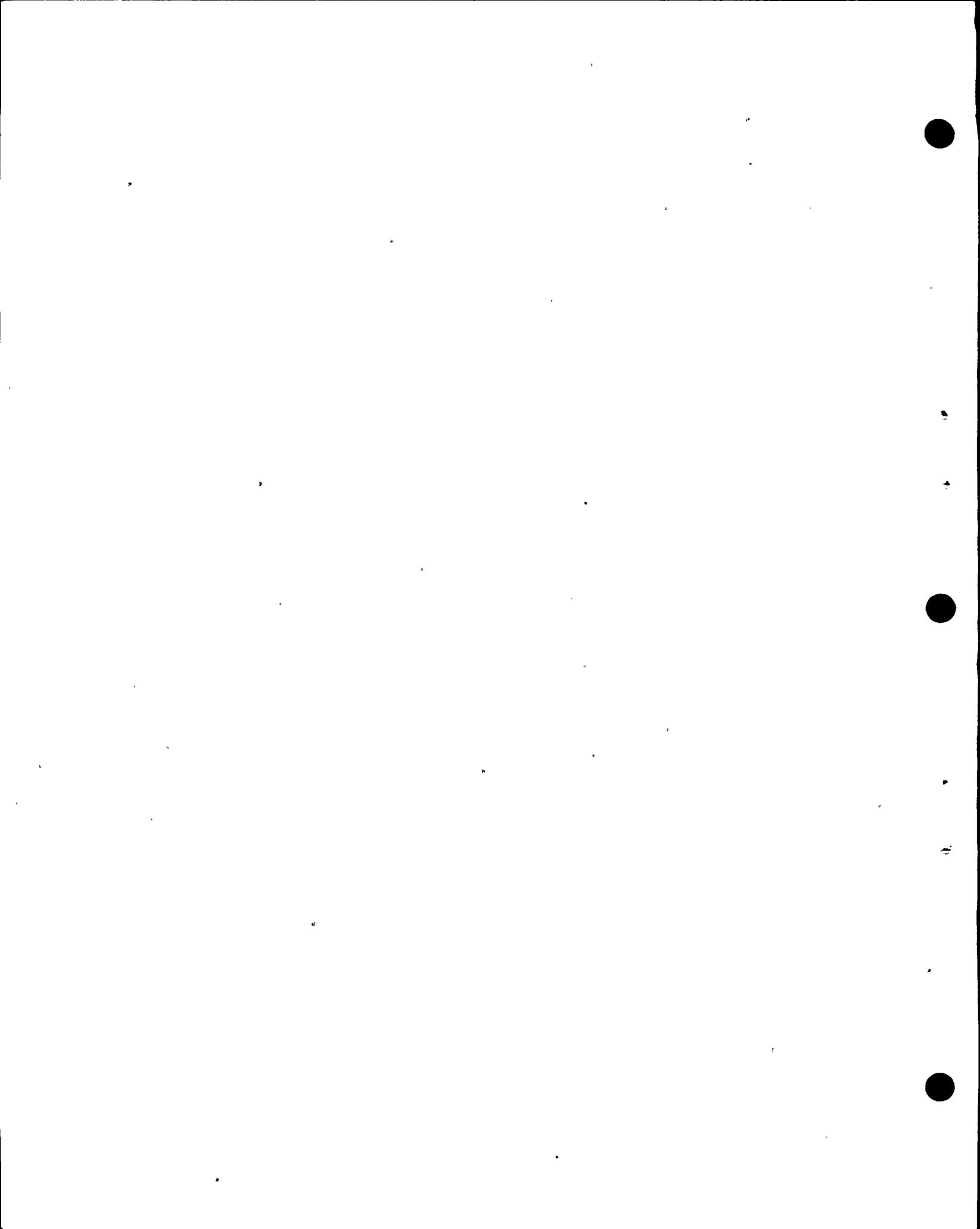
11 The amplitude of all three of the package we
12 have here -- I almost hesitate to use that word -- but we
13 have a low -- now I'm speaking of the area to the left of
14 the fault; to the west of the fault -- we have low, high,
15 low.

16 The first low has a similar amplitude adjacent
17 to the fault as the low, high, low pattern to the east of
18 the fault.

19 The high a similar amplitude to the high to the
20 east of the fault.

21 The next low, to the west of the fault, similar
22 amplitude and shape to the low to the east of the fault.

23 So, our bullseyes have a good bit of similarity,
24 so much similarity that one becomes -- you know, it becomes
25 almost, in a geologic sense, invoking far too much coincidence
26 not to expect them to be related.



wel 22 1

Can we see the next slide?

2

(Slide.) (Applicant's Exhibit 48.)

3

Q Excuse me. Before you discuss that, the last slide we were looking at is Applicant's Exhibit 47 and this is Applicant's Exhibit 48.

6

A The reason the San Gregorio Fault was drawn as a broad straight line was simply so that we could cut the previous slide along that line. And that's what has been done here.

10

I simply took a pair of scissors, cut down the center of the line, and then began sliding the eastern portion of the slide northward, looking for a better alignment or a better match than we previously had.

14

After we have moved the eastern side in a northwesterly direction, approximately ten kilometers, we find that we get a very excellent match of the anomaly patterns.

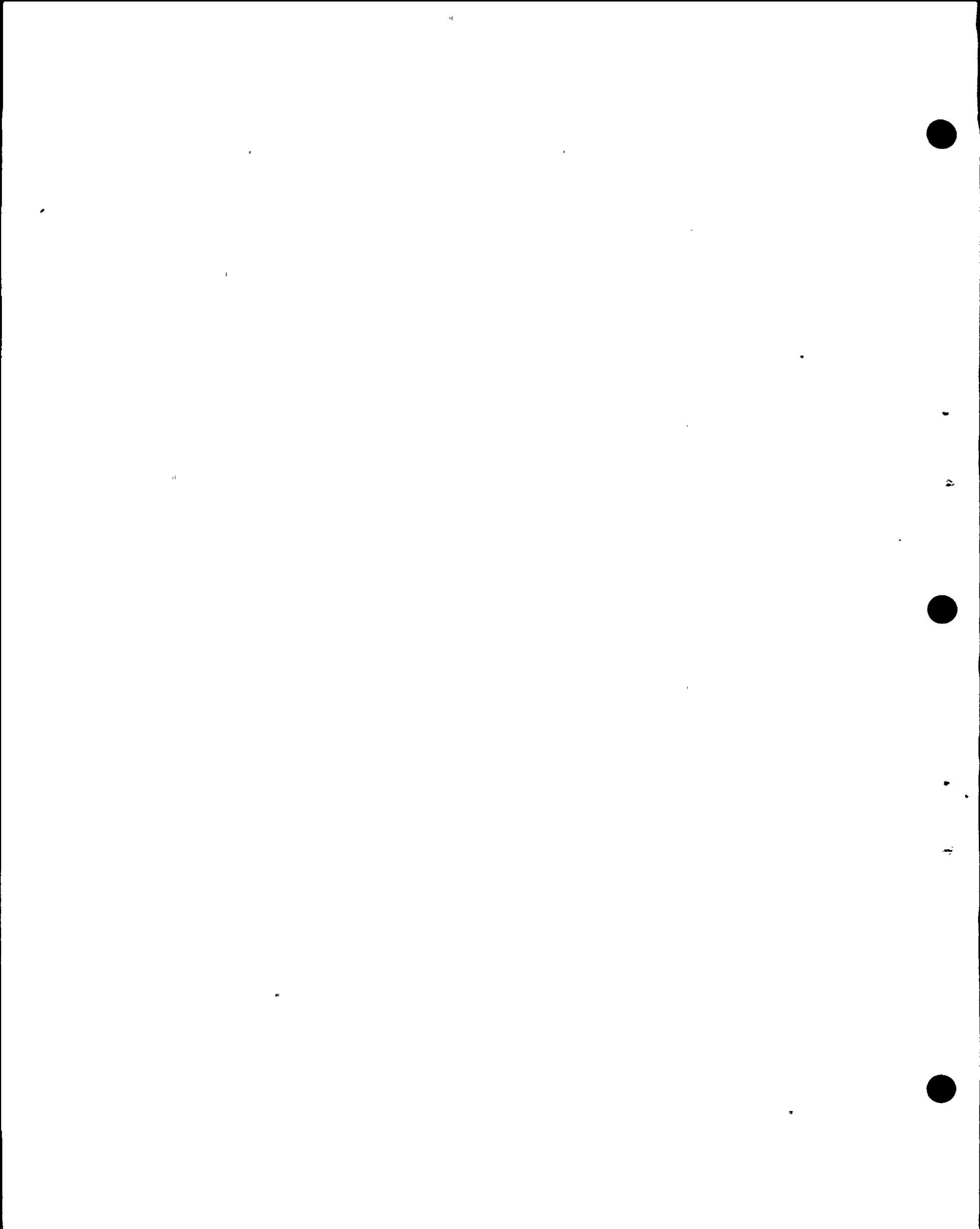
18

If we go to the northernmost of the features we've been concerned with, the first gravity low that we encounter, moving southward across the slide, we see the 5-milligal line looking directly at 5 milligals; we see that the shape of the pattern on the east makes a very logical continuation of the pattern that we have seen developed on the west.

22

Likewise, when we go to the south to our granitic high and our gravity high, we see the pattern of anomalies

25



wel 23

1 interrupted only by the notch caused by the fracturing of
2 the rocks in the San Gregorio Fault zone itself. It continues
3 directly across, 35 looking at 35. 30 looking at 30.
4 20 looking at 20. The pattern to the west making a very
5 logical continuation with the pattern to the east.

6 And, again, as we go to the southernmost of our
7 anomalies, the outer Santa Cruz basin, we see, again, a very
8 striking match, in form and in amplitude of the anomalies on
9 either side of our fault zone.

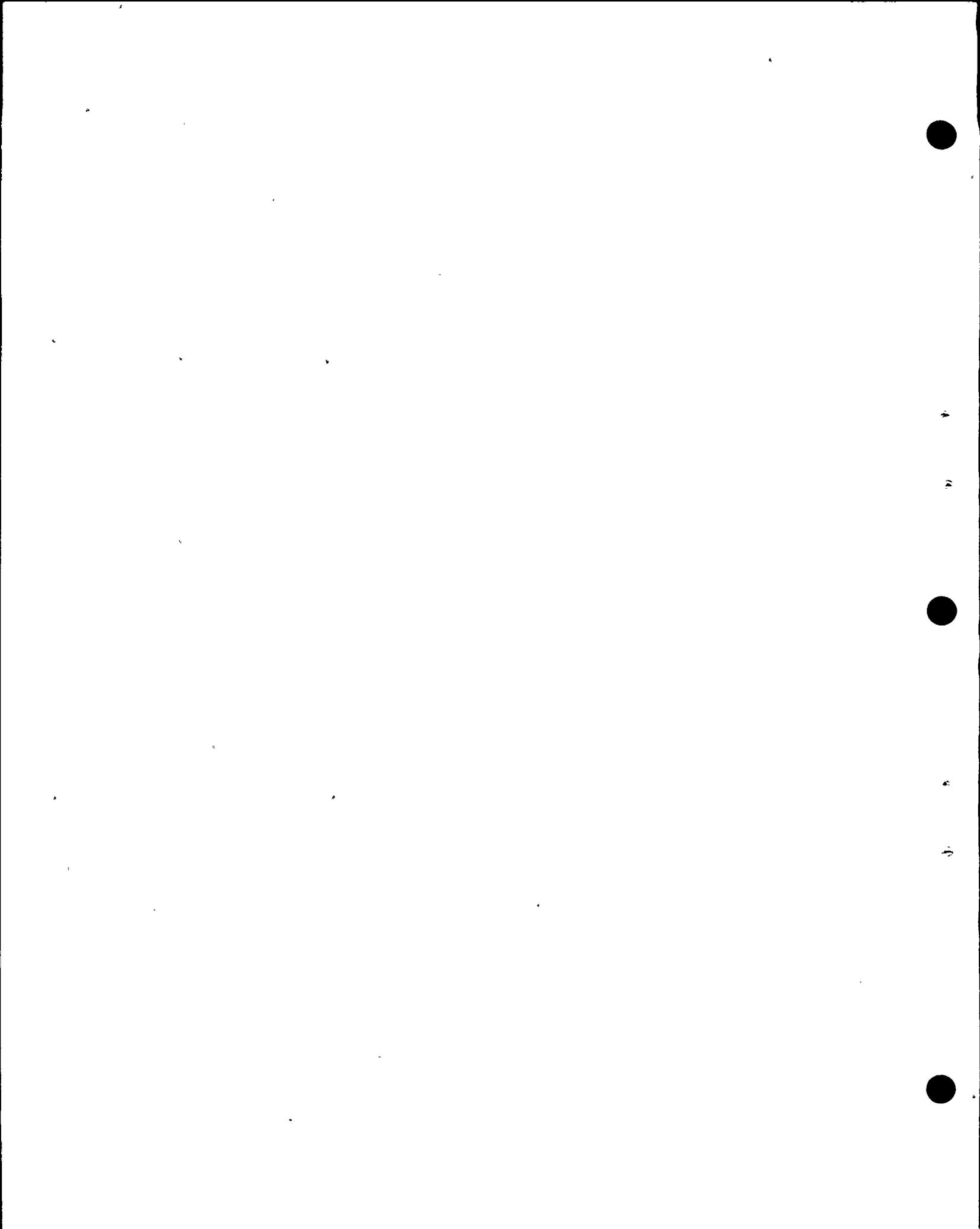
10 For this to be coincidence is geologically
11 and geophysically unreasonable.

12 What we have done is moved the San Gregorio Fault
13 10 kilometers to the northwest to reconstruct what we believe
14 was the configuration of the fault zone in a time span that
15 would take us back approximately 12 million years, in making
16 this final reconstruction.

17 So, 12 million years ago the patterns matched
18 beautifully, on either side of the fault, as they should have.
19 And today, after the formation of the fault, after slippage
20 of the fault, we can account for no more than 10 kilometers.

21 If we try to push this to the northwest any
22 farther, we lose the matching, we lose the patterns. The
23 matches become much worse.

24 So in my judgment this low, high, low sequence
25 makes a very unique and very definitive line across the



wel 241

San Gregorio Fault zone.

2 Quite literally, a textbook example of matching
3 gravity patterns that very definitively indicates that there
4 has been no more than 10 kilometers of total displacement
5 on the San Gregorio Fault zone in the last approximately
6 12 million years.

7 Q Thank you, Mr. Willingham.

8 We're back to Mr. Hamilton now, and I believe
9 Mr. Hamilton will discuss the Monterey Bay basin, and I
10 believe the next slide will be Exhibit 49.

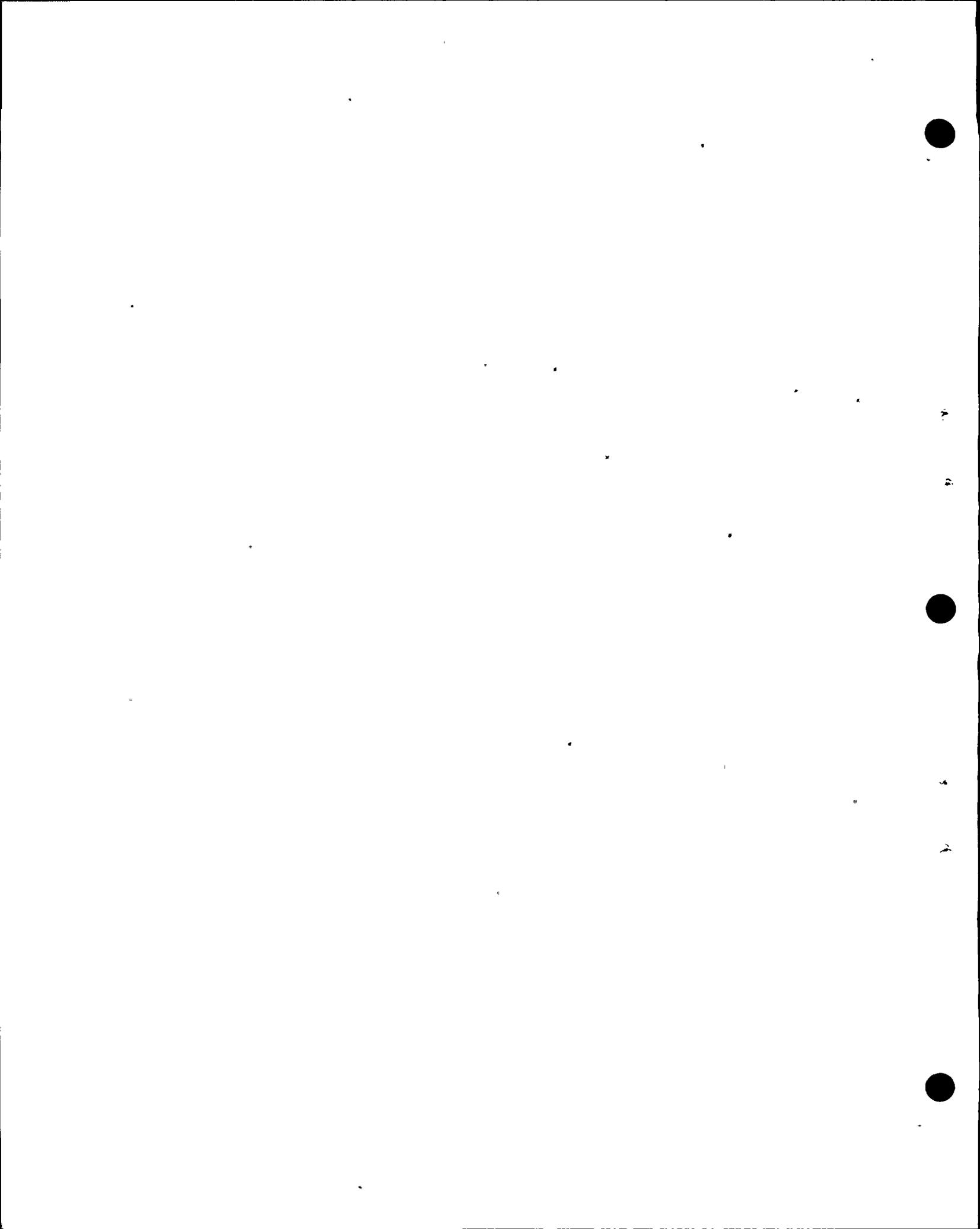
11 (Slide.) (Applicant's Exhibit 49.)

12 A (Witness Willingham) This is similar to an
13 illustration that was used previously, but we have used the
14 same bathymetric base which illustrates the subsea contours
15 and shows the location of the Monterey submarine canyon.
16 To it we have added red lines indicating the trace of the
17 San Gregorio Fault.

18 So this is a standard published bathymetric chart
19 on which has been superimposed the geologic location of the
20 San Gregorio.

21 I'd first like to just respond to Dr. Graham's
22 comment of -- I believe he said something to the effect that
23 one gully looks very much like another.

24 This submarine canyon has, as I think I mentioned
25 during previous testimony, about the dimensions of the Grand



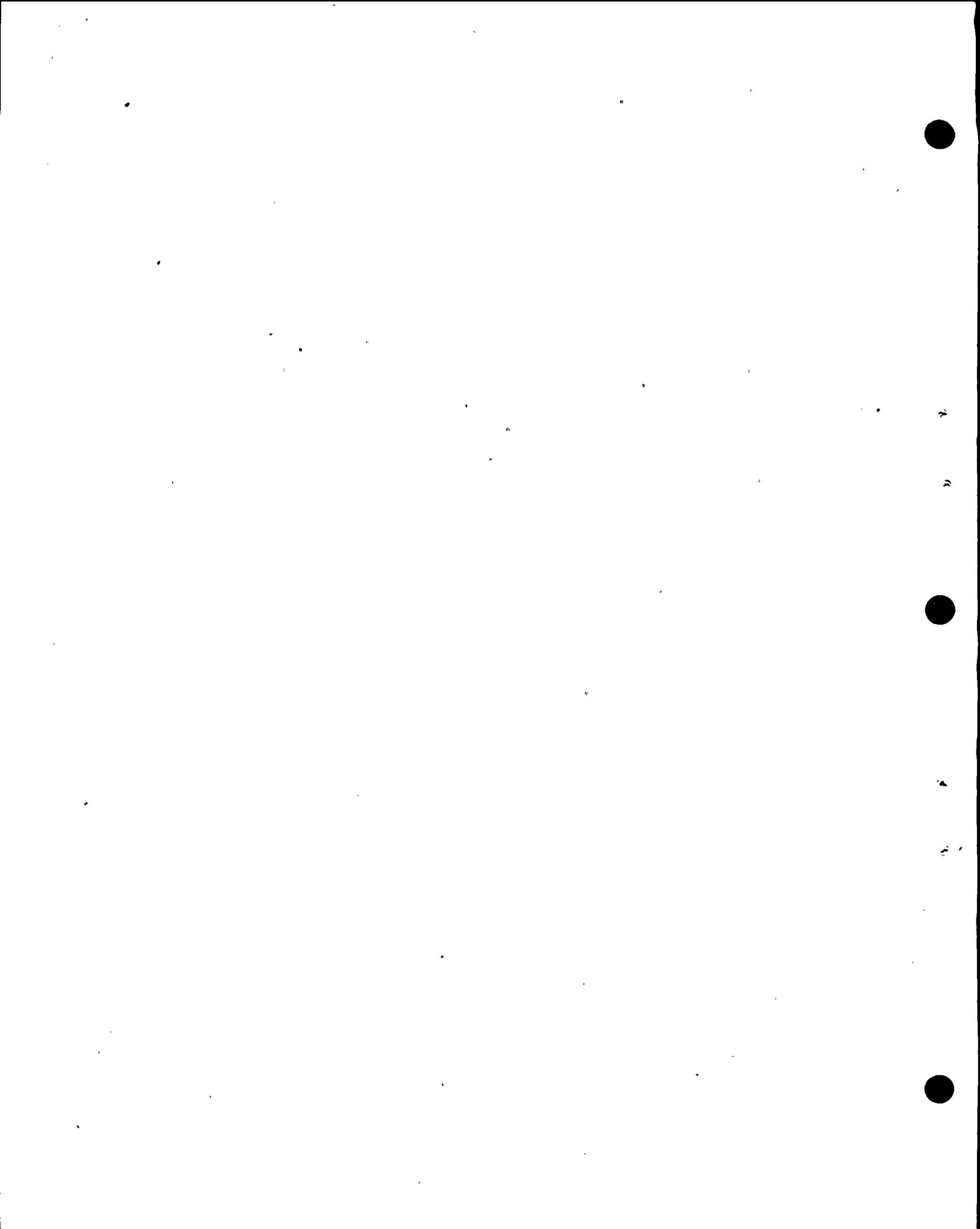
wel 25

1 Canyon. The published discussions of it show that it
2 probably originated back in Miocene time, more than 10 million
3 years ago. That is in a publication by a couple of
4 researchers named Stark and Howard, published in the
5 Geological Society of America bulletin, and that also seems
6 to be the view taken by Dr. Green, to whom reference was
7 made yesterday as being the prime researcher in the Monterey
8 Bay region.

9 In addition to wanting to reemphasize that this
10 feature is not just another gully, but, rather, is a very
11 prime geological feature in the whole California coastal
12 region, I also wanted to touch on a couple of other points
13 made about it.

14 First, it was noted that Dr. Green had the
15 opinion that there was deviation of the canyon where it is
16 crossed by the San Gregorio Fault. And that's true. It
17 does.

18 Madelon
19 fls.
20
21
22
23
24
25



mpbl 1
1 Madelon
Elws 2
1 WEL

Okay.

There are two points about Dr. Green's comments about this situation where the Monterey Canyon goes across the San Gregorio fault that I'd like to make:

One is that the actual deviation of the canyon would indicate left lateral movement rather than right lateral movement. The canyon swings out and is farther north at the point west of the fault than it is at the point east of the fault by a few kilometers.

The other point that Dr. Green makes is that the deviation on the canyon apparently resulted from preferential erosion along the weakened zone on the fault rather than from actual fault offset of the canyon.

Now the other point regarding Dr. Green is that it is his thesis that was certainly correctly stated by Dr. Graham that Dr. Green believes that the downstream continuation of this canyon has been successively offset to points successively farther north by right slip along the San

Gregorio fault, and that the canyon that you see located northwest of the present extension of Monterey Canyon culminating with Ascencion Canyon here in the upper northwest part of the stream represent earlier downstream continuations of this submarine canyon.

It was my view expressed during earlier testimony that in fact these are not downstream continuations of the main



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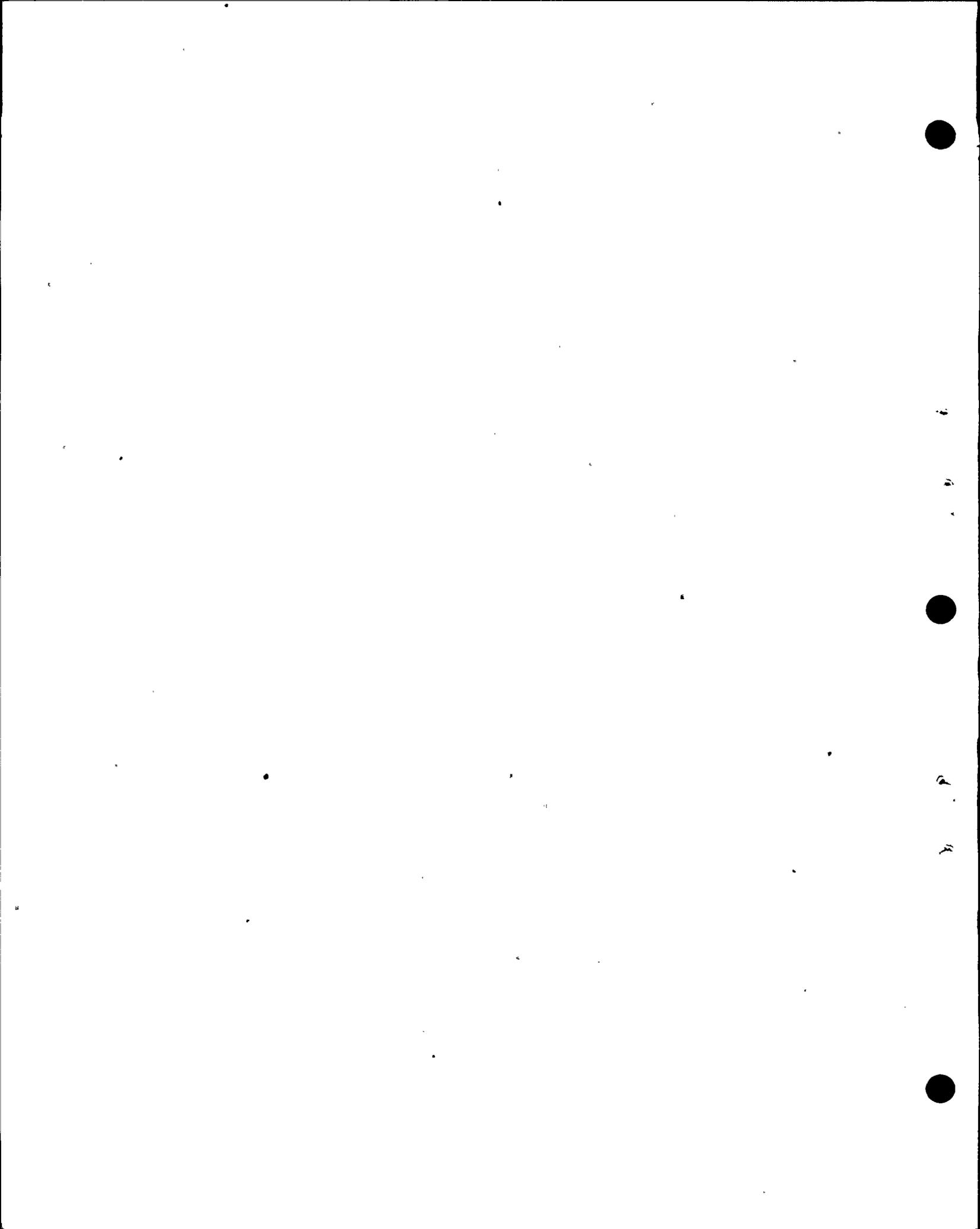


mpb2

1 canyon, and the reasons for that were several, among them
2 being that the canyon itself is a very large feature which
3 continues on out into the sub-sea plane along its present
4 course, and in addition that the canyons that lie farther
5 north of the main canyon, including Ascencion Canyon, are
6 much higher than the depth of the canyon at the point where
7 it is intersected by the fault. And further that they appear
8 to not actually continue to the fault zone as you would expect
9 if they were previous downstream continuations of the exist-
10 ing main canyon.

11 Since that time when I made that earlier testi-
12 mony I have examined some more data, including a seismic
13 reflection line. It's line 4 from leg 1 of the USGS BARTLETT
14 survey of 1972. That line goes across the head of Ascencion
15 Canyon here and then traverses this area upstream from these
16 canyon heads and goes on across the San Gregorio fault.

17 Now the theory as Dr. Green expresses it is that
18 there should be varied extensions of these canyons extending
19 up to the fault zone. And in fact this seismic line shows
20 that that's not the case, that Ascencion Canyon at this point
21 is essentially no deeper in the past than it is right now.
22 It's not a much larger feature that was subsequently buried
23 and partially reexcavated, and there are no buried canyons
24 in this ground here where the other canyons that are proposed
25 as intermediate downstream courses are.



mpb3

1 So I feel that the evidence is quite good that
2 in fact we are seeing the main canyon continue across the
3 fault as both the present and past principal expression of
4 Monterey Canyon, and that the theory that the canyons farther
5 north are offset is simply not valid given the geologic facts.

6 One other point made regarding Dr. Green's ideas
7 of the total offset is one that I think should be brought up
8 here.

9 And if I could have the viewgraph, I would like
10 to show a map that's from Dr. Green's open file report.

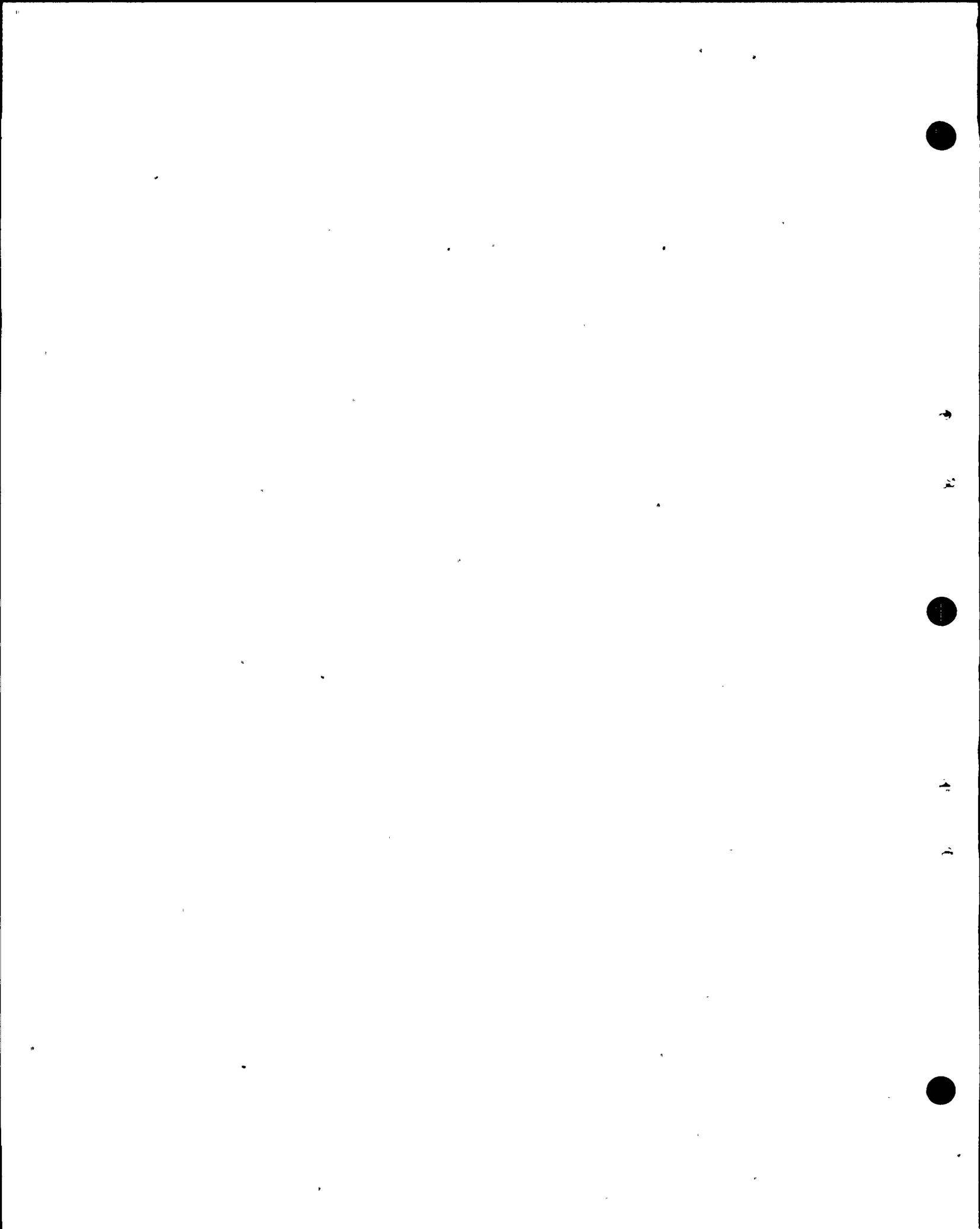
11 (Slide.)

12 Q This is Applicant's Exhibit 50.

13 A The map that I'm now showing is Figure 40
14 from Dr. Green's open file report on Monterey Bay, which I
15 believe is referenced in our testimony. And this is a map
16 showing the regional fault pattern as Dr. Green interprets
17 it to be.

18 And for your reference, the area covered extends
19 from around Point Sur at the southeast to Point Arena at the
20 northwest. And the coastline as indicated by a dark line is
21 Monterey Bay in the lower third and San Francisco Bay. And
22 the course of the San Gregorio fault is shown as a dark line
23 extending across Monterey Bay and then joining the San Andreas
24 fault near Bolinas north of San Francisco.

25 Also on this map is another line which can be seen



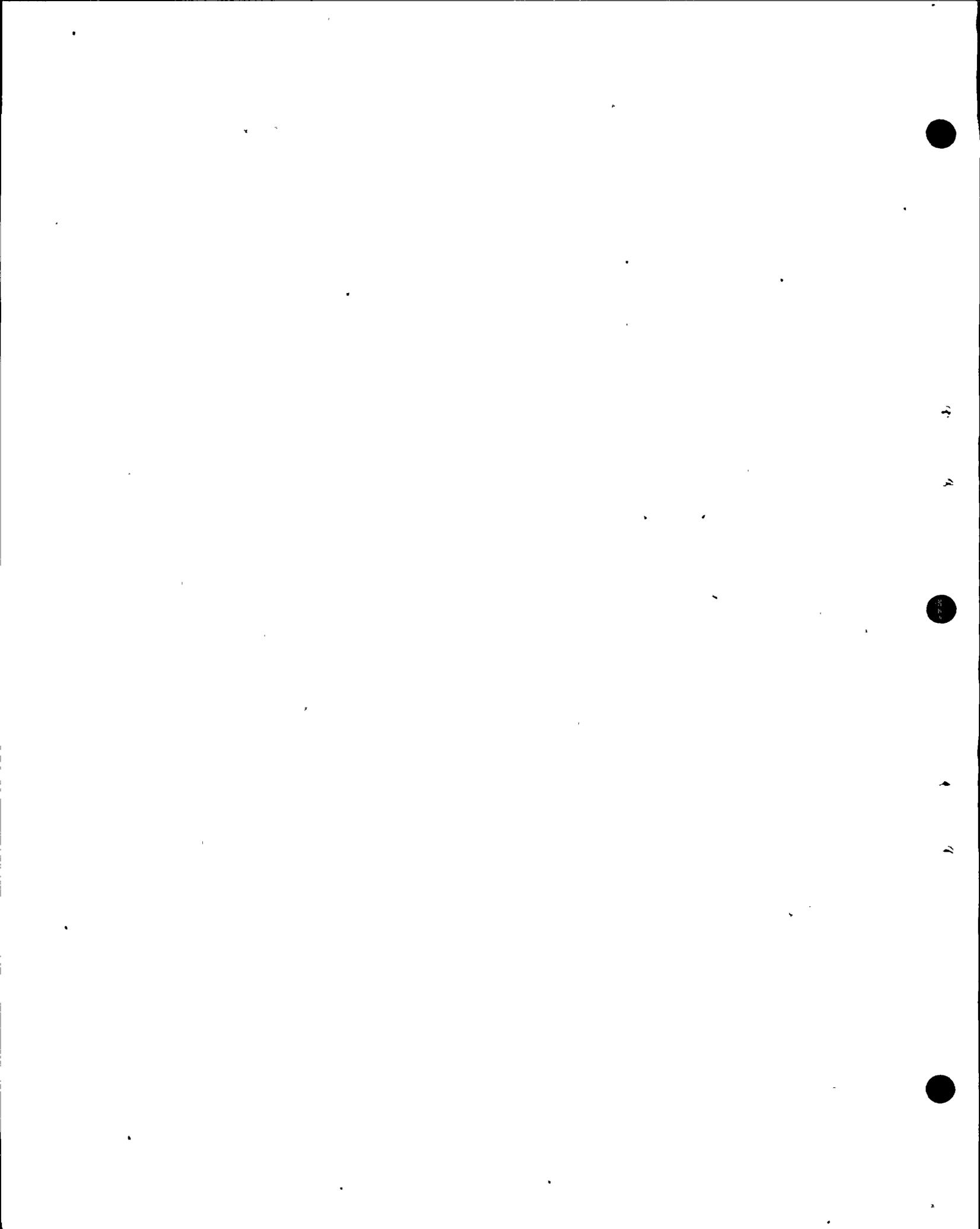
mpb4

1 extending from slightly west of the San Gregorio fault south
2 of Monterey Bay and continuing on in the ground offshore
3 from San Francisco bay, several kilometers distance, extending
4 well west of Point Reyes, and eventually heading back toward
5 the San Andreas fault north of Point Arena.

6 Now it's Dr. Green's theory, as expressed in his
7 open file report, that the evidence as he sees it does indi-
8 cate 110 kilometers of offset at submarine canyons along faults
9 in the Monterey Bay region. But I think it's of interest
10 to note that he accomplishes this first by assigning about
11 60 kilometers of offset of the rocks that are younger than
12 about ten million years age on the San Gregorio fault. So
13 he's now taking rocks -- or he's taking this canyon from
14 Monterey Bay and he's shifting it up to Ascencion Canyon --
15 which as I just finished explaining, I believe is not a valid
16 interpretation of the data.

17 Anyway, that's what he says. And that way he
18 gets about 50 kilometers of right offset of rocks that are
19 equivalent in age to the younger part of the group of rocks
20 that Dr. Graham would move from the Santa Cruz mountains to
21 Point Reyes.

22 But the other 40 or so kilometers of offset that
23 Dr. Green gets is accomplished by moving along the Ascencion
24 fault in a time prior to about ten million years ago. And
25 his evidence for that is to take is to take the distance from



mpb5 1 Ascencion Canyon which is about more or less opposite the
2 Ano Nuevo area and shifting that up to Pioneer Canyon which
3 is approximately opposite the Golden Gate. So that if Dr.
4 Green's theory were the one to apply, we could see that the
5 earlier episode of movement that is required to add up to his
6 total of 110 kilometers of proposed right offset would not
7 take the rocks that one sees in the Santa Cruz area anywhere
8 near Point Reyes. And these rocks would be presumably offset
9 along a fault now lying some 20 kilometers offshore and would
10 be carried well into the offshore region far west of Point
11 Reyes.

12 So there's really, except in the final number, very
13 little correspondence between the offset proposed by Dr. Green
14 and that proposed by Drs. Graham and Dickinson.

15 That's all I have on the Monterey Canyon point.

16 MR. HORTON: Mrs. Bowers, could we perhaps take a
17 five minute break or a ten minute break at this time? It's
18 ten o'clock.

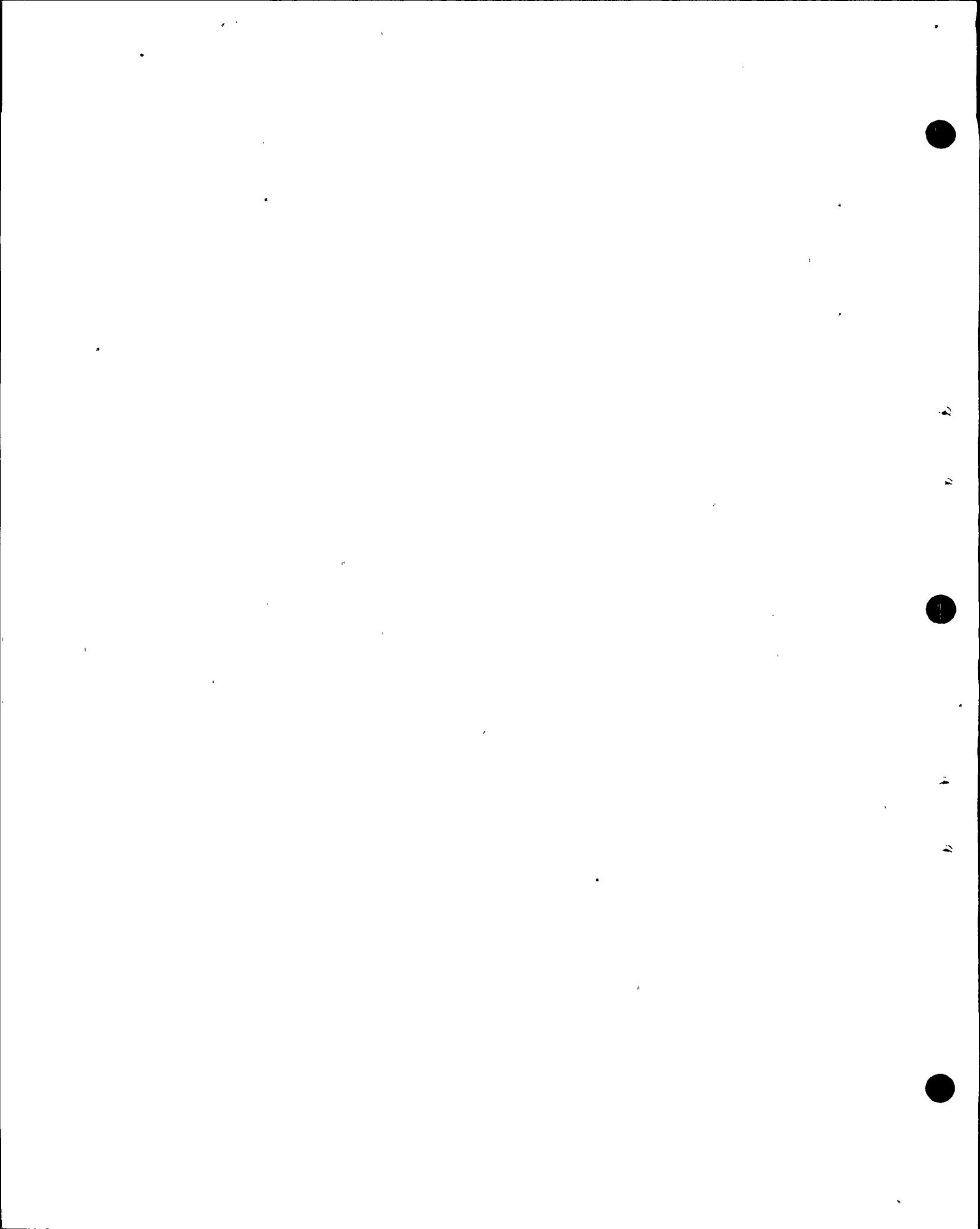
19 MRS. BOWERS: Fine.

20 (Recess.)

21 MRS. BOWERS: We'd like to begin.

22 (Slide.)

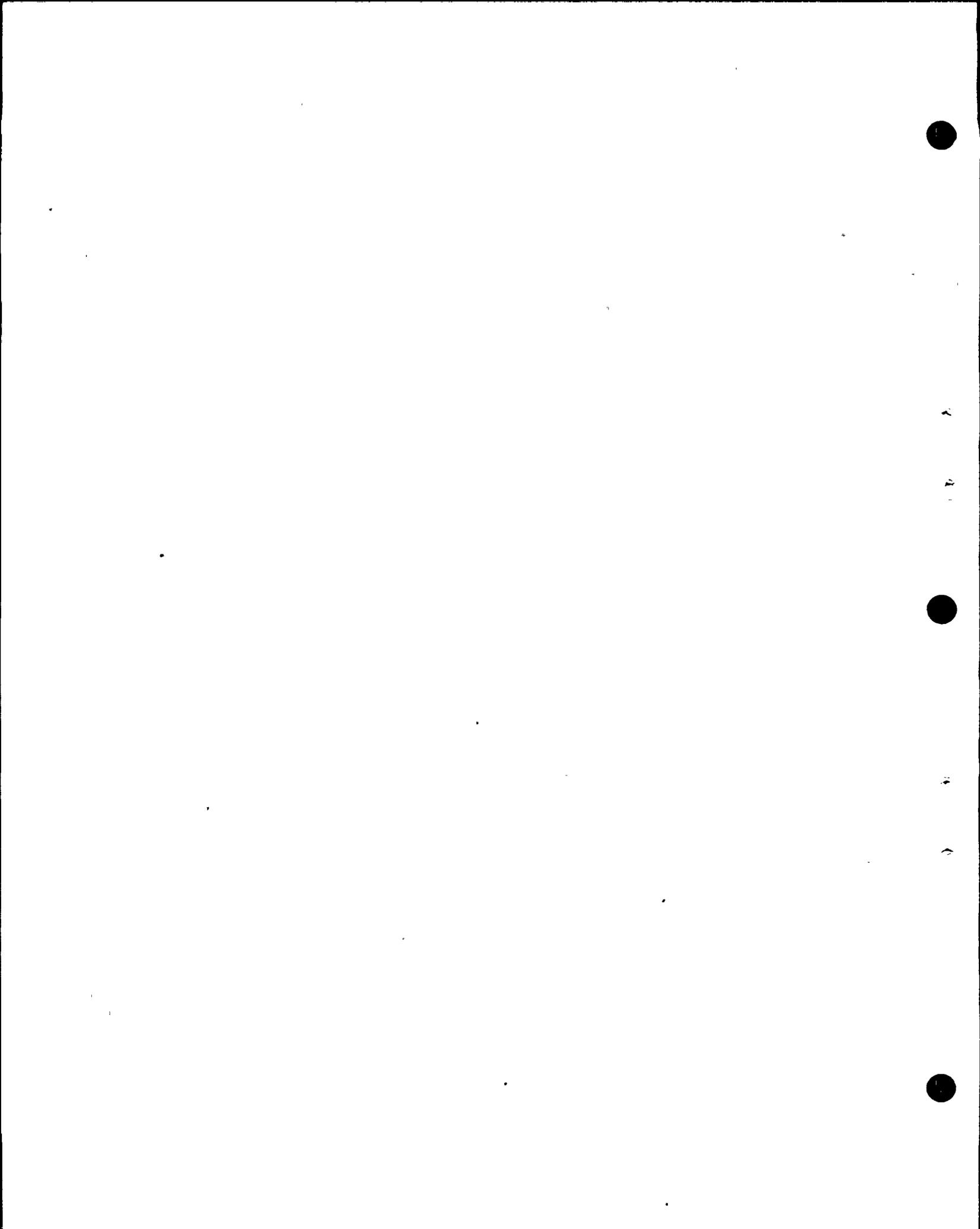
23 WITNESS HAMILTON: For the final one of the points
24 that Dr. Graham discussed in relating to the four points that
25 we had indicated we felt constrained, the amount of lateral



mpb6 1 slip that might have happened on the San Gregorio fault
2 during the Neogene time had to do with the geologic relation-
3 ships that can be seen at Hurricane Point in the Big Sur
4 area south of Monterey Bay and in the southeast corner of
5 this reference map.

6 In that area, if you'll recall, we found that a
7 distinctive upper Miocene breccia consisting of materials
8 derived from lithologically identical rock on the east side
9 of the Serra Hill fault which outcrops at Hurricane Point
10 was present. And we presented the opinion that we felt that
11 this was another constraining factor which limited the amount
12 of lateral slip that could take place along a fault that
13 would extend down the coast from the recognized San Gregorio
14 fault.

15 Now Dr. Graham's argument was that in fact there
16 are places along the San Andreas fault where one finds slivers
17 of rock that are at an intermediate point from a source
18 somewhere else, but that other kinds of evidence would show
19 that actually the total displacement along the fault was
20 greater than that that would exist at the east intermediate
21 point. And he suggested that while our point might be quite
22 an important one if these rocks really were in place west
23 of the Serra Hill fault at Point Sur, that maybe this is only
24 an area of a fault wedge similar to the point that he cited,
25 which was the quarry near Logan on the San Andreas fault.



mpb7

1 He mentioned that various people have mapped
2 faults in ground that lies west of the Serra Hill fault in
3 the Big Sur area.

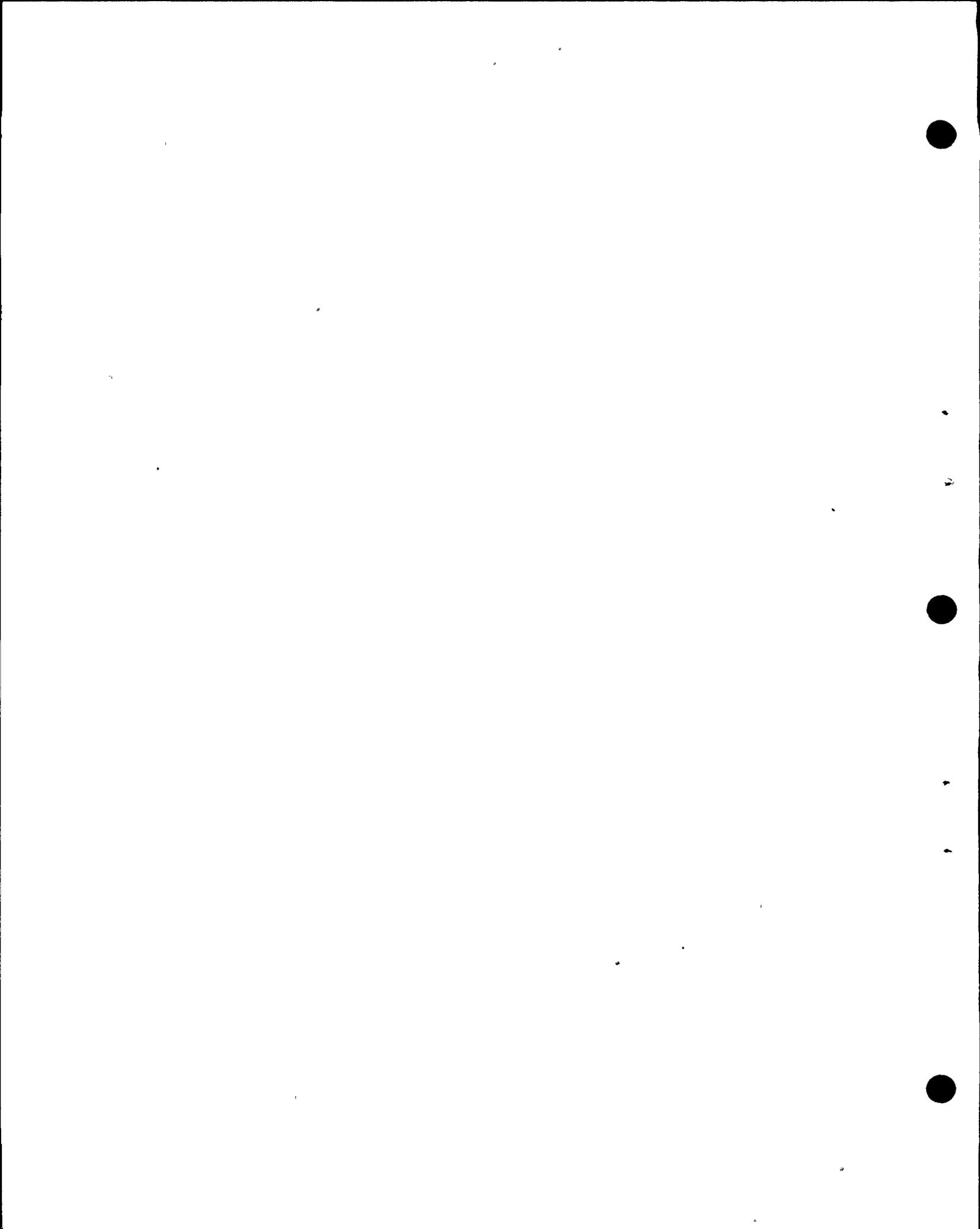
4 I'd just like to make two points about that:

5 One is that the Serra Hill fault is generally
6 recognized to be the main boundary between the crystalline
7 rock lying northeast of the Sur fault system in the Big Sur
8 area and the Franciscan rocks and some overlying sedimentary
9 rocks that lie southwest of the fault in that area.

10 The faults that are mapped west of the Serra Hill
11 fault all lie essentially within the Franciscan rocks. So
12 they don't seem to have the characteristics of area fault
13 slivers that would be within this fault zone, but rather they
14 are subsidiary faults within the general Franciscan terrain
15 that lies to the southwest of the Sur fault zone.

16 And one other point is that there's another
17 opinion which would suggest that that really is the main
18 trace of the fault, and that is an opinion expressed by Dr.
19 Eli Silver on page 1.2-4 of his written testimony. In that
20 Dr. Silver wrote that:

21 "Woodson in 1973 presents a bottom gravity
22 map offshore of the Point Sur area showing a
23 linear gravity gradient extending from offshore
24 Point Lobo southward to the area of Hurricane
25 Point. The main trace of the San Gregorio fault



mpb8

1 from the map of Buchanan, Banks and others
2 trends into this gradient at its northern end
3 southwest of Point Lobo. From this gravity
4 map the most likely course of the main fault
5 trace continues to the Hurricane Point area."

6 So we concur with Dr. Silver's opinion that this
7 is indeed the most likely course of the main trace of any
8 southward extension of the San Gregorio fault, and it is
9 into that area that we encounter this condition which I think
10 Dr. Graham agreed would represent a considerable constraint
11 to the amount of lateral movement that might occur in this
12 area because rocks from the crystalline terrain to the north-
13 east are present in the sedimentary terrain to the southwest.

14 BY MR. NORTON:

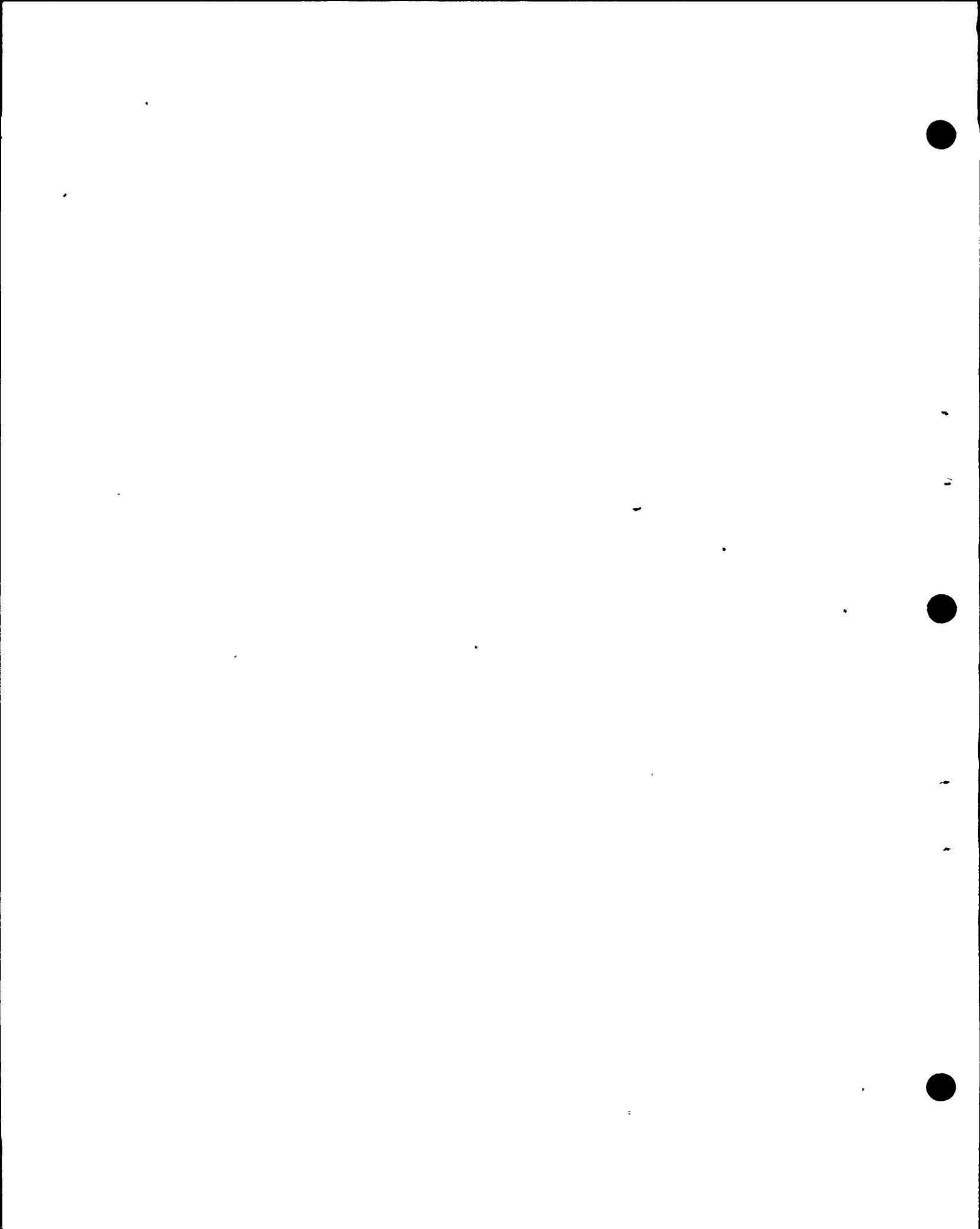
15 Q Mr. Hamilton, could you identify the figure that
16 you're been referring to and the portion of the figure on the
17 extreme lower right-hand corner?

18 A (Witness Hamilton) Yes.

19 I've been speaking about the area at the southeast
20 corner or the lower right-hand corner of the map identified
21 as near Point Sur in the image, and this is the figure that's
22 Joint Intervenors' Exhibit number 18.

23 Okay.

24 I would like now to just go on to comment on
25 some of the points that Dr. Graham has cited in support of his



mbb9 1 theory that 110 kilometers of lateral offset has taken place
2 on the San Gregorio fault.

3 " Could I have the next in the sequence of slides,
4 please?

5 (Slide.)

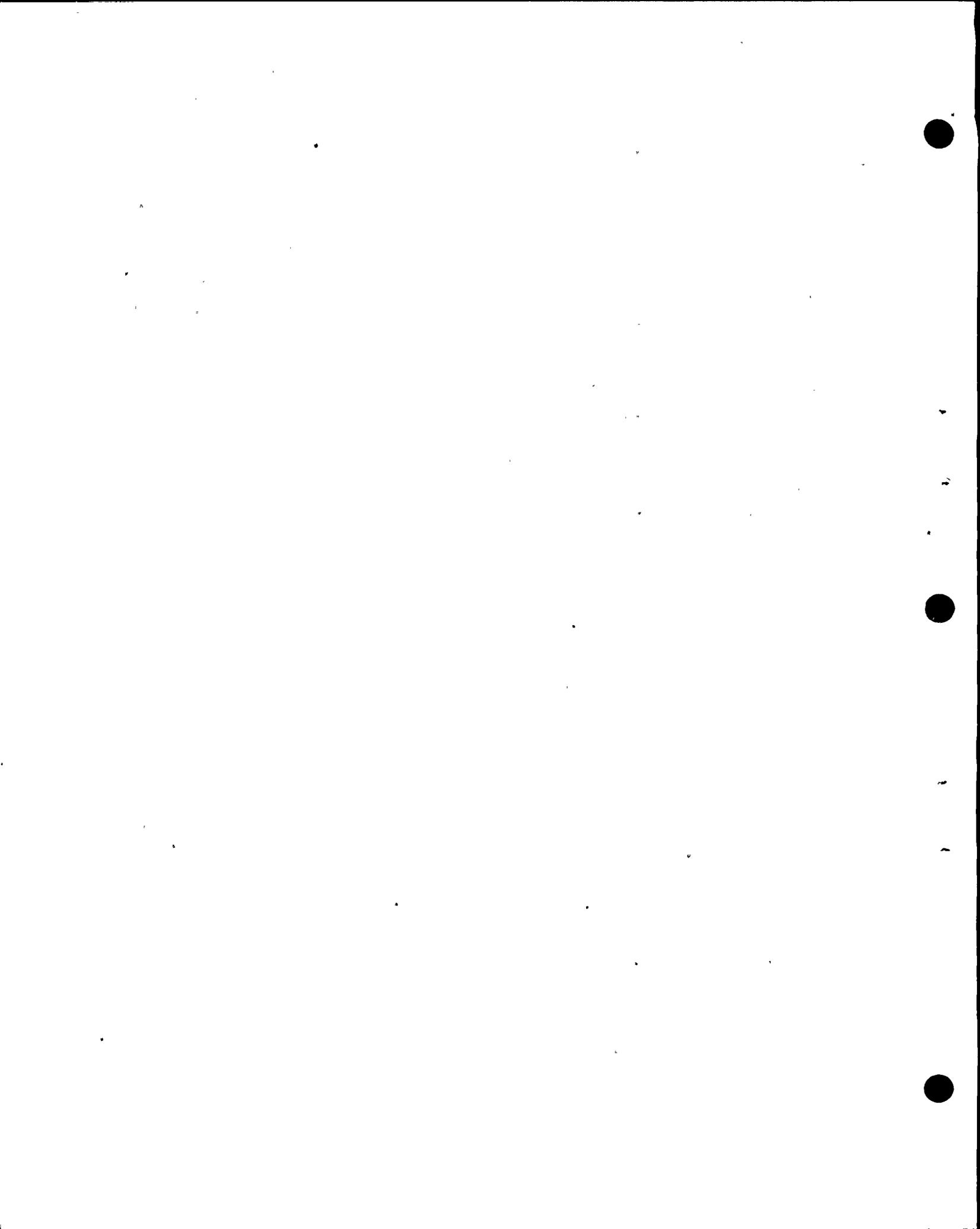
6 Q This next exhibit will be Applicant's Exhibit 51.

7 A This is a regional map which has a title on it
8 identifying it as "Maps Showing Magnetic Intensity and Major
9 Faults in the Coastal Region Between Point Arena and Pigeon
10 Point, California".

11 This map extends, as indicated in the title, from
12 Pigeon Point along the coast past San Francisco Bay, past
13 Point Reyes and Bodega Head, and on to Point Arena at the
14 upper-left northwest corner.

15 Shown on the map are the coastline, a series of
16 black lines which represent lines of equal magnetic intensity,
17 and red lines which indicate the location of the major faults,
18 including the San Andreas fault extending diagonally from
19 upper left to lower right across the map, the San Gregorio
20 fault, branching southward from the San Andreas near Bolinas,
21 and coming across onland near Pigeon Point, and the Pilarcitos
22 fault, shown as another set of lines running out to join the
23 San Gregorio fault offshore from the Golden Gate and running
24 back to the Santa Cruz Mountains there.

25 (Indicating.)



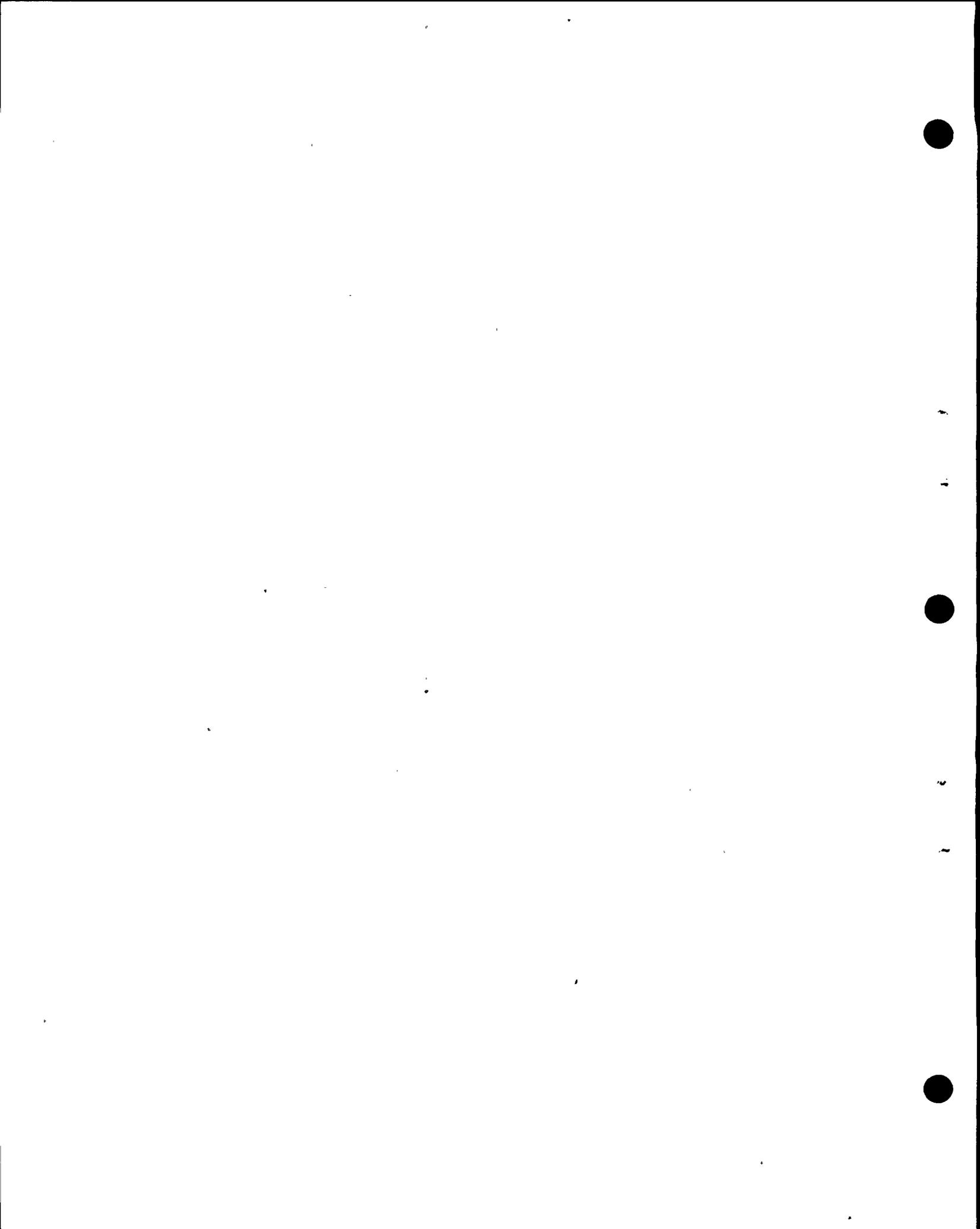
mpb10 1

2 During earlier testimony in response to cross-
3 examination I made the point that the Pilarcitos fault --
4 well, let me backup for a moment.

5 It's the first of Dr. Graham's points of correla-
6 tion of proposed offset features that that Pilarcitos fault
7 representing the boundary between Franciscan rocks to the
8 northeast and granitic rocks to the southwest is a very
9 unusual and very unique location of granitic rocks -- excuse
10 me, of Franciscan rocks lying southwest of the San Andreas
11 fault. And he proposes that this boundary corresponding to
12 that Pilarcitos fault has been offset to the area between
13 Bodega Head, where granitic rocks exist west of the San
14 Andreas fault and the region around north of Fort Ross where
15 a terrain including rocks are interpreted as possibly being
16 Franciscan near Black Point exists west of the San Andreas.

17 So the proposed offset would be from some region
18 where the Pilarcitos fault is west of San Francisco to
19 somewhere between Bodega Head and Fort Ross.

20 The point that we made in our earlier testimony
21 was that there is a distinctive magnetic pattern associated
22 with that Pilarcitos fault which has no corresponding appar-
23 ance in the area between Bodega Head and Fort Ross. And also
24 that the rocks that are identified as possibly of Franciscan
25 in the vicinity near Black Point are extremely magnetic in
character and no corresponding high of magnetic rocks like that

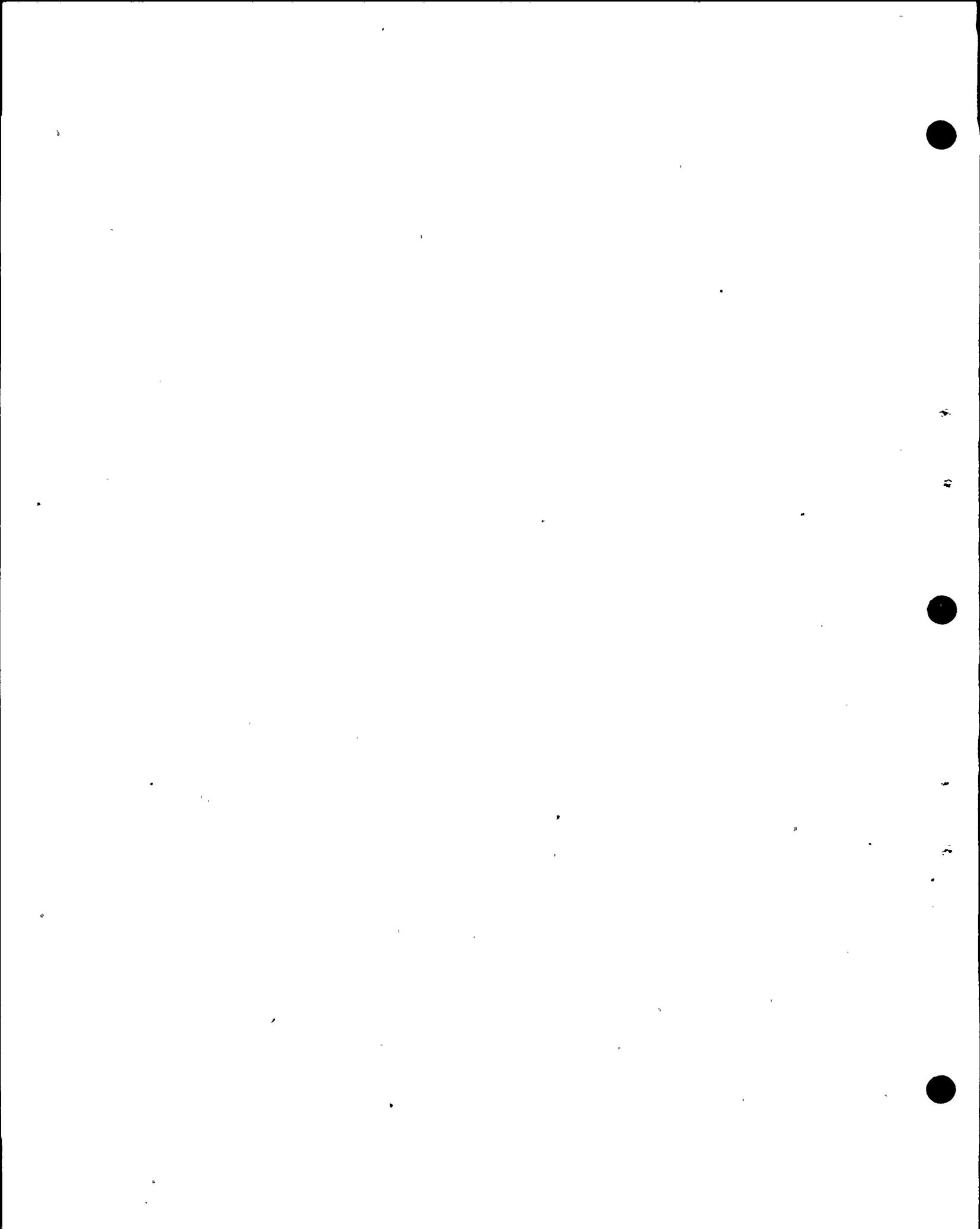


mpbll 1 exists over a wide area near the region of the Pilarcitos
2 fault.

3 Dr. Graham's points were that the Franciscan
4 rock is very diverse in its character. It's sometimes even
5 called a melange because of the fact that there are different
6 units mixed together, and that's quite true. However, in the
7 areas that we are looking at, the gravity signature essen-
8 tially tends to smooth out and average the properties of the
9 Franciscan rock over a rather wide area of occurrence. So
10 we're seeing a kind of an average character of the Franciscan
11 rock throughout the area across the Pilarcitos fault and
12 between that and the San Andreas fault.

13 When we go up to the area north of Fort Ross
14 we're seeing something that is very very distinctive magnet-
15 ically. It forms a bulls-eye, to use that term, of which
16 there is no real counterpart in this area here of much higher
17 magnetic intensity than anything in the rocks that purportedly
18 are offset from this region north of Fort Ross.

19 The other point that Dr. Graham made was that
20 in the mapping of Hoskins and Griffiths, that he felt that
21 they had shown a fault that existed somewhere in the area
22 west of Point Arena, and that he felt that that might repre-
23 sent the fault that he was looking for as corresponding to
24 the Pilarcitos fault in this area. In fact, I've spent a
25 fair amount of time working with other seismic reflection data



mpb12 1 in the area and in reviewing the Hoskins and Griffiths data,
2 so I'd like to show the Board what their map section looked
3 like.

4 Could we have the next two viewgraph slides now,
5 please?

6 MRS. BOWERS: Mr. Hamilton, I'm not sure that the
7 people in the back of the room can hear you if you don't use
8 the microphones.

9 WITNESS HAMILTON: Well, we'll experiment again.

10 MRS. BOWERS: Do you think the movable mike was
11 the problem?

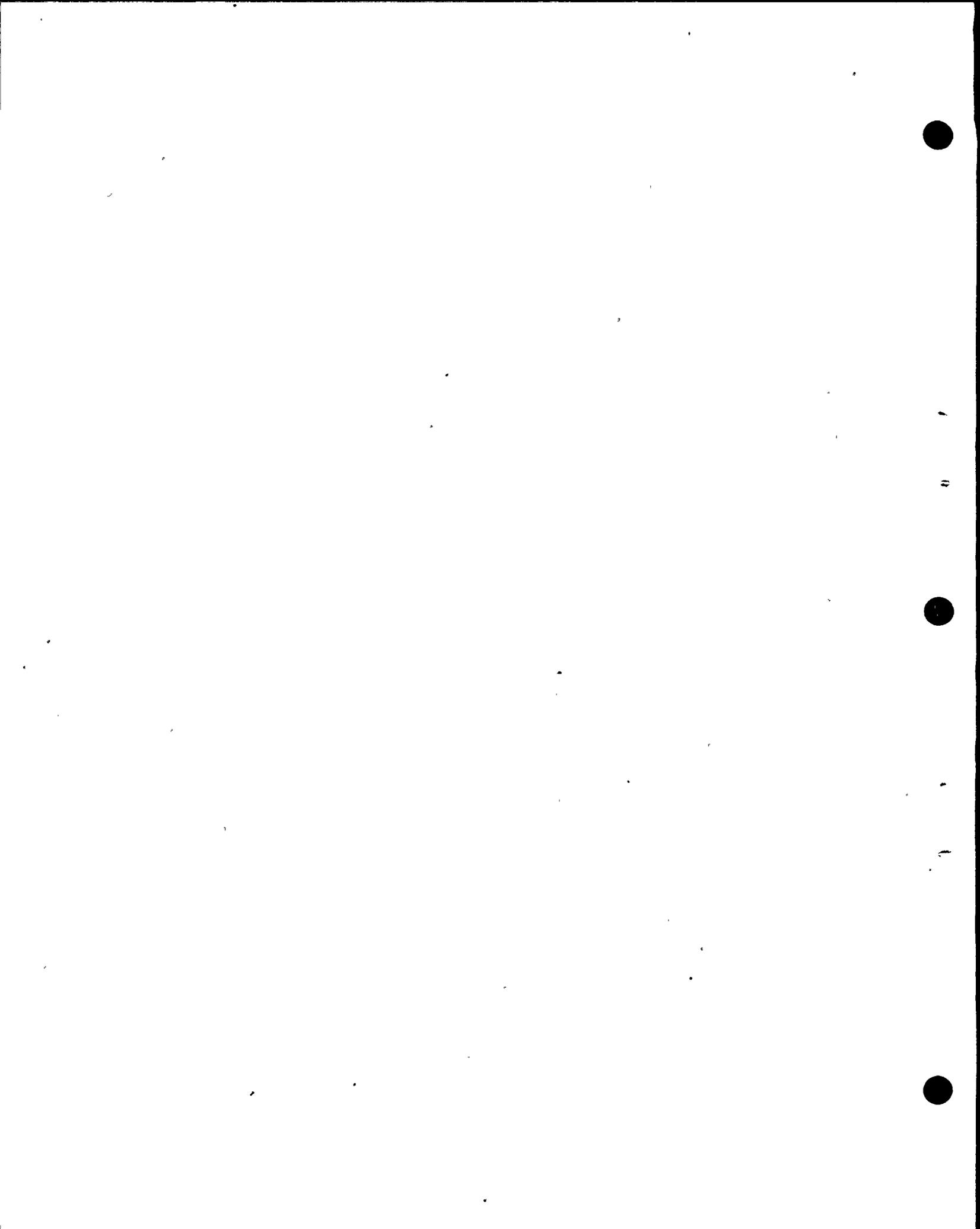
12 MR. NORTON: No, I think it was outside inter-
13 ference.

14 (Slide.)

15 MR. NORTON: This viewgraph is Applicant's Exhibit
16 52 and the next one will be 53.

17 WITNESS HAMILTON: The first of the two viewgraph
18 slides which I will now refer to are, I believe, the Hoskins
19 and Griffiths maps that Dr. Graham was speaking of. And these
20 are from the same paper by Hoskins and Griffiths, 1971, that
21 we've referenced earlier in this testimony.

22 The map in this case shows major faults, contours
23 on a unit described by Hoskins and Griffiths as the base of
24 the upper Miocene, and it also shows the shoreline. And in
25 this area the figure goes from the San Francisco region at the



mpb13 1

2 lower southeast corner of the map to Point Arena at the upper
3 northwest corner of the map. And the map shows the San Andreas
4 fault indicated as running from Point Arena down toward
5 San Francisco, and it shows the offshore region, and it shows
6 Point Reyes up in here and Bodega Head.

7 The location of the fault that Dr. Graham and
8 Dr. Dickinson would propose is offset from the Pilarcitos
9 fault located near San Francisco. It would be between
10 Bodega Head and a southerly part of the area south of the
11 San Andreas which would correspond to Fort Ross on the previous
12 slide.

13 And in that area in their diagram they show a
14 fault, dashed, extending out at an angle of about 30 to 40
15 degrees to the San Andreas, extending in the westnorthwesterly
16 direction. This is the actual map, of course, that Hoskins
17 and Griffiths published, and it's clear that they don't show
18 any fault in that area, nor do they show that the structural
19 grain, as indicated on the contours on the surfaces of the
20 sedimentary units there, have any orientation that would
21 correspond to a fault like that.

22 I believe that the faults that Dr. Graham is
23 referring to are two faults that are in fact located much
24 farther north parallel to the coastline and near Point Arena.
25 These faults can be seen to not extend in the offshore region
or at least not be mapped in the offshore region farther south,



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mpbl4 1 down toward the region where this presumed offset of the
2 Pilarcitos should be located. They in fact don't even extend
3 as far south as the rocks that are correlated with the
4 Franciscan, which gives rise to the very high magnetic
5 signature in the last slide.

6 So you can see that the map that is prepared by
7 Hoskins and Griffiths in fact does not really provide any
8 support that I can see for any inference that a corresponding
9 fault to the Pilarcitos fault should lie in this area north
10 of Bodega Head.

11 Q Could we have the next slide?

12 (Slide.)

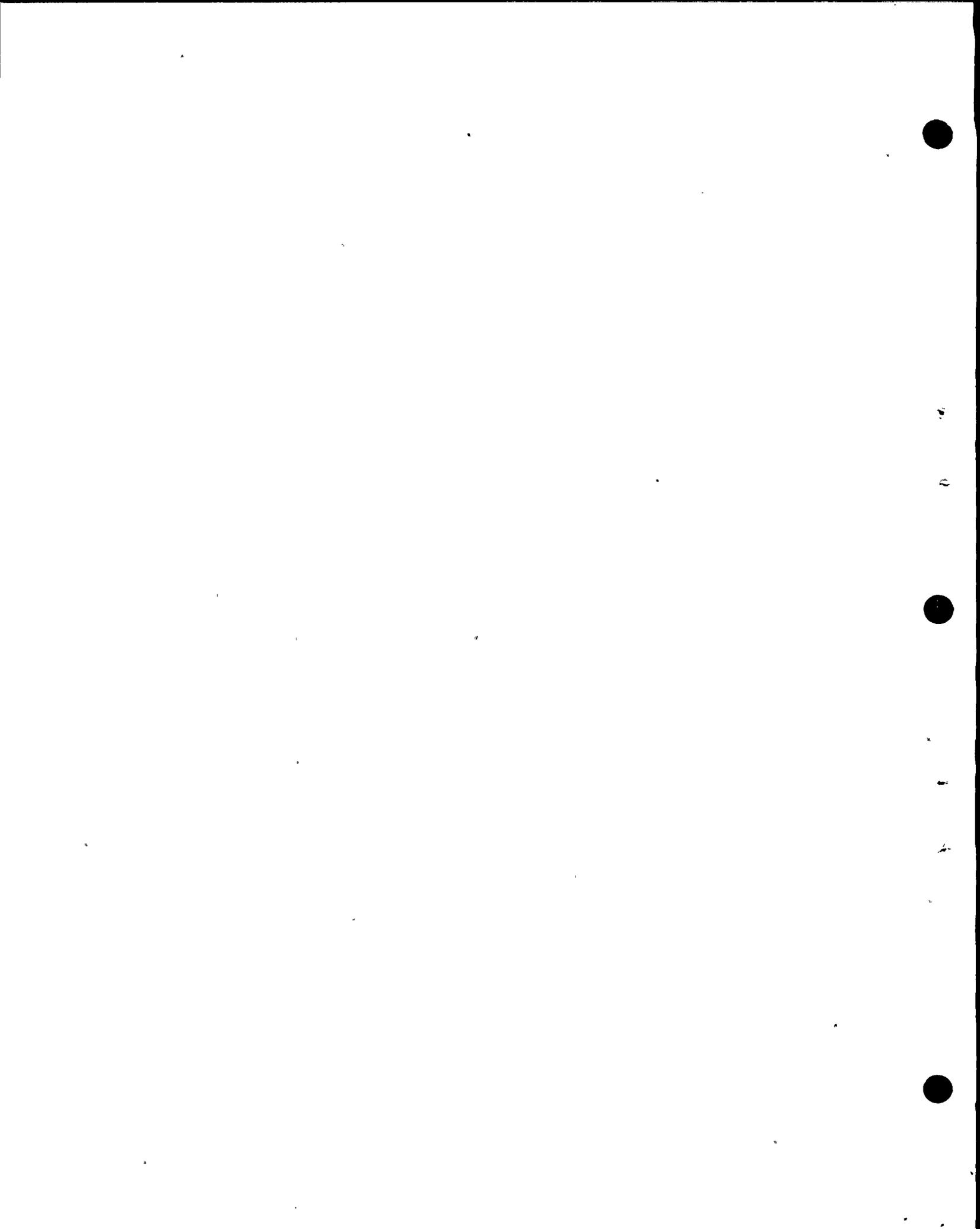
13 Q Excuse me, Dr. Hamilton.

14 Before you move on, can you give any indication
15 of the distance between the faults up at Point Arena that
16 are mapped by Hoskins and Griffiths and where the Pilarcitos
17 fault is, can you give us a distance?

18 (Slide.)

19 A Well, the Pilarcitos fault doesn't actually show
20 on here. But if we presume that 110 kilometers is the
21 distance from the Pilarcitos to the region between Bodega
22 Head and Fort Ross, judging by the scale on this map here,
23 it looks like that we're about 50 kilometers farther north
24 to the most southerly end of the fault mapped farther north.

25 Q So that it would have to be about 165 or thereabouts



mpbl5 1 kilometers of offset if that were indeed the Pilarcitos
2 offset?

3 A If one used the faults as mapped by Hoskins and
4 Griffiths as shown on the map, yes.

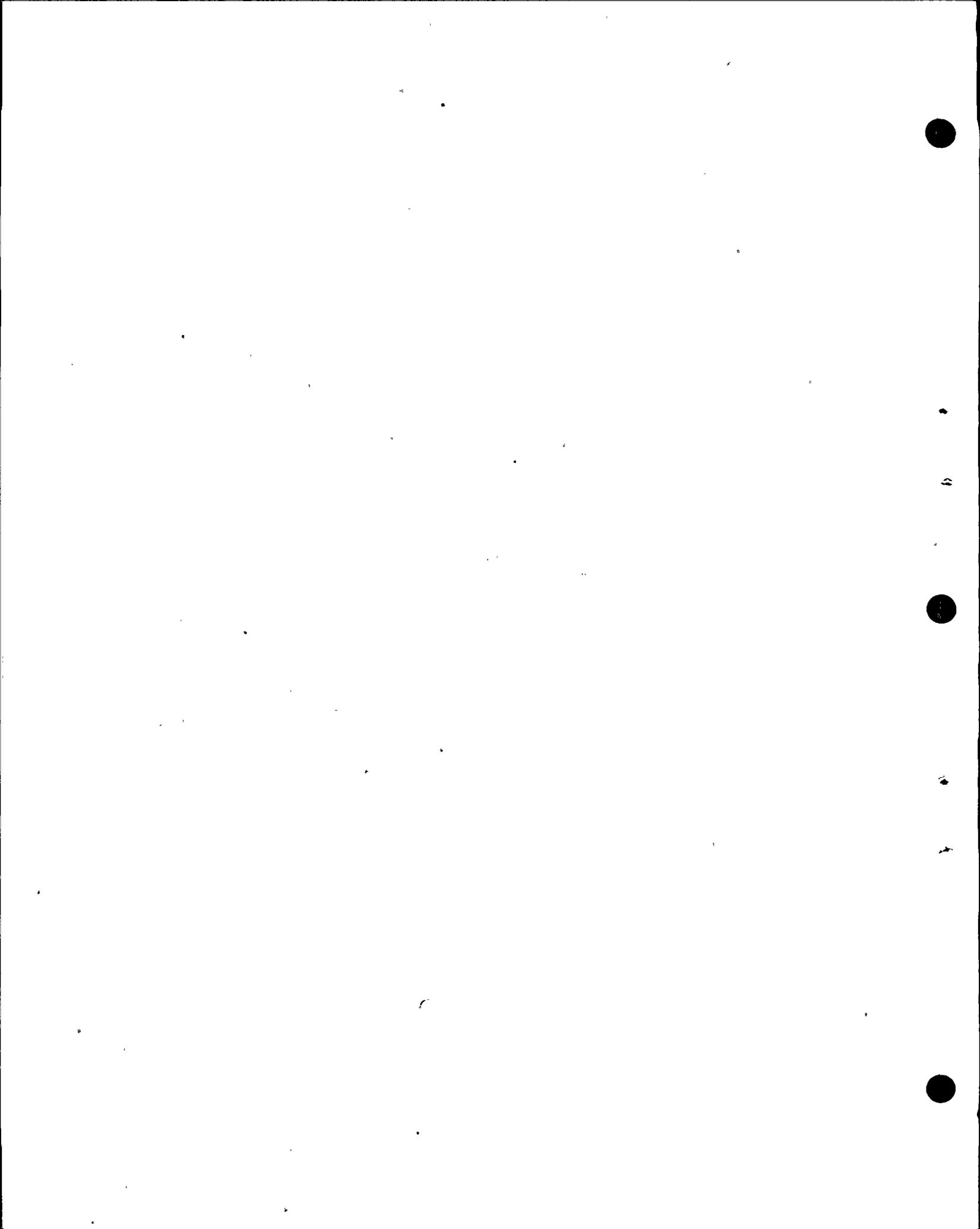
5 Q All right.

6 (Slide.)

7 A The next slide is simply a continuation of the
8 Hoskins and Griffiths series of maps that run northerly
9 along the coast. And this map goes from the area of roughly
10 around Black Point on the coast west of the San Andreas fault
11 up to Punta Gozda just south of Cape Mendicino. And the same
12 two faults that were shown on the previous map are now shown
13 on the overlapping here as the faults lying southwest of the
14 area identified as Point Arena on the map. And it can be
15 seen, in fact, these faults are either cut off or die out
16 within the area of mapping that was done farther to the north.

17 And supplemental to that, I have reviewed a very
18 detailed collection of surveys that were done in the area
19 around Point Arena in which we were trying to work out the
20 offshore geological structure in this region. And we find
21 that the fault that is closest to shore as mapped by
22 Hoskins and Griffiths, it does indeed exist. But it can't
23 really be traced in the offshore much beyond where they show
24 the fault to be mapped.

25 So I think that there is really no geologic basis



mpb18

1 for drawing any kind of conclusion that would relate the two
2 faults shown by Hoskins and Griffiths to a presumed analogue
3 of the Pilarcitos fault.

4 That's really all I have on that point.

5 (Slide.)

6 Okay.

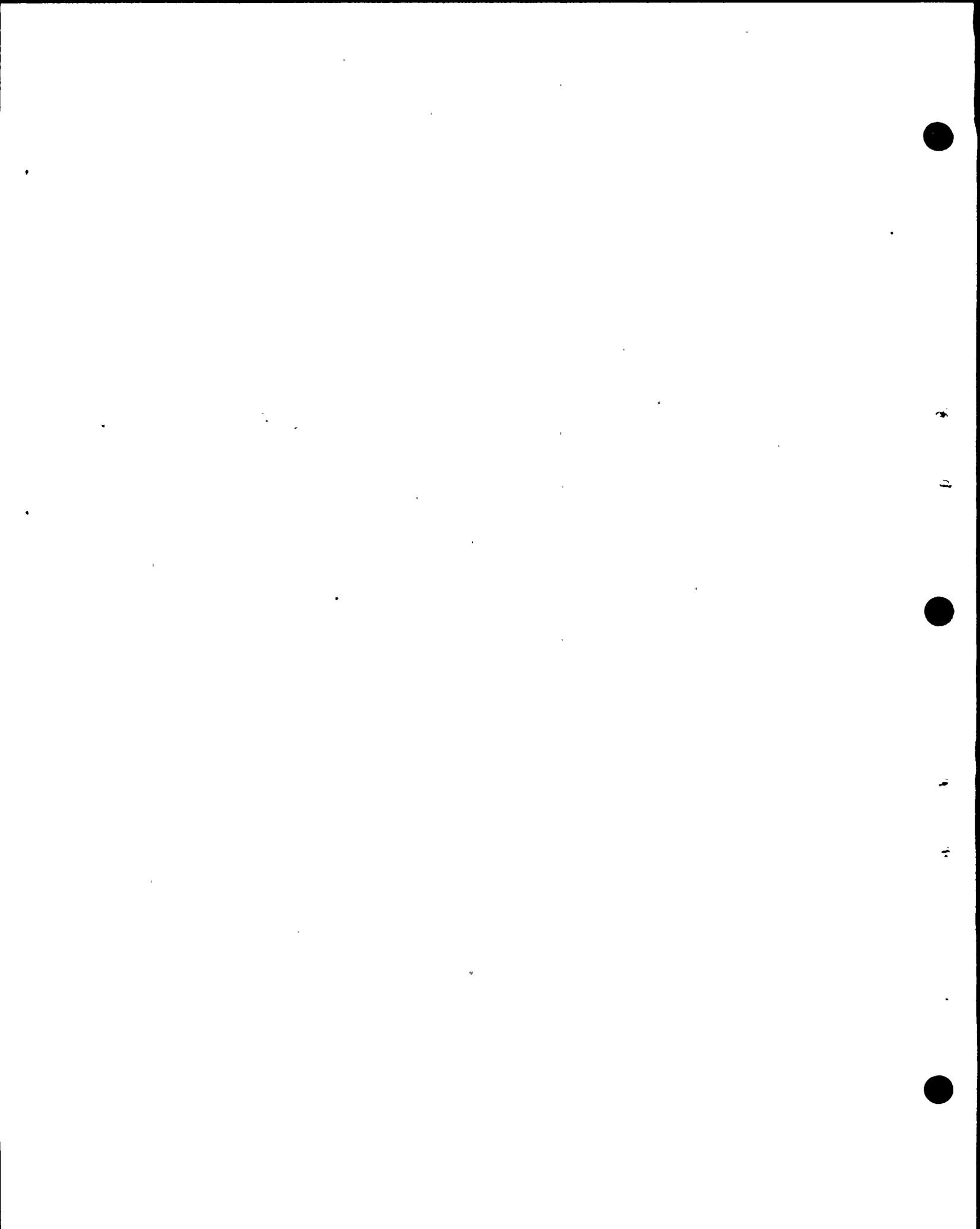
7 The next point that Dr. Graham referred to had to
8 do with the distribution of rocks of upper Miocene down through
9 Pliocene age in areas including the Santa Cruz Mountains east
10 of the San Gregorio fault and Point Reyes west of the San
11 Andreas fault about 110 kilometers farther north. And he
12 made the point that, I believe as he phrased it, that he
13 agrees that the rocks were widespread as we have pointed out
14 in testimony in December, but that rather it was the packag-
15 ing that was the feature which in his mind was significant
16 in correlating these rocks in the Santa Cruz Mountains with
17 rocks in the Point Reyes area.

18 Let me back off for a moment to identify this
19 next slide figure.

20 This is a map --

21 Q Exhibit 54.

22 A Exhibit 54 which shows the distribution of upper
23 Miocene and Lower Pliocene Sedimentary Rocks, Coastal North
24 Central California region. And this shows the area from
25 Pigeon Point right along the coast nearly to Cape Mendocino.

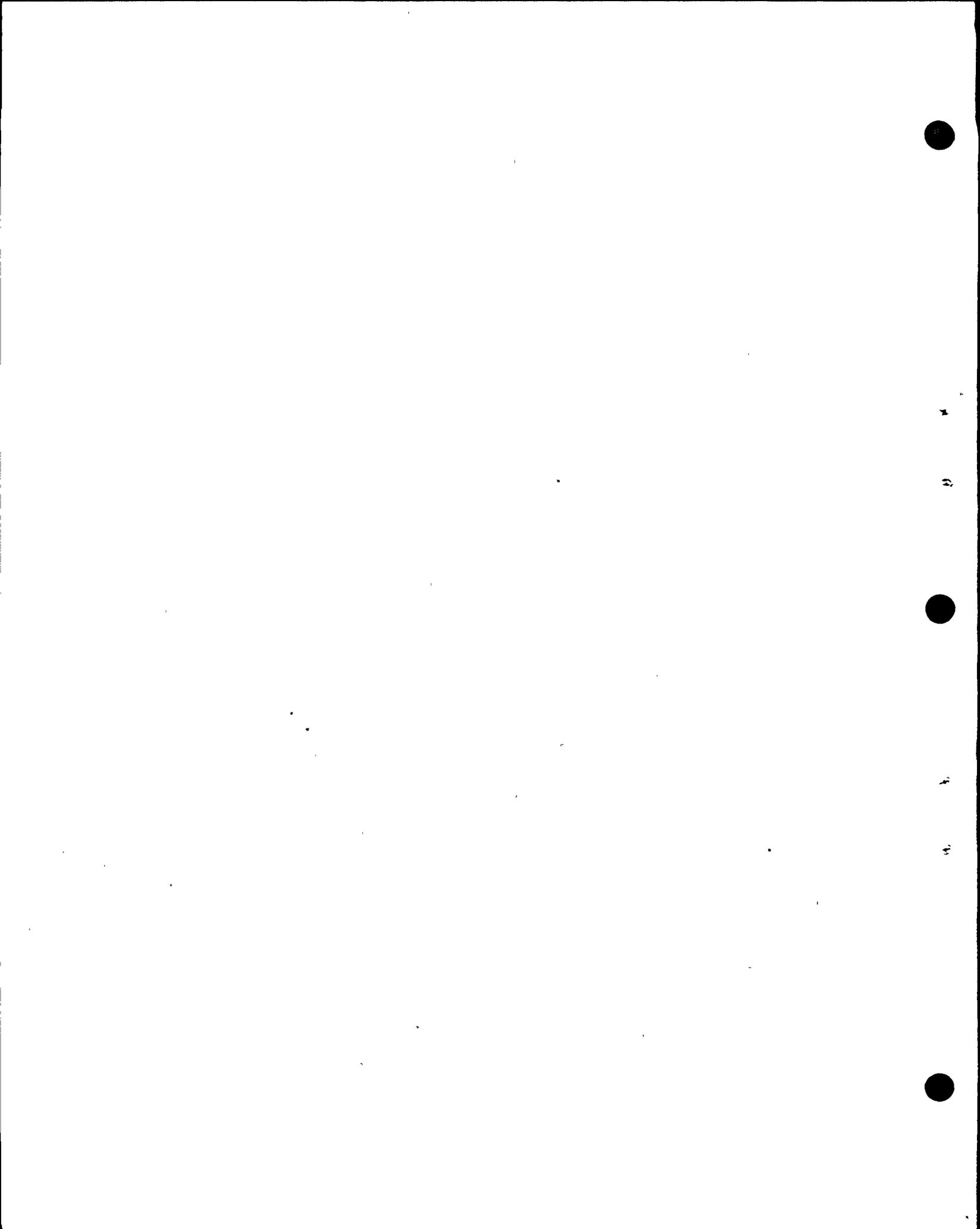


mpb17 1 It includes the onshore Santa Cruz Mountains area, San
2 Francisco Bay, Point Reyes, Bodega Head, and Point Arena
3 as identified points, and shows the San Andreas fault as a
4 continuous and dashed line extending nearly north-south up
5 and down the axis of the drawing.

6 The area colored in a solid green pattern here
7 is the area where upper Miocene and Pliocene rocks which
8 correspond to the uppermost of the units that Drs. Graham
9 and Dickinson are proposing are offset from the Santa Cruz
10 Mountain area to the Point Reyes area, and his map and
11 succeeding maps that I'll try to quickly go through simply
12 are to give you an indication of just how widespread these
13 units are.

14 They exist in some onshore regions east of
15 Monterey Bay in the Santa Cruz Mountains area and in the
16 Point Reyes area and in the offshore they exist throughout
17 much of the region of Monterey Bay on both sides of the
18 San Gregorio fault, and in a wide and more continuous band
19 in the offshore region going for a distance of several hundred
20 kilometers from well south of this map area and even well
21 up to beyond the Cape Mendocino region.

22 Now this gives you an idea of how widespread these
23 units, which are usually correlated from one region to another
24 region, which both happen to be on land, are. And you can
25 see that your proposed possibilities of correlation range



mpb18 1 From 100 kilometers, also left slip, to several hundred
2 kilometers right slip using this particular unit.

3 Next slide, please.

4 (Slide.)

5 Q This is Applicant's Exhibit 55.

6 A The slide now being shown is identified as
7 Distribution of Middle Miocene Sedimentary Rocks, Coastal,
8 North Central California. And this is the second of the
9 package of units being proposed as correlative as between
10 the Santa Cruz Mountain area and the Point Reyes area.

11 And here again we see that all of these rocks
12 are -- some occur on land. In fact, the areas being correlat-
13 ed, as shown, is quite a small one, with a fairly small
14 area of outcrop at Point Reyes, that the rocks in question
15 really are extremely widespread. And they are located, for
16 example, at all of the offshore drill holes that exist in
17 the outer Santa Cruz basin and the outer Bodega Basin.

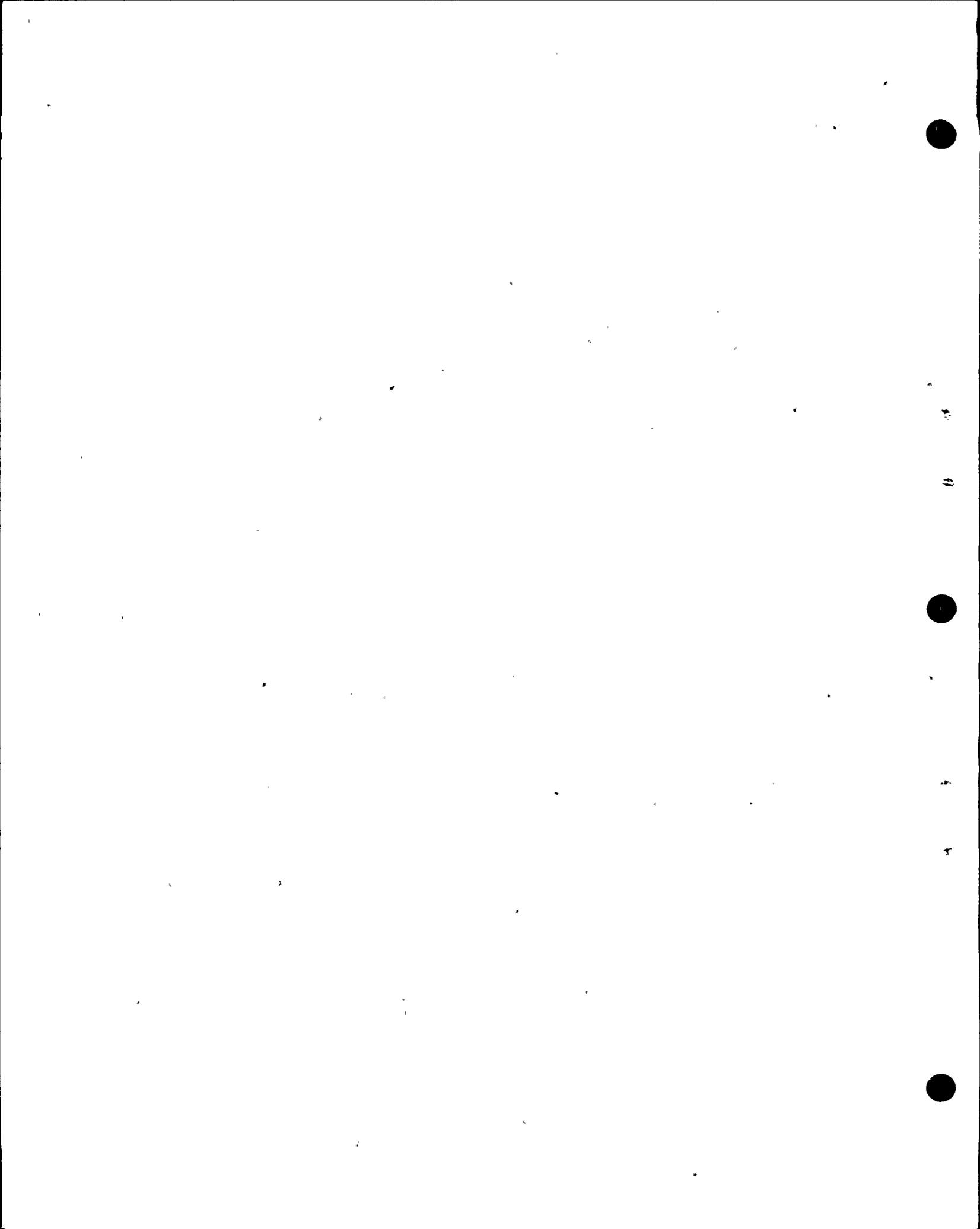
18 Once again we would propose that either this
19 unit lies south, or this unit in combination with the one
20 shown in the previous slide are not acceptable bases for
21 comparing offsets between one region and another region.

22 Next slide, please?

23 (Slide.)

24 Q This is Applicant's Exhibit 56.

25 A The slide now being shown is identified as



mpb19 1 Distribution of Oligocene - Lower Miocene Volcanic Rocks,
2 Coastal North-Central California.

3 And this is presenting information that was also
4 presented on Joint Intervenors' Exhibit number 18, the first
5 slide I started out with this morning. And this shows both
6 outcrop areas and areas indicated by drill holes in the
7 subsurface of the volcanic rocks of Oligocene and lower
8 Miocene age in the region between the San Andreas and the
9 San Gregorio fault in the offshore region farther north.

10 And we can see that these rocks exist in a fairly
11 limited area in the Santa Cruz Mountains. They exist at the
12 bottom of the basin that has been testified to, drill holes
13 in the region immediately west of the San Gregorio area
14 offshore, and they are absent in the series of drill holes
15 that exist around Point Reyes that are also absent in out-
16 crops there.

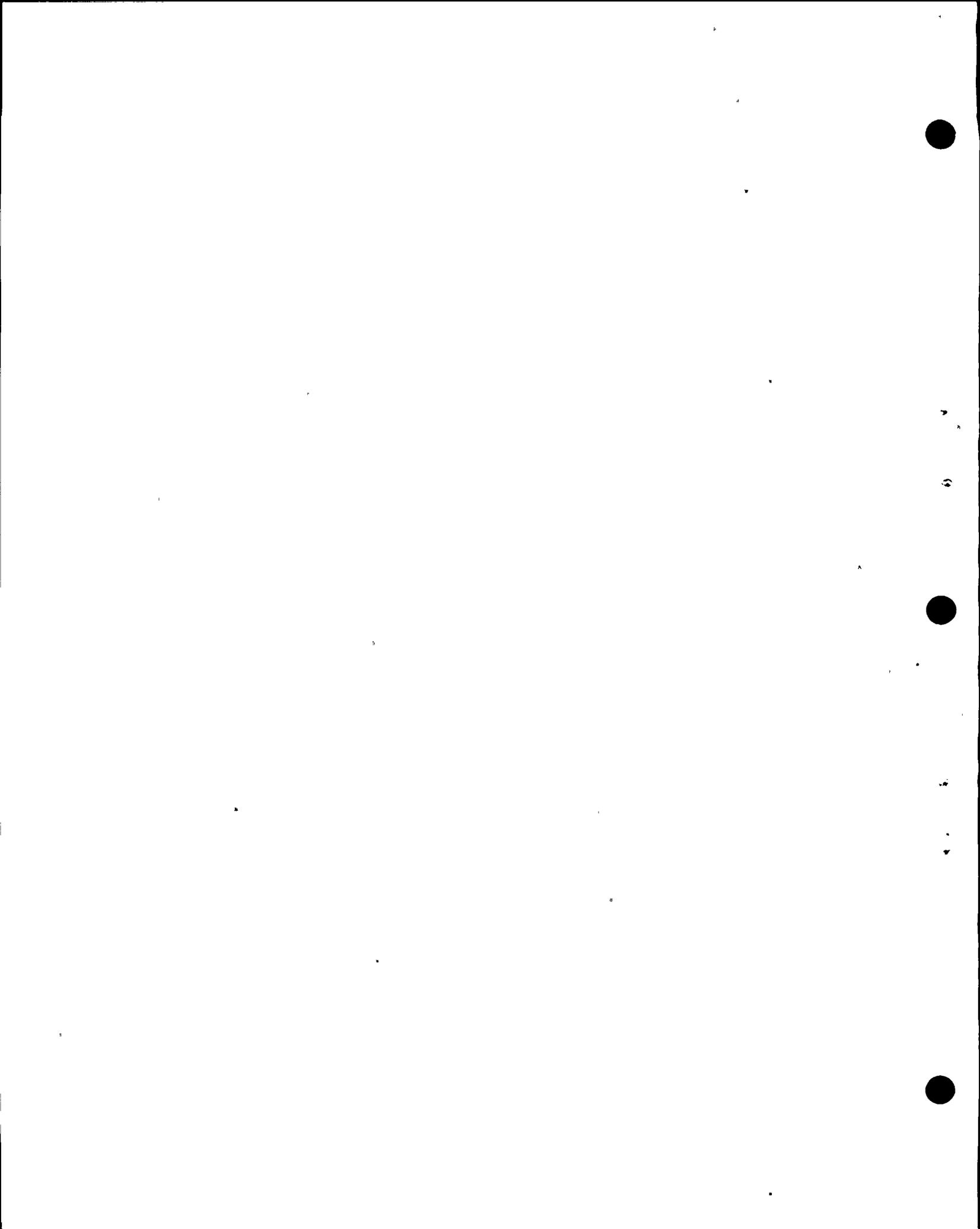
17 Next slide, please.

18 (Slide.)

19 Q This is Applicant's Exhibit 57.

20 A This is the last slide in this series, identified
21 as Distribution of Paleocene Sedimentary Rocks, Coastal
22 North Central California.

23 This is the lower-most units in the package of
24 rocks that are proposed as correlative between the Santa Cruz
25 Mountains and the Point Reyes area. It covers the same area

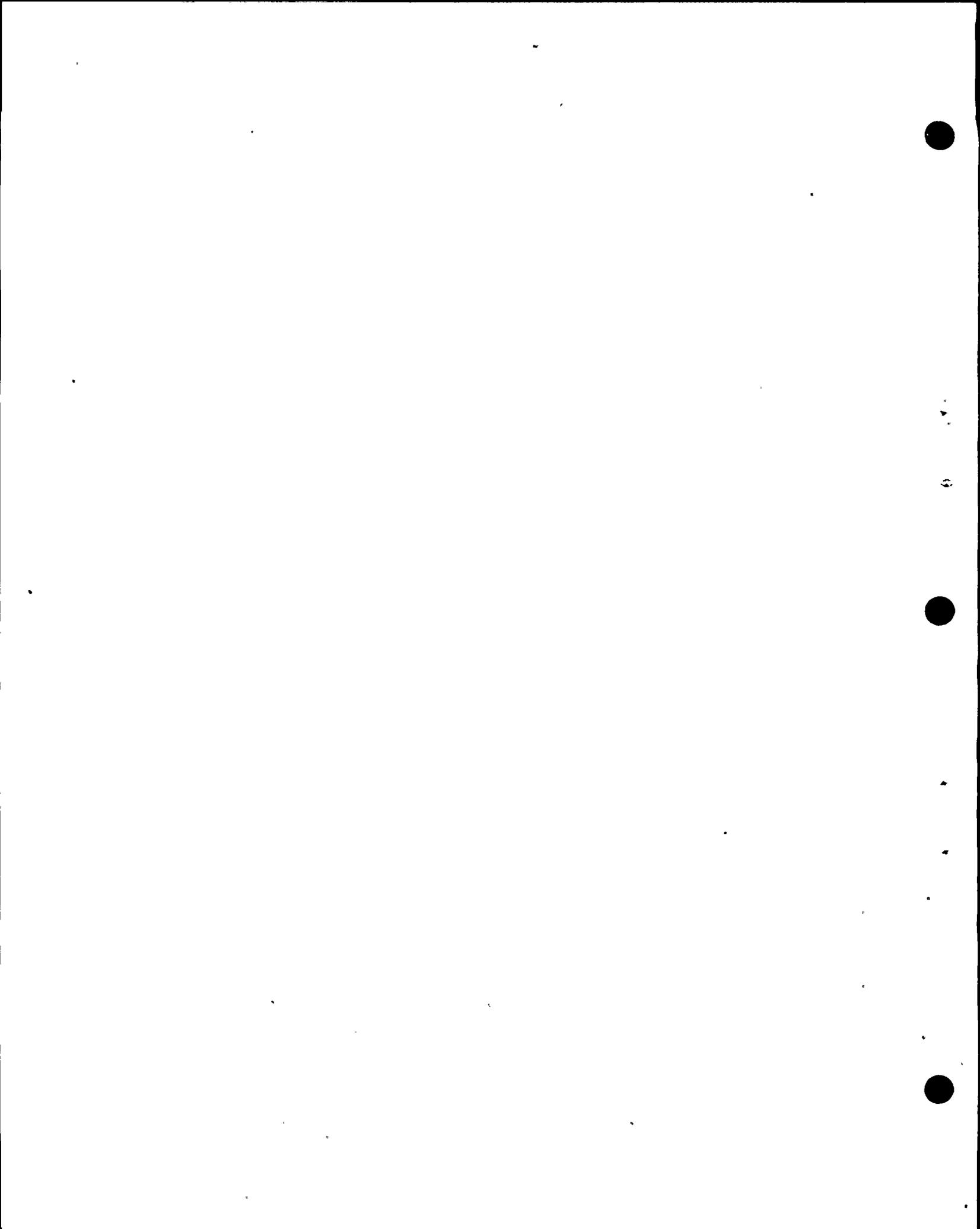


mpb20 1 as the preceding set of maps. And on it you can view the
2 Paleocene rocks identified as the solid dark blue color are
3 much more limited in their present distribution. They are
4 older and are subject to erosion. There is a wedge of them
5 that lie in the San Francisco peninsula.

6 There are scattered outcrops which I believe are
7 generally in the same place as the outcrops of the Miocene
8 and upper Miocene rocks in the Santa Cruz Mountains area.
9 There's a little patch of them down south of Monterey. There
10 is a patch out at Point Reyes, and quite a widespread area
11 that exists in the basin between Fort Ross and somewhere south
12 of Point Arena.

13 So once again, these rocks are fairly widespread.
14 It's of interest that the rocks that look most like those at
15 Point Reyes are actually the ones that are down in the area
16 of Point Lobo there, and the ones that are up in the Gualala
17 area are those which are correlated with the Eagle Rest Peak
18 source train across the San Andreas fault, as giving evidence
19 for the large post-Cretaceous slip on the San Andreas.

20 But again, these rocks occur at a number of
21 different places, and seem to not define a particularly
22 unique set of occurrences in just the two places cited as
23 offset for one another.
24
25



1 (Slide)

2 B/wol
3 fls Madelon

4 The last point that I'm going to address has
5 to do with one of the points of the proposed series of
6 correlative offset features. And to address that point I
7 have a slide.

8 MR. NORTON: Applicant's Exhibit 58.

9 BY MR. NORTON:

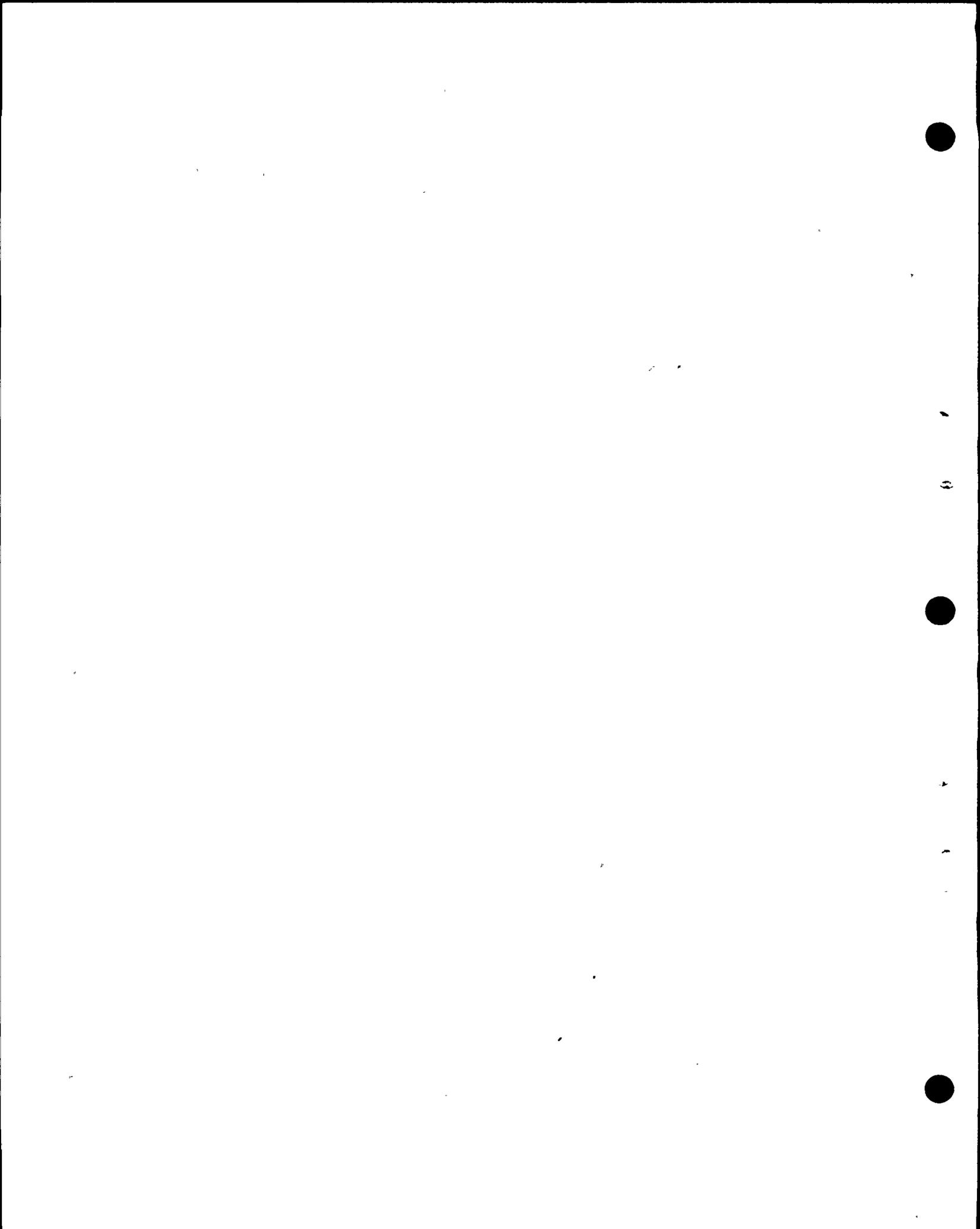
10 Q Please go on.

11 A (Witness Hamilton) It's identified as
12 "Content of Potassium Feldspar in Franciscan and other
13 Mesozoic Sandstones, Coastal Central California."

14 This map is derived from a professional paper
15 publication by, I believe, Bailey, Irwin and Jones. It
16 covers a widespread region along the coast from Point
17 Conception up to Point Arena, Point Conception to the lower
18 right and Point Arena at the upper left.

19 It shows a series of faults along the coast,
20 including the San Gregorio. It shows the San Andreas
21 fault extending diagonally across the map. And it shows
22 areas that are identified as Franciscan terrane by Bailey,
23 Irwin and Jones.

24 There are numerous dots indicated on this map,
25 and the dots are shown in the key as being of three dif-
ferent colors, which are black, blue and red. That may be
difficult to see, but I hope it will show up better on the



1 xerox copies of this slide that we passed out.

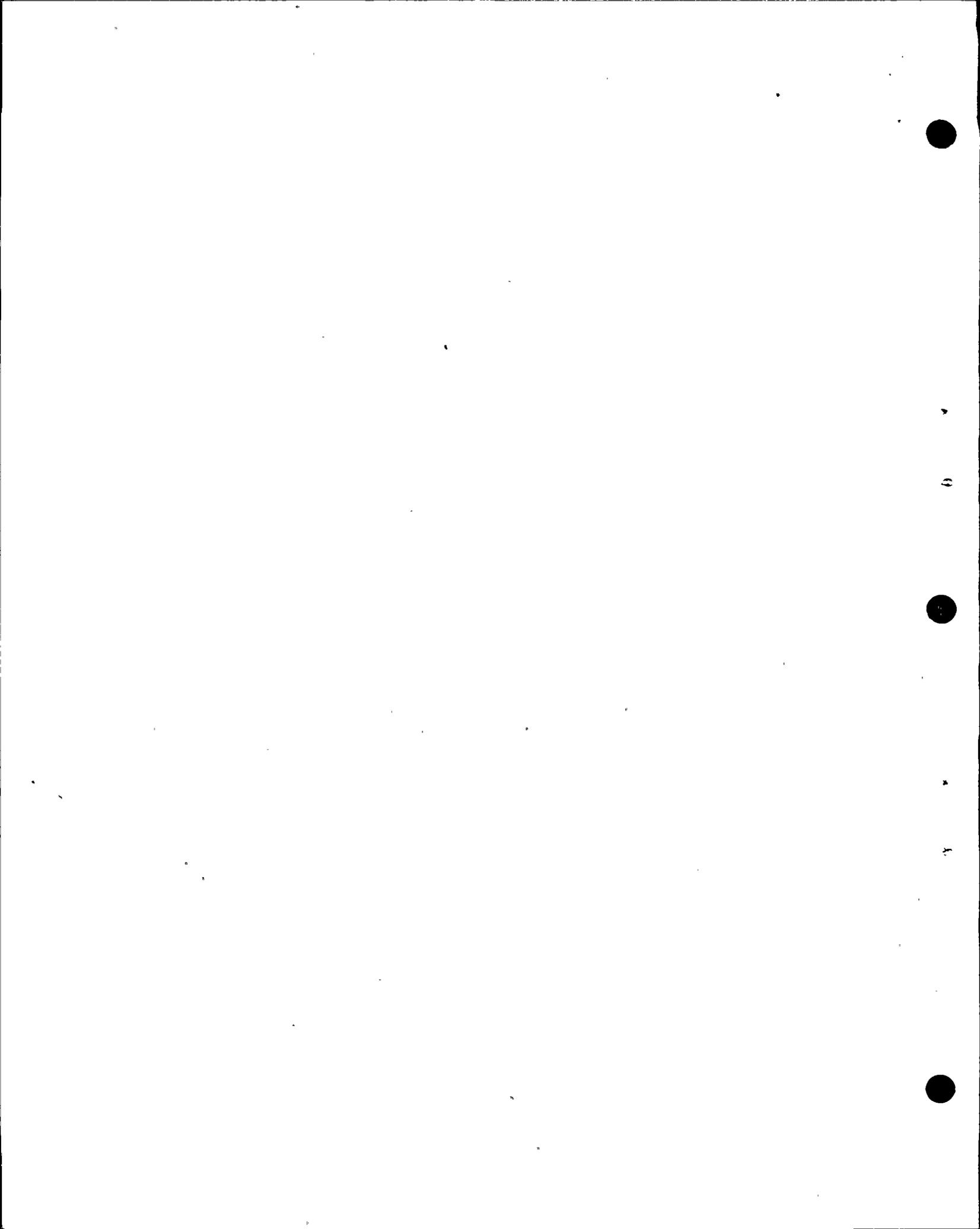
2 What the slide shows is that-- Well, let me
3 back off to say that what is claimed is that rocks in the
4 Point Sur region--

5 Q Excuse me, Mr. Hamilton. What is claimed by
6 whom?

7 A One of the points used as evidence for large
8 offset of the San Gregorio fault is that, as claimed by
9 Drs. Graham and Dickinson, is that sandstone rocks in the
10 Point Sur region have a relatively high content of potash
11 feldspar, and that rocks in the Franciscan terrane east of
12 the fault do not in general show that high content of
13 potash feldspar, but that rocks in the Cambria region
14 located farther southeast just north of Estero Bay also
15 have a high content of potash feldspar.

16 This map presents the published results of a
17 great many samplings of the potash feldspar content of
18 rocks that are either identified as Franciscan or rocks
19 of about the same age. So this shows that indeed there
20 are red dots in the Point Sur area corresponding to the
21 position taken by Drs. Graham and Dickinson.

22 However it shows that, while there are a good
23 many blue dots showing lower potash feldspar content, there
24 are some red ones, including some fairly close to and east
25 of the course of a presumed fault trace extending southward



1 from Point Sur. There are a good many red dots at inter-
2 mediate points near Point Lopez and Cape San Martin. And
3 finally there certainly are red dots in the area around
4 Cambria.

5 There are two points to be made from this: One
6 is that the rocks at Point Sur are not uniquely correlative
7 on the basis of potash feldspar with rocks in the Cambria
8 region, but, rather, they could equally well be correlative
9 with rocks at many intermediate points lying east of a
10 presumed fault path extending between the two regions.

11 The second point is one that is made in the
12 recent Open File Report 79-385 by Seiders, which points out
13 that the rocks at Point Sur are lithologically rather dif-
14 ferent from the rocks at Cambria, that the rocks at
15 Cambria in particular are characterized by a very massive
16 thick-bedded sequence of sandstone while those at Point Sur,
17 while they do include sandstone also include melange-like
18 features that are structurally quite disturbed and do not
19 give the same aspect as the rocks near Cambria.

20 So we feel also that this point does not lend
21 any kind of strong support to inferring large lateral off-
22 set from one point to another along a fault along the
23 coast.

24 Q Excuse me, Mr. Hamilton. You referred to a
25 recent report. Is that the report that the Intervenors



3

6



2

1



1 marked as, I believe, Joint Intervenors 109, by Seiders?

2 A I can't testify to that number.

3 Q No, it wasn't 109. 109 was the abstract. I
4 can't remember what the number was.

5 A I can't testify to the number. But my recol-
6 lection of the testimony is that it's the same report.

7 Q Joint Intervenors' 110, USGS Open File Report
8 79-385 by Seiders.

9 A Yes, that's the one.

10 Q Did Seiders' report in fact state that the
11 rocks, as claimed by Graham and Dickinson to be offset
12 from Cambria, were in fact different rocks? I mean, while
13 they did have the feldspar content, other rocks in there
14 were different than those found at Cambria?

15 A That's my recollection, yes.

16 Q Have you relied-- reviewed that report? Have
17 you reviewed it in detail?

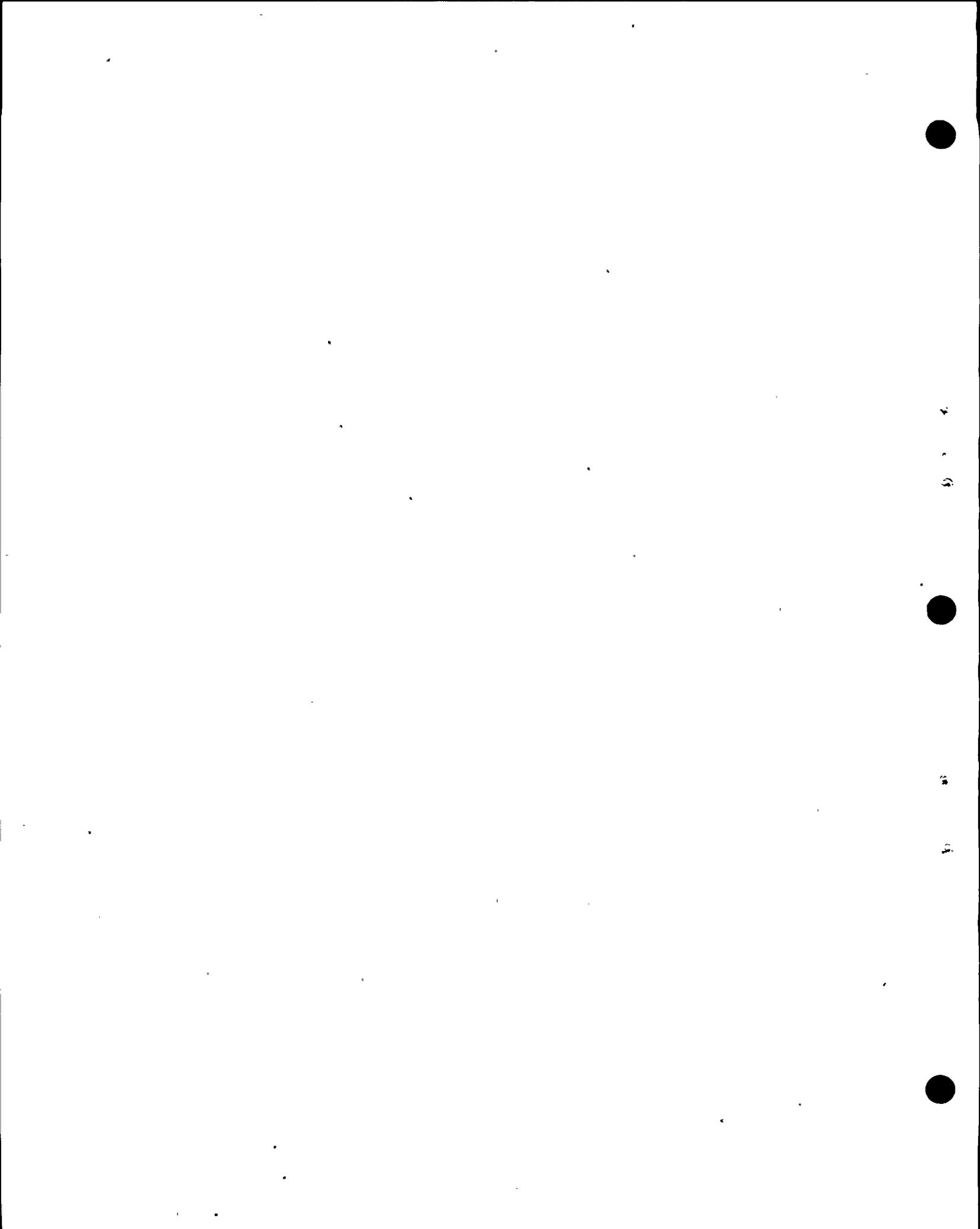
18 A Yes, I have.

19 Q All right.

20 Is that USGS Open File Report supportive of a
21 115 kilometer offset on the San Gregorio-San Simeon-Hosgri
22 fault zone?

23 A No, it is not.

24 Q Is it supportive of an 80 to 95 kilometer
25 offset?



1 A No, that's not his conclusion.

2 Q All right.

3 What is the conclusion of that report?

4 A The conclusion seems to be that--

5 MR. FLEISCHAKER: Objection. Because-- I
6 withdraw the objection.

7 WITNESS HAMILTON: The report concludes that
8 there is evidence that supports a maximum of about 35
9 kilometers of offset on the Hosgri fault.

10 BY MR. NORTON:

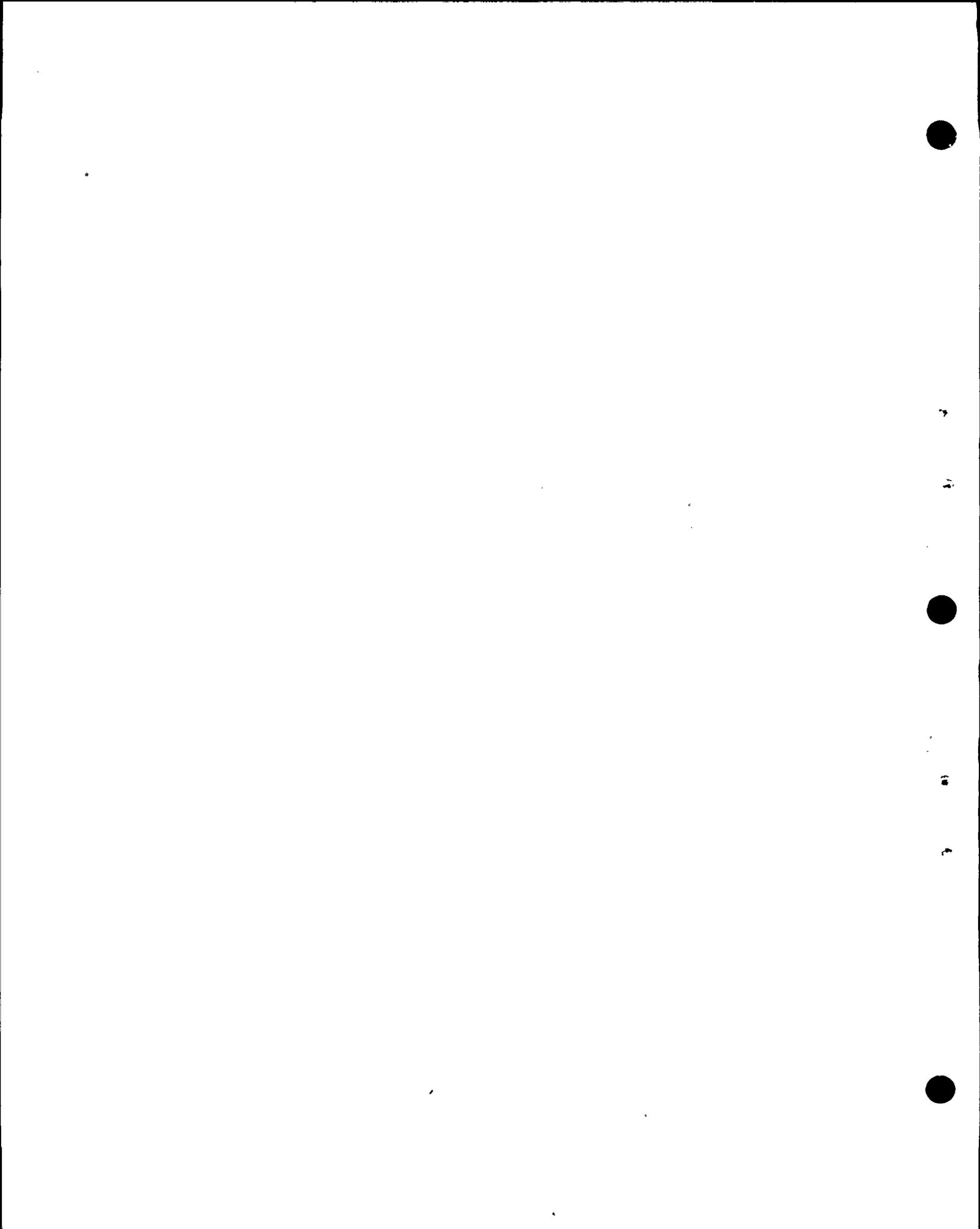
11 Q Does that report treat the publications, or
12 the alleged support in the publications of Graham and
13 Dickinson, both their earlier paper and their paper con-
14 tained in CDM-137 and Dr. Hall's paper of 1975 and his
15 later paper in CDM-137?

16 A (Witness Hamilton) It's chiefly concerned with
17 some of the same lines of evidence that Dr. Hall considered.
18 But it does also address some of the points of evidence --
19 not all of them -- that Drs. Graham and Dickinson brought
20 forth.

21 Q I take it it does not treat, for example,
22 gravity and aeromagnetic data, things like that? It simply
23 treats the stratigraphic--

24 A That's correct.

25 Q Please go ahead.



1 A Could I have the next slide, please?

2 (Slide)

3 Q Excuse me, Dr. Hamilton, I have one more
4 question.

5 In your review of that USGS Open File report
6 do you feel that the facts, or evidence stated therein
7 are corroborative of the stratigraphic evidence that you
8 have presented?

9 A Yes, I feel that that's the case.

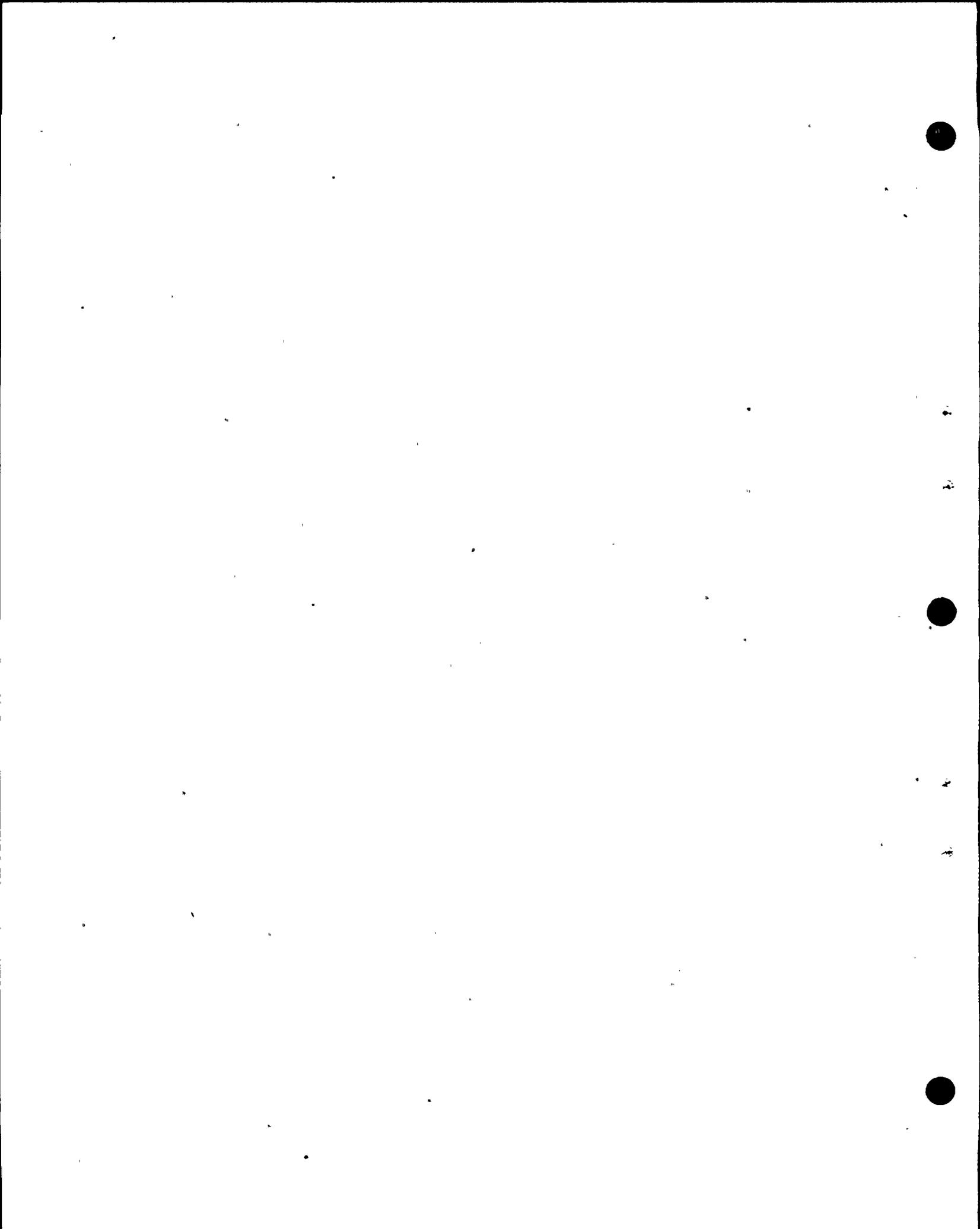
10 MR. NORTON: Mrs. Bowers, that report, USGS
11 Open File Report 78-385, Joint Intervenors' Exhibit 110,
12 we would ask that that be admitted into evidence at this
13 point in time.

14 There've been a great number of articles and
15 open file reports on this question by non-appearing wit-
16 nesses admitted into evidence. And we would at this time
17 ask that this be admitted into evidence.

18 MR. FLEISCHAKER: Well I object to that.
19 There are a couple of problems we have with this report.

20 First of all, it's an open file report. But,
21 as the front page says, the report is preliminary and has
22 not been edited or reviewed for conformity with Geological
23 Survey standards and nomenclature.

24 Secondly, it's apparent from the report that it
25 is a draft report. The footnotes are interspersed throughout



1 the text.

MRB/wb7 2 Thirdly, more importantly, an adequate founda-
3 tion cannot be made with this witness. We cannot cross-
4 examine this witness, I think, as we would like to,
5 because he's not the author of this report.

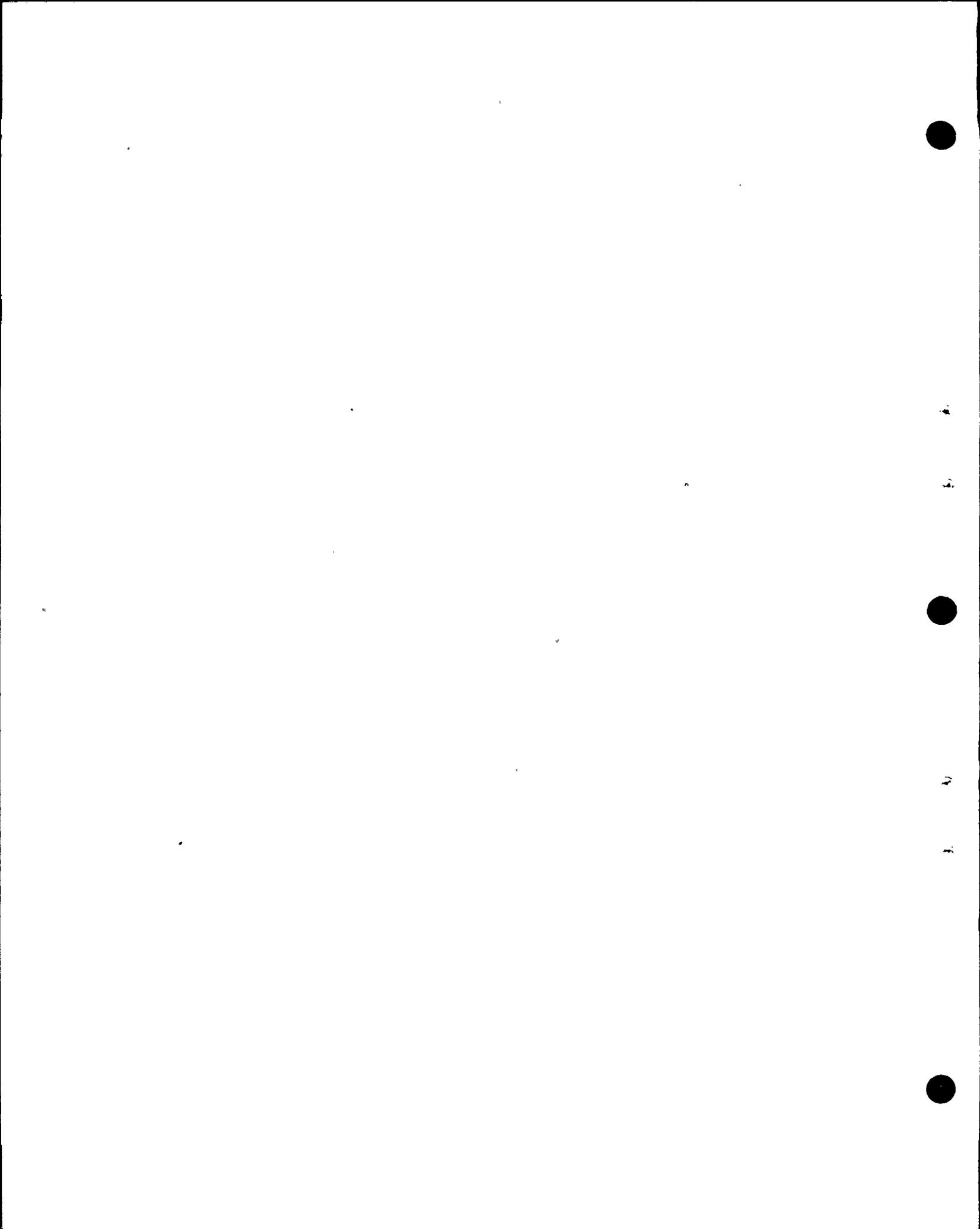
6 Finally, as we indicated yesterday, Dr. Hall
7 was here, he was prepared to make a point-by-point in detail
8 rebuttal. And at that time the Board indicated that it
9 wanted merely a summary from Dr. Hall.

10 Dr. Hall had perhaps thirty type-written pages
11 of detailed testimony to address this paper point-by-point.
12 And we kept him here all day yesterday, too.

13 But, in any case, the point is that at that
14 time the Board indicated it would rather have a brief sum-
15 mary.

16 So that we feel that bringing this preliminary
17 report into the record at this time does not permit us
18 adequate opportunity to cross-examine the author. And,
19 secondly, it's unfair, because Dr. Hall was here and the
20 board had indicated they wanted Dr. Hall to make his remarks,
21 to limit his remarks to a succinct summary statement when
22 he was, in fact, prepared for an in detail point-by-point
23 page-by-page rebuttal.

24 MRS. BOWERS: How many pages did you say he had
25 of type-written comments?



1 MR. NORTON: He said thirty, Mrs. Bowers, and
2 he held up a couple of pages.

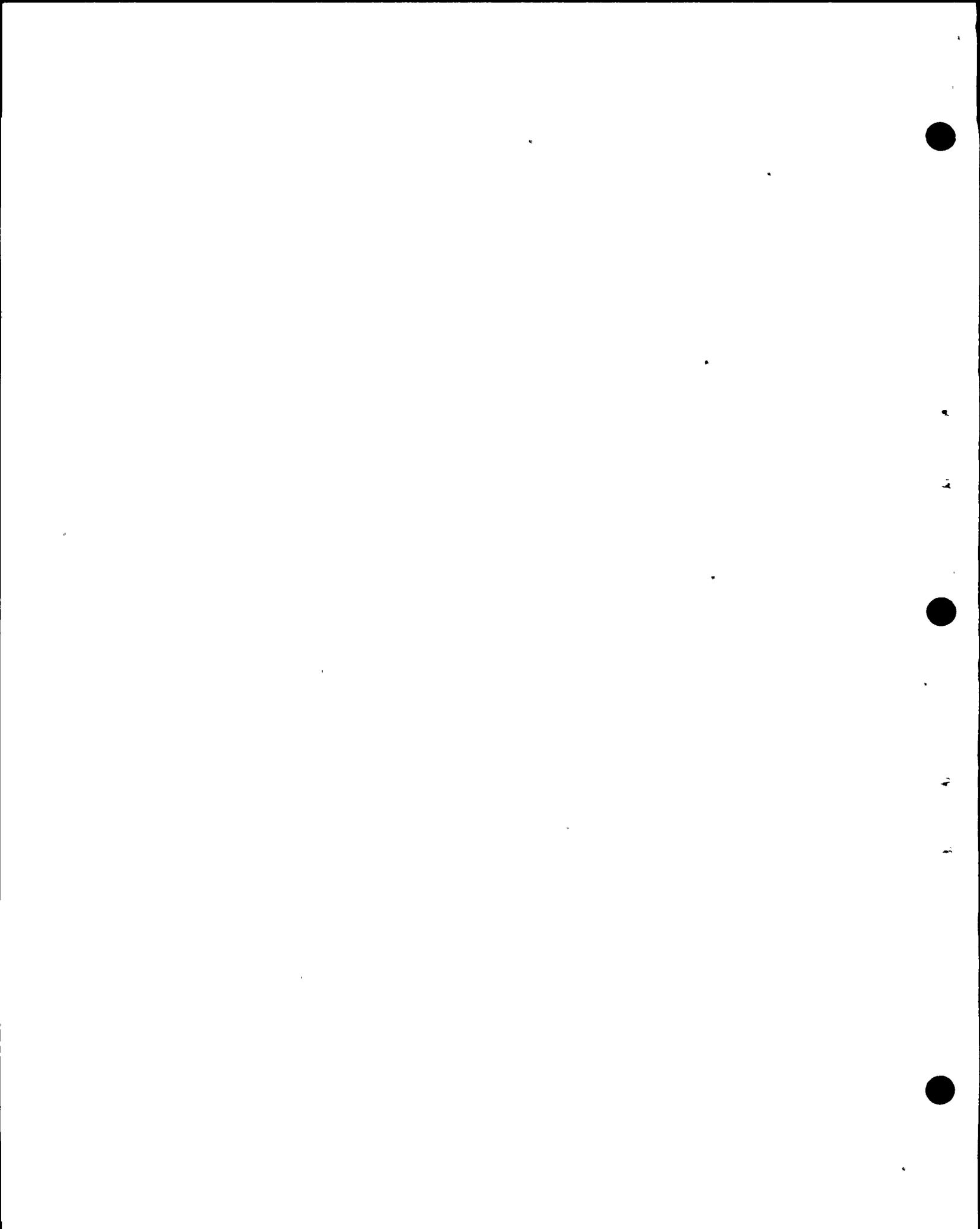
3 MR. FLEISCHAKER: I will amend that overstatement
4 by counsel. There were maybe sixteen pages, I think, that
5 I saw, that were typewritten, single-spaced.

6 MR. NORTON: Mrs. Bowers, am I correct that when
7 Mr. Fleischaker held up a stack of papers saying that he
8 had thirty pages of comments, that that stack of papers
9 was not indeed, the comments?

10 MR. FLEISCHAKER: I don't know what difference
11 that makes. The answer to the question is yes, they are
12 not the comments. These are questions that were written
13 out, not the comments Dr. Graham had prepared. --excuse me;
14 that Dr. Hall had prepared.

15 If we need more evidence on that I could testify
16 that he had maps out in his car, he had nine or ten abstracts
17 in here, he had oil tract surveys. He was prepared to go.

18 MR. NORTON: Well, Mrs. Bowers, the problem we
19 had with Dr. Hall was that Mr. Fleischaker marked into
20 evidence -- excuse me; marked for identification. the Seiders
21 paper, and then he asked him what he agreed or disagreed
22 about. And the Board said, Well we don't want a word-by-
23 word, line-by-line refutation of the paper. That hasn't
24 been done with any paper that has been submitted by anybody,
25 or relied upon by anybody in these proceedings. If it did,



1 these proceedings would go on for years.

2 We have literally thousands of pages of, you
3 can call them -- most are not papers, but they are reports
4 and are very similar to papers. I don't quite understand
5 why Joint Intervenors marked that for identification and
6 then asked their witness questions about it if they didn't
7 want it in the record. I mean, all they had to do was
8 remain silent about it. But they marked it for identifica-
9 tion.

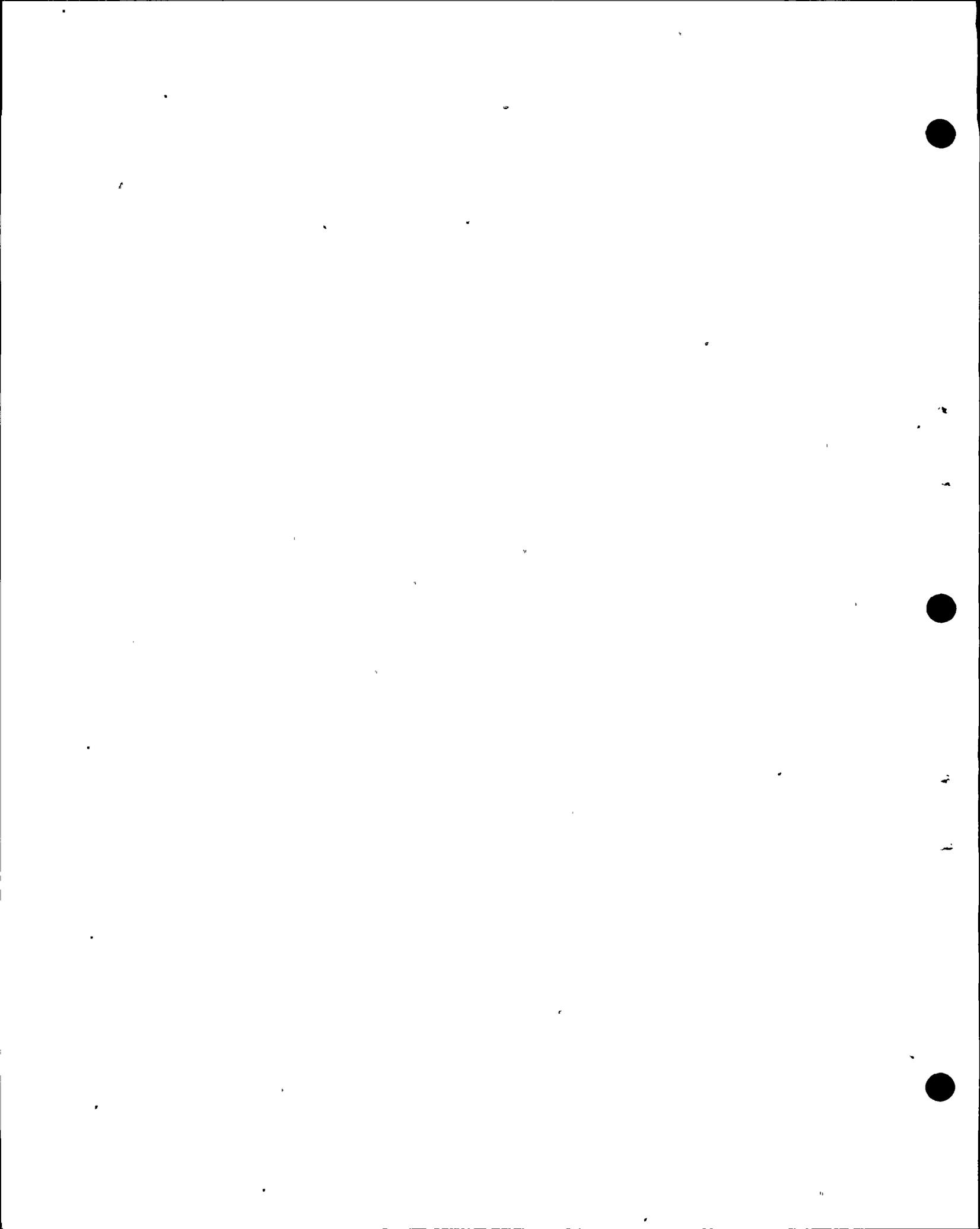
10 Our geologists have reviewed that paper, as
11 literally dozens of other papers, papers by Green that were
12 relied on by Dr. Graham in his testimony yesterday. There've
13 been -- I could sit and go through the text, or the transcript
14 and name literally dozens of such articles, many of which
15 have been relied upon.

16 This happens to be one that was just released.
17 It happens to be relevant to these proceedings. I don't
18 understand....

19 Well, I do understand why the Intervenors don't
20 want it into evidence, because it's contrary to their theory.

21 But it is another piece of evidence that I think
22 this Board ought to review.

23 Mr. Seiders is sitting in the audience and I'm
24 sure we could clear up any of Mr. Fleischaker's foundational
25 objections. Mr. Seiders could be sworn, I suppose, and say



1 yes, he prepared this paper; yes, he's the one that went
2 out in the field and walked the hills and valleys and mapped
3 the rocks, and looked at the rocks; and, yes, indeed, that's
4 the paper he wrote, and it says what it says.

5 I don't think that's necessary. It hasn't been
6 necessary with many of the other papers that have been sub-
7 mitted in evidence here. CDM-137 contains a lot of papers.
8 That's in evidence.

9 MR. FLEISCHAKER: No, it isn't.

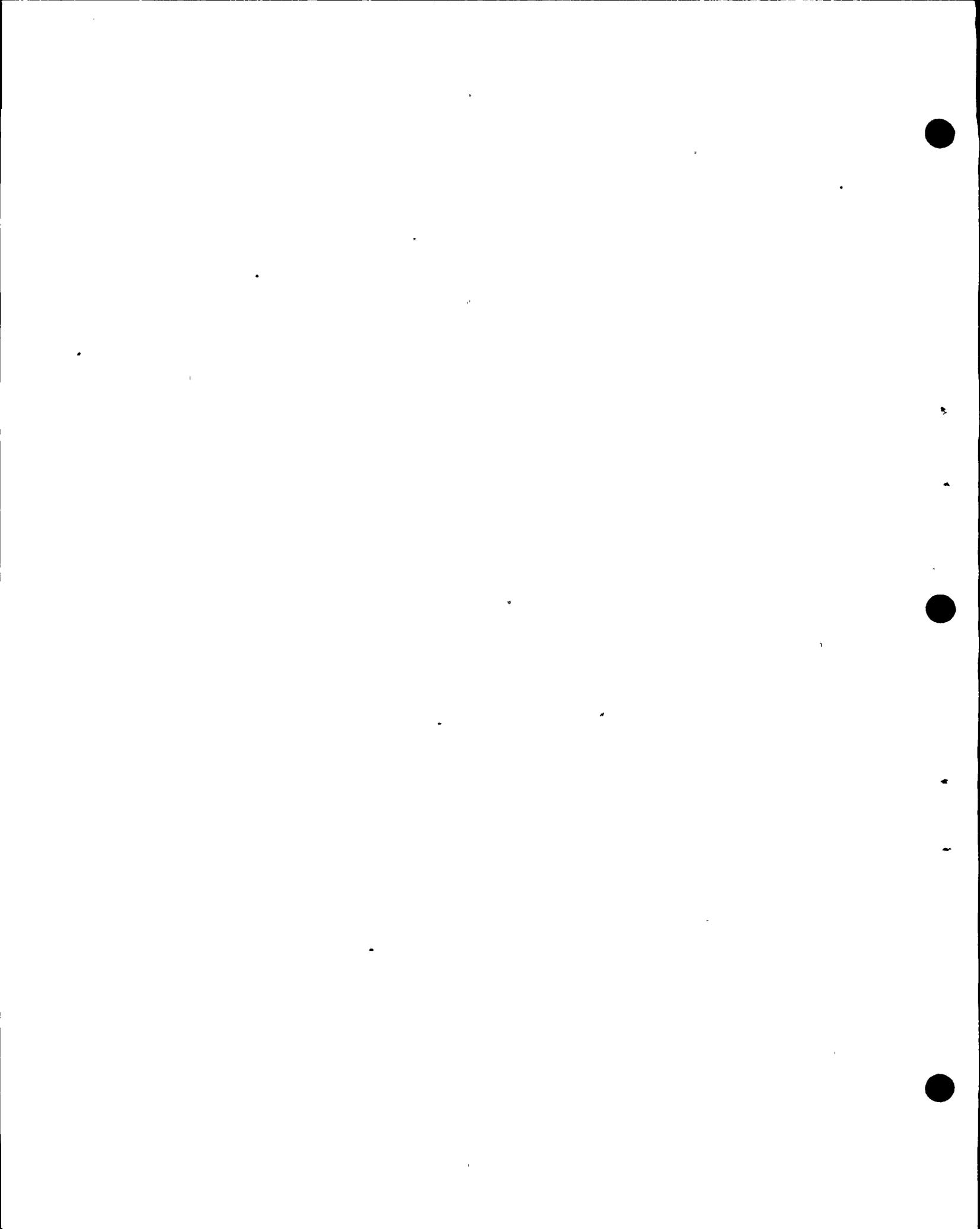
10 MR. NORTON: I believe CDM-137 is in evidence.
11 Let me check my list.

12 (Pause)

13 Incidentally, I would move, if Mr. Fleischaker
14 is successful in keeping the Seiders report out of evidence,
15 I would move to strike absolutely every single word of
16 Dr. Hall's refutation of that paper. That's unbelievable.
17 He sets up a straw man, has his witness refute it, and then
18 tries to keep out the straw man. I can't believe it.

19 MR. FLEISCHAKER: I really have nothing in
20 addition to say; except that my recollection is that Dr. Hall
21 was there and he had his presentation prepared, and limited
22 his remarks to a very brief refutation of this paper, which
23 was very summary in form.

24 The reason why he had such an in-detail, in-depth
25 refutation is because the paper, the rationale of the paper



1 is built up by comparing stratigraphic sections in the
2 Cambria-Morro Bay area, the San Simeon area, and the Point Sal
3 area. And there are approximately ten or eleven rock types
4 or formations in each that have been compared. And he was
5 prepared to deal with every single comparison because he
6 has mapped that area in detail. He has studied that area
7 in detail. And he was prepared to go and demonstrate that
8 the correlations that have been made in this paper are not
9 correct.

10 That's all I have to say.

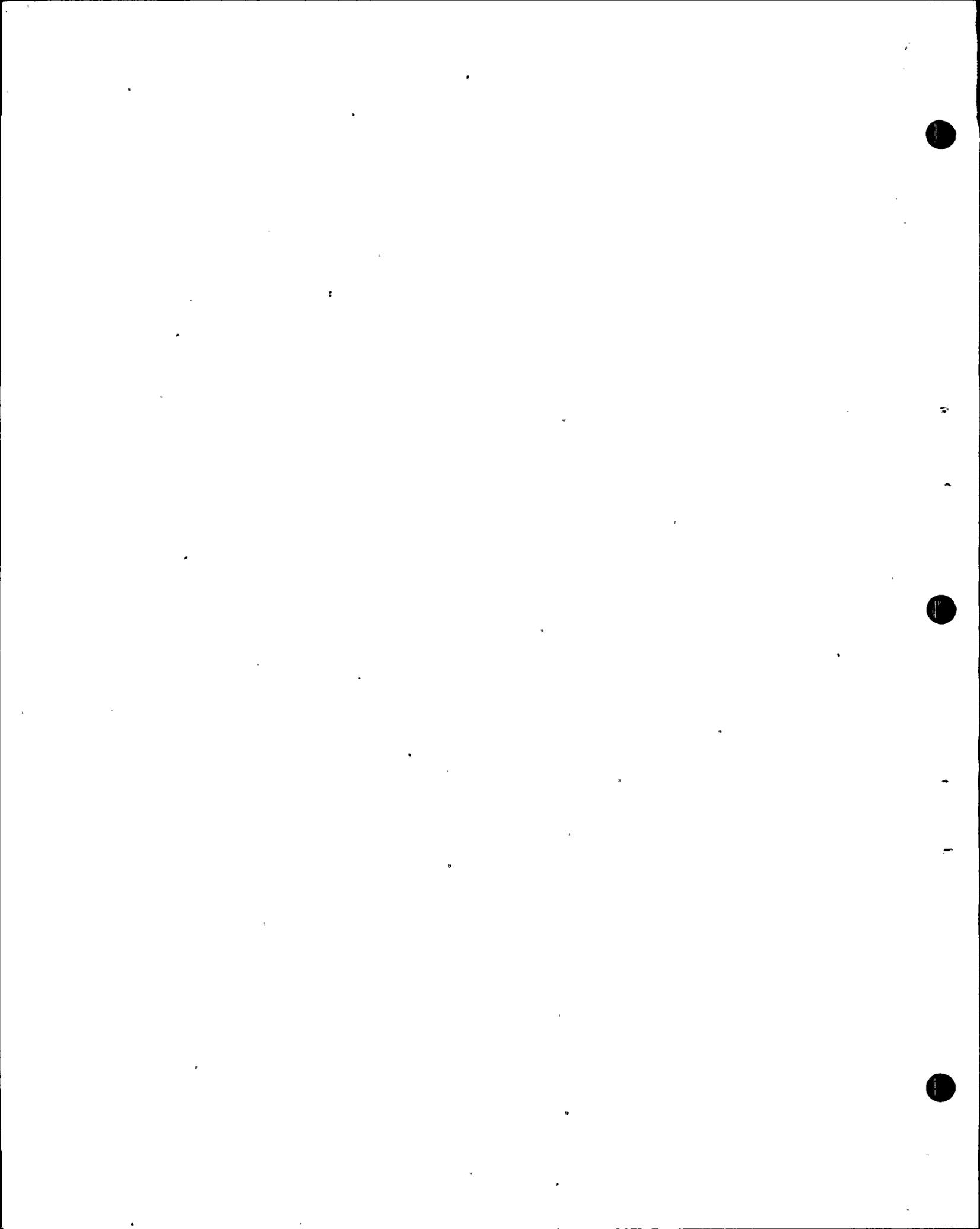
11 MRS. BOWERS: Did you find what you were
12 looking for, Mr. Norton?

13 MR. NORTON: I'm not sure whether CDM-137 is in
14 evidence or not. I believe, if it's not, then evidently some
15 of the articles are not in evidence, of their witnesses.
16 I don't believe that Dr. Hall's article in CDM-137 was ever
17 marked as a separate exhibit; I'm not sure, it may have been.

18 Mr. Hamilton is shaking his head yes, so I assume
19 it was marked as evidence.

20 WITNESS HAMILTON: I believe Dr. Hall's and
21 also Dr. Graham's and Dickinson's papers from that are in
22 evidence.

23 MR. NORTON: We also have Geological Survey
24 Circular 672 in evidence, of course. I don't see
25 the authors of that over here to testify about that. It's



1 Joint Intervenors' Exhibit 45.

2 MR. FLEISCHAKER: It was moved in by the applicant.

3 MRS. BOWERS: Mr. Staenberg, does the Staff
4 have a position on this matter?

5 MR. STAENBERG: If memory serves, we did not
6 engage in the debate over the Seiders paper at the time that
7 Intervenor was presenting its rebuttal case. However, it
8 strikes us this morning that much of the discussion that
9 has just gone on seems to be missing the mark, and we are
10 having some difficulty understanding the basis once again
11 of Intervenors' objection.

12 We agree, and also not unusually, with the
13 applicants having stolen our thunder, because the comment
14 that I wanted to make was that Intervenor brought in the
15 Seiders paper. It had not previously been brought into
16 the proceeding. It brought it in so that it could knock
17 it down, so that it could refute it. However, it did not
18 accomplish bringing the entire paper in, and therefore its
19 witness wasn't able to go through a laborious point-by-
20 point refutation. But it does not seem inappropriate to
21 the Staff this morning if applicant wishes to bring in that
22 paper because it believes it supports the points it wants to
23 make on rebuttal that it should be denied that opportunity.

24 That of course does raise perhaps the question
25 of whether the intervenor has some opportunity, since this



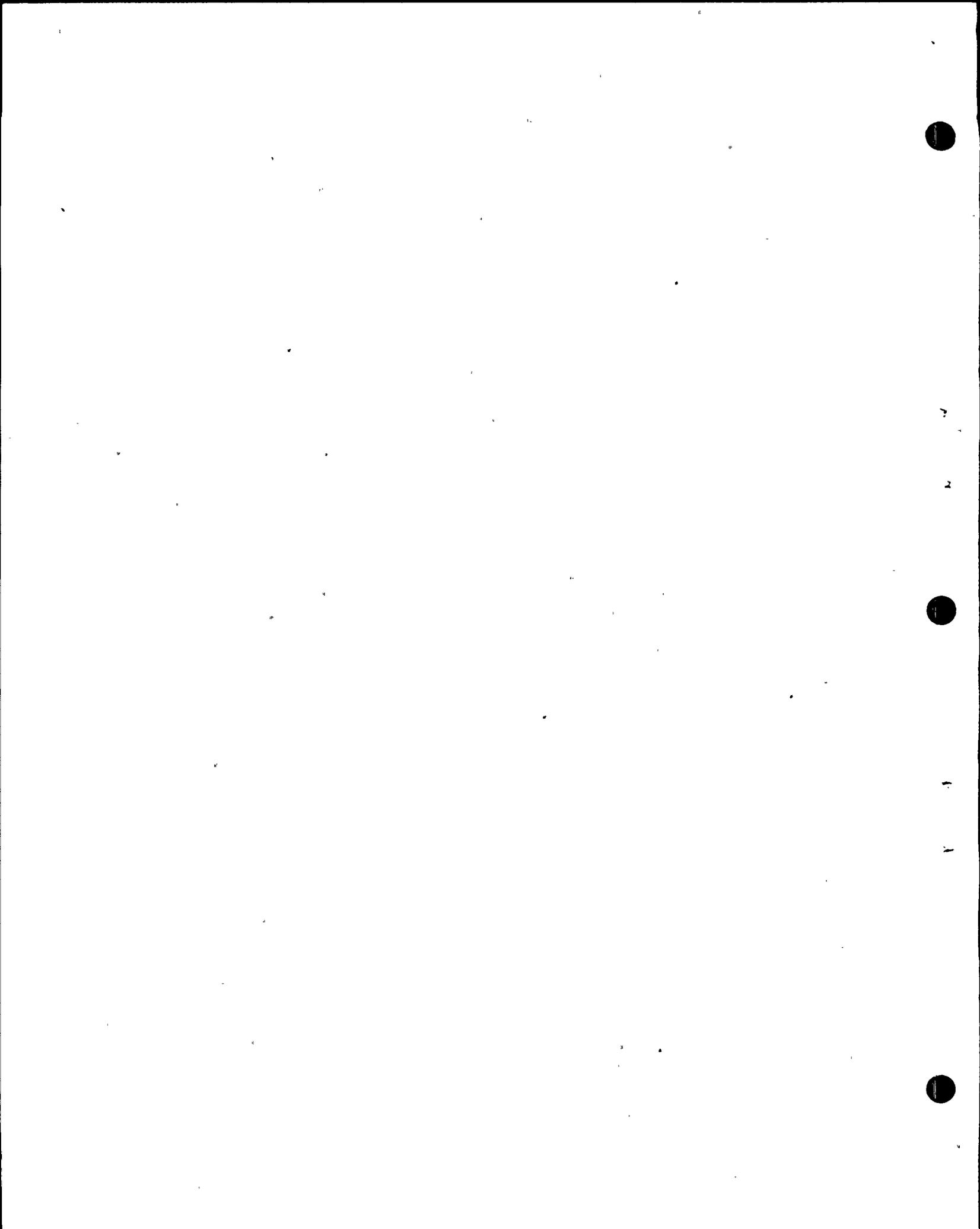
1 is a new paper, to bring in additional cross-examination or
2 rebuttal testimony. But it doesn't seem inappropriate to
3 us for applicant to be entitled to bring in a paper which it
4 is going to rely upon, it's going to use as supporting its
5 case. It's not coming out of left field the way the
6 Intervenor wanted, through the back door to bring in Seiders
7 paper, only to refute it when it had not previously been
8 introduced into the proceeding.

9 MR. NORTON: Mrs. Bowers, I find now, for
10 example, a paper brought in by Joint Intervenor to sub-
11 stantiate a point, called "Geophysical Assessment of Peak
12 Accelerations," Bulletin of the Seismological Society of
13 American, 1976, Hanks and Johnson, Joint Intervenor's
14 Exhibit 47, identified December 15th and put into evidence
15 December 16th. And I don't remember seeing Dr. Hanks and
16 Dr. Johnson here to support that. It was relied upon by
17 their witnesses.

18 MR. FLEISCHAKER: Stewart Smith was the first
19 one to refer to that.

20 MR. NORTON: And who marked the paper and put
21 it into evidence? If Stewart Smith relied upon it and that's
22 why you put it into evidence, then I'm putting this into
23 evidence because Dr. Hall brought it up.

24 MR. FLEISCHAKER: We marked it, but you moved
25 that paper. But that isn't the issue before the Board.



1 MR. STAENBERG: We're getting a little far
2 afield now.

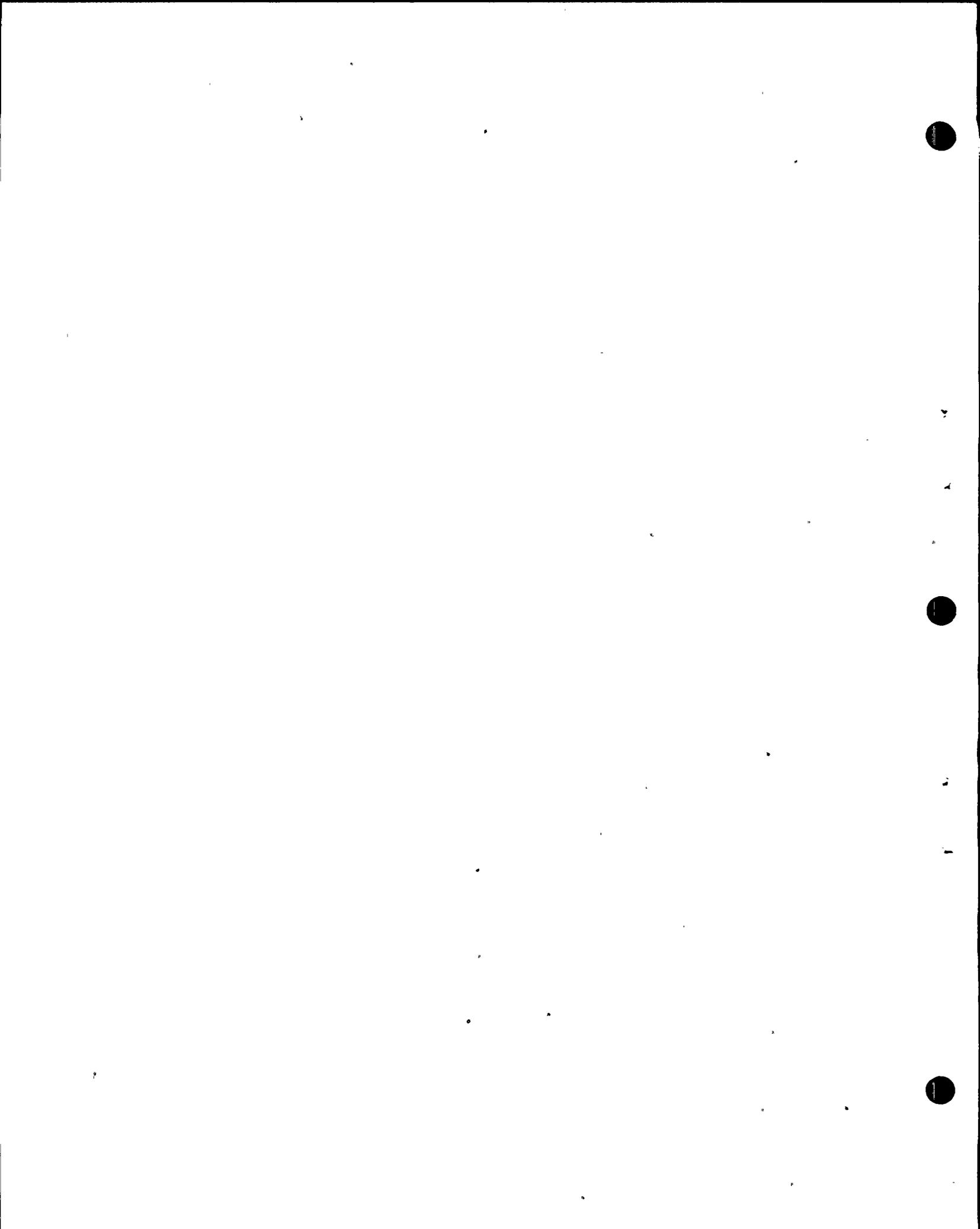
3 (The Board conferring)

4 MRS. BOWERS: Well, first we'd like to say
5 the Board certainly had no intention to keep Dr. Hall from
6 making his points on the Seiders paper. But what we did
7 say is that we don't want to box you in, but we don't think
8 it's necessary for you to go down on a line-by-line basis
9 in reviewing the paper.

10 Now we think Joint Intervenors' 110 should be
11 admitted in evidence. But Applicant's witnesses are held
12 to that same constraint. We don't want a line-by-line,
13 but there can be a brief summary reference to it.

14 MR. NORTON: Mrs. Bowers, we have no intention
15 of going line-by-line. I think we've said all we're going
16 to say. It is supportive of Dr. Hamilton's position and
17 it's a further piece of evidence that he relies upon now
18 for his position. It didn't come out until several weeks
19 ago, so it was not available to him before that time. But
20 it is supportive of his position, it is another piece of
21 information he relies on.

22 (Whereupon the document referred to,
23 heretofore marked for identification
24 as Joint Intervenors' Exhibit 110,
25 was received in evidence.)



1 BY MR. NORTON:

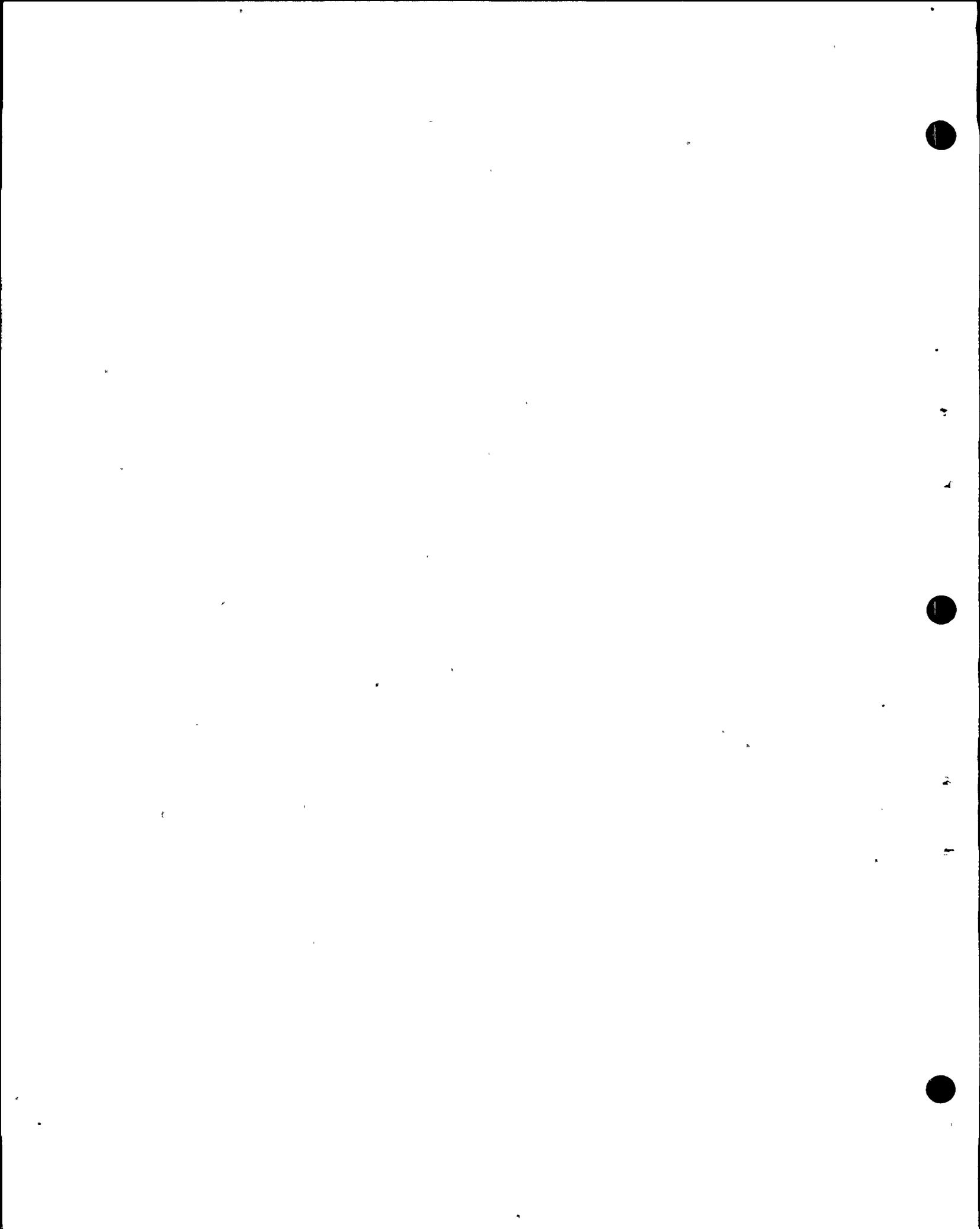
2 Q I believe at this time, Mr. Hamilton, you
3 were going to move on to another area of discussion with
4 Applicant's Exhibit 59, which is the slide presently on
5 the screen.

6 A (Witness Hamilton) Yes. We have now moved
7 down the coast to the area of San Simeon. And this is
8 the area where the San Simeon fault outcrops on land,
9 where the on-land geology has been mapped by Dr. Hall,
10 where a good deal of other work has been done. And it's an
11 area where a couple of different points, I think, have been
12 made either in direct contentions or in some of the sub-
13 sequent discussion.

14 The map before you covers the on-shore and
15 off-shore area near the region of San Simeon. San Simeon
16 itself is indicated at a point toward the lower southeast
17 corner, or right corner of the map. Ragged Point is toward
18 the northwest, or upper left corner. Point Piedras Blancas
19 is at an intermediate point along the coastline.

20 Shown on the map are the mapped trace of the
21 San Simeon fault, and a series of faults that branch from
22 it in a more westerly direction.

23 Also shown on the map are the corresponding
24 latitude parts of the Hosgri fault as we have mapped them
25 from various kinds of offshore techniques. And these are

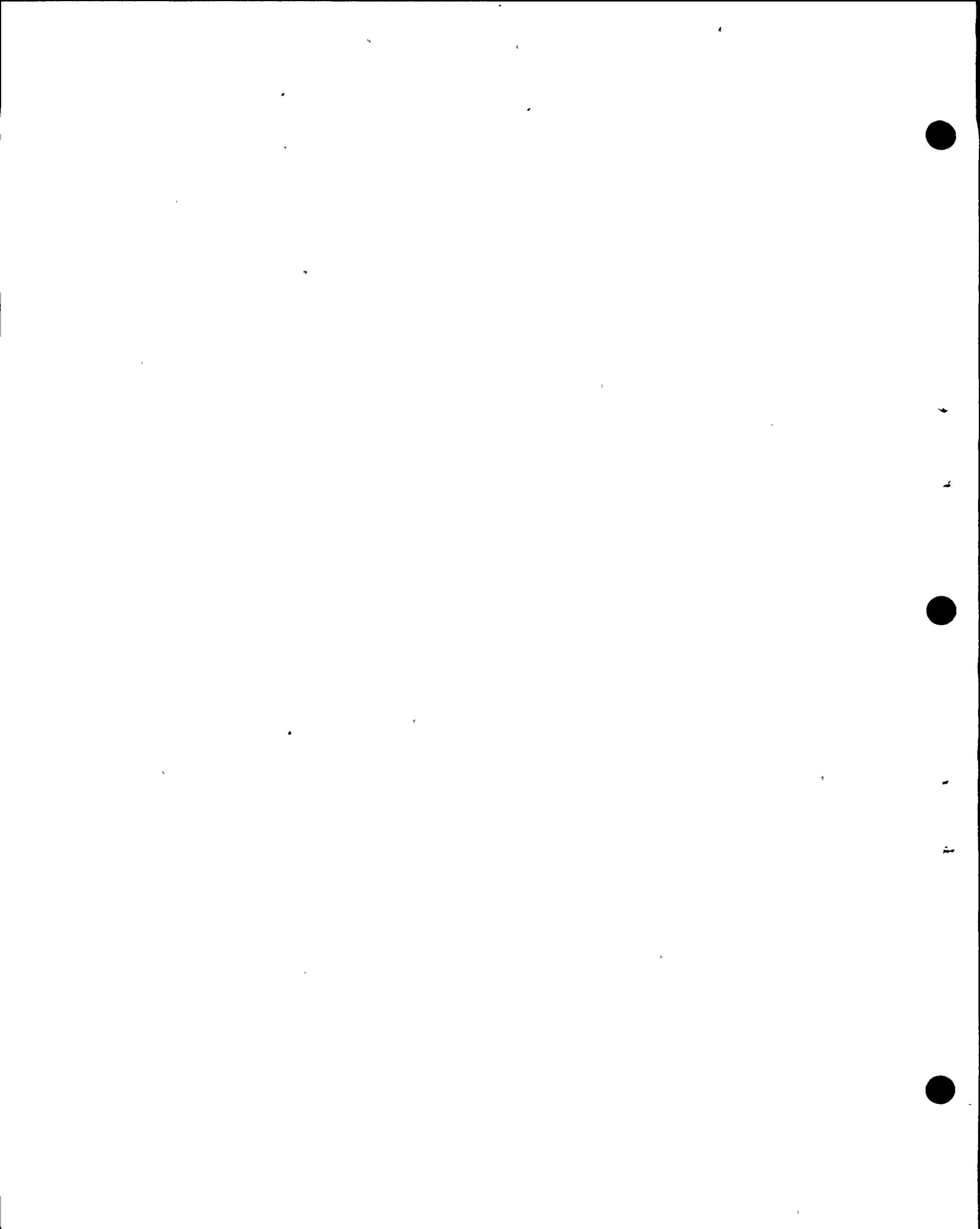


1 shown as heavy red lines in both cases.

2 In addition, I've shown generalized geologic
3 units identified by different colors. I won't go through
4 all of them; except to say that the basement rock units,
5 the old rocks, are shown either as two different shades of
6 dark green, representing the Franciscan formation which
7 partly exists on both sides of the San Simeon fault in
8 this area, or rocks called ophiolites about which there has
9 been much discussion in the past, identified by purple
10 colors, and serpentine identified by sort of a magenta
11 color. The ophiolites and the serpentines exist in a
12 fault-bounded slices in some parts of the area west of
13 the San Simeon fault.

14 Younger rock units that are present and are
15 significant to the discussion include the rocks of the
16 Lospe formation, shown as a kind of light tan color in
17 the upper middle part of the drawing, rocks of the Monterey
18 and Sisque formations, shown as a light blue color near
19 Point San Simeon, and rocks of approximately corresponding
20 age to either the Monterey and younger rocks, or to Upper
21 Pliocene and Pleistocene rocks, shown as a yellow color in
22 the offshore.

23 The third kind of data shown on this map is
24 indicated by the contour lines. These lines represent lines
25 of equal magnetic intensity, and they are taken from the



1 aeromagnetic survey that was run by the US Geological Survey
2 and the California Division of Mines and Geology.

3 The sources of the distribution of units and
4 the locations of faults on land is from Dr. Hall's mapping,
5 which I have generalized and simplified, but which corresponds
6 to his published map of the onland geology near San Simeon.
7 And the offshore geology is from the maps that are
8 presented in our direct testimony and in the FSAR.

9 Now there are two points that I want to make
10 with this drawing. The first has to do with the possible
11 connection that is inferred by Dr. Silver for the Hosgri
12 fault to the San Simeon fault.

13 I think it is generally agreed that if there is
14 a connection between the Hosgri fault and the San Simeon
15 fault it should happen near, or south from the Point San
16 Simeon region.

17 Now Dr. Silver, on page 1.2-5 of his written
18 testimony, writes as follows: It's section 3.1.3 of his
19 testimony, entitled "Connection between the San Simeon
20 and Hosgri fault zones."

21 "The San Simeon fault zone projects
22 southward into a zone of shallow water where
23 Buchanan-Banks and others indicate no seismic
24 reflection data is available. Good aeromagnetic
25 data is available, however. The San Simeon fault



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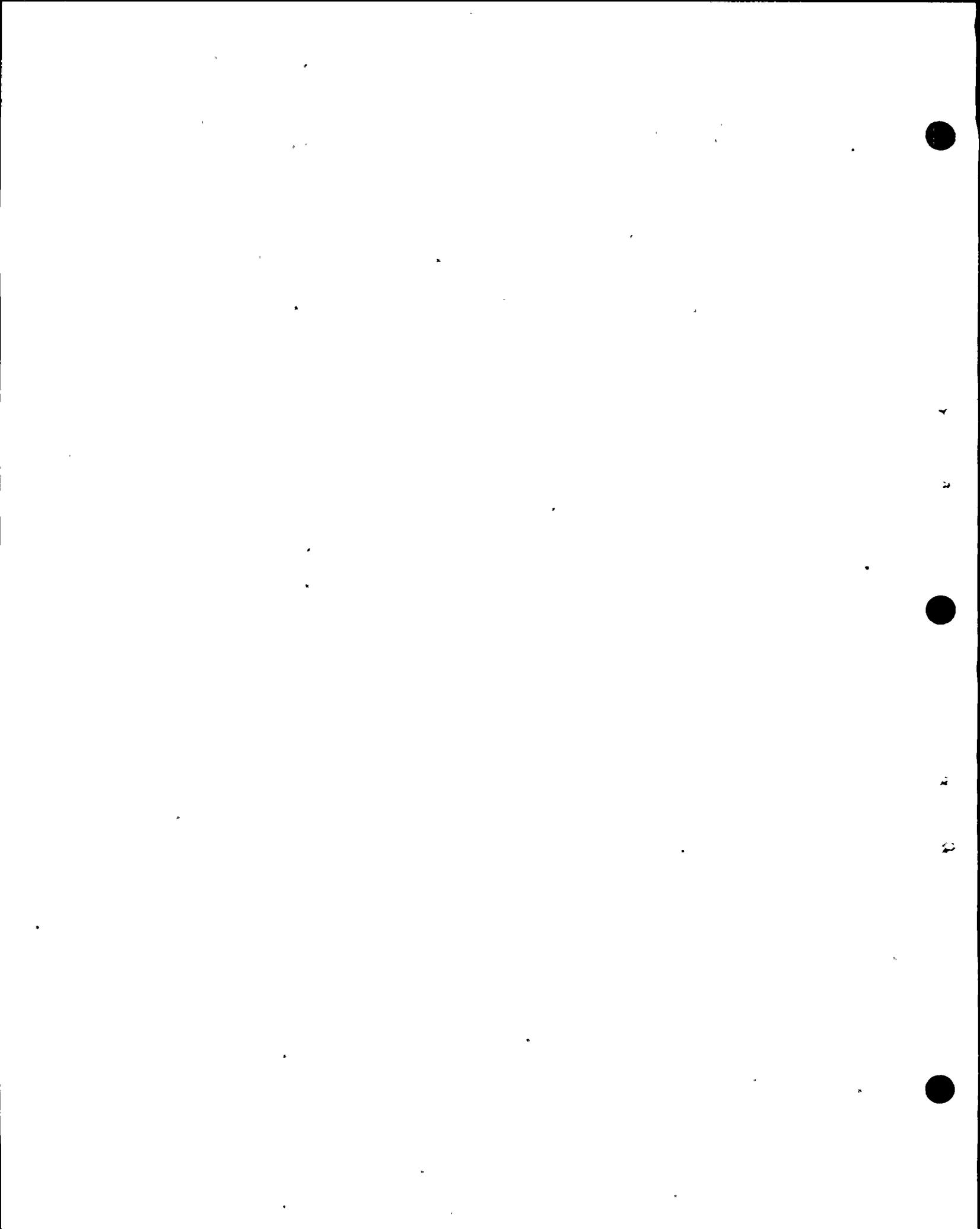
1 projects southward along a magnetic high of the
2 same strike. The Hosgri, where mapped to the
3 south, projects northward along the upper west
4 flank of this magnetic high. If followed to the
5 coast it would intersect a segment of the San
6 Simeon fault zone as seen on the aeromagnetic
7 map, and would be within 1 to 2 kilometers of the
8 main trace of the San Simeon."

9 And then he goes on to say:

10 "Definitive seismic reflection data
11 are lacking in this area, but the aeromagnetic
12 data provide a guide to the possible location
13 of the fault zone in this area."

14 Okay. To show what the data for this looks like
15 now, the San Simeon fault is mapped on land quite clearly
16 in the area shown by the red line, and it can be projected
17 to the southeast. And it follows along. If you run up this
18 series of contours here, they are progressively higher
19 values. So the San Simeon fault does indeed follow along
20 a magnetic high as indicated by Dr. Silver.

21 The Hosgri fault as it is traced by good seismic
22 reflection data from the southeast does in fact follow
23 along the flank, the west flank of a magnetic gradient that
24 runs down from this magnetic high. And that is quite well
25 defined to a point in the offshore a few kilometers south of

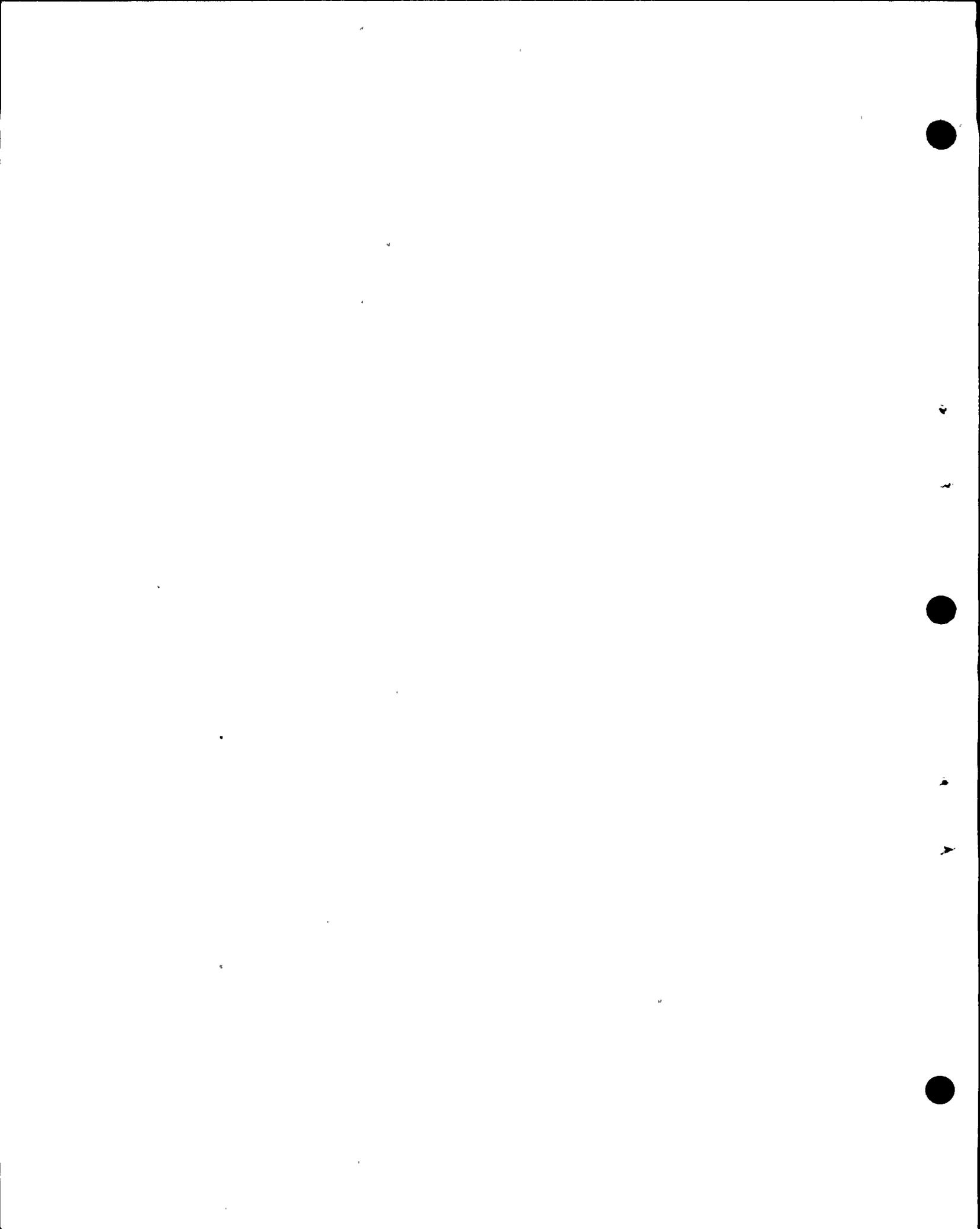


1 San Simeon.

2 Now Dr. Silver goes on to say that if
3 projected northward the Hosgri fault would run on land
4 near the San Simeon fault at a point 1 or 2 kilometers to
5 the west.

6 The point I want to make is, if we make the
7 projection we find that the San Simeon -- the Hosgri
8 fault would project to a place along the shoreline that
9 does indeed lie a few kilometers west of the San Simeon
10 fault. This is an area that has been very carefully mapped
11 both by myself and my associates and also by Dr. Hall,
12 and it's an area where there are very good exposures right
13 along the seacliff with more scattered exposures inland.
14 There is no major fault appearing in this area. There is
15 no disruption of the geologic units that extend from right
16 next to the San Simeon fault going out across this area.
17 There is also no pattern in the branching faults that would
18 permit some kind of a branch connection from the SanSimeon
19 fault to transfer to the Hosgri fault.

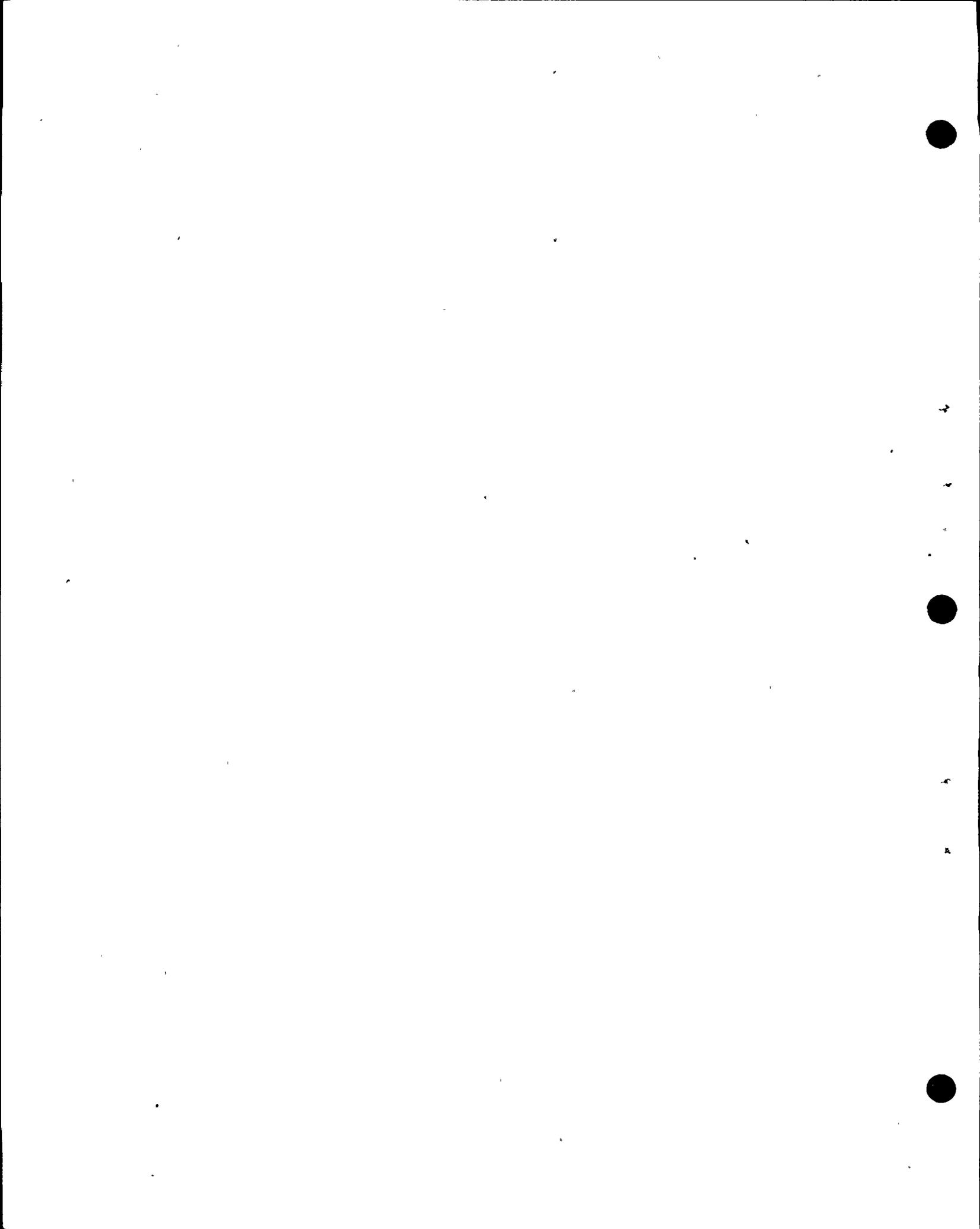
20 So the point simply is that if one takes the
21 contention that Dr. Silver describes in his written
22 testimony and you compare it with the data, you do not
23 get a connection between the two faults. You, instead, find
24 them separated, as we have claimed, by an intact mass of
25 Franciscan bedrock that has several kilometers' width and



1 lies between the two.

2 While this map is up, I wanted to make a couple
3 of other points. One of them has to do with the actual
4 purpose for which we chiefly went in to map the faults in
5 this region when we first started doing that about five
6 years ago; that was that we were chiefly concerned with the
7 issue, I think, that is before the Board, and that has to
8 do with earthquake potential of faults. So we were looking
9 to see where the faults were, and, in particular, what
10 their relationships were with fairly young deposits. And
11 so we were looking to see whether these faults would
12 cut terrace deposits, by how much, and with what sense of
13 movements, and what their relationships were, to indicate
14 what the recency of movement and the amount of recent
15 movement might have been.

16 In connection with that we made essentially an
17 inch-by-inch traverse around the periphery of the coastline.
18 We also made a careful examination of the inland area.
19 And in the course of that we identified the two places
20 which have been I think fairly conclusively shown to be
21 offsets of uplifted marine terraces. Both of them are
22 along this westerly branch that extends westward from the
23 San Simeon fault, one in the area, the upland area east of
24 Piedras Blancas and one between Point Sierra Nevada and
25 Piedras Blancas where that fault intersects the shoreline.

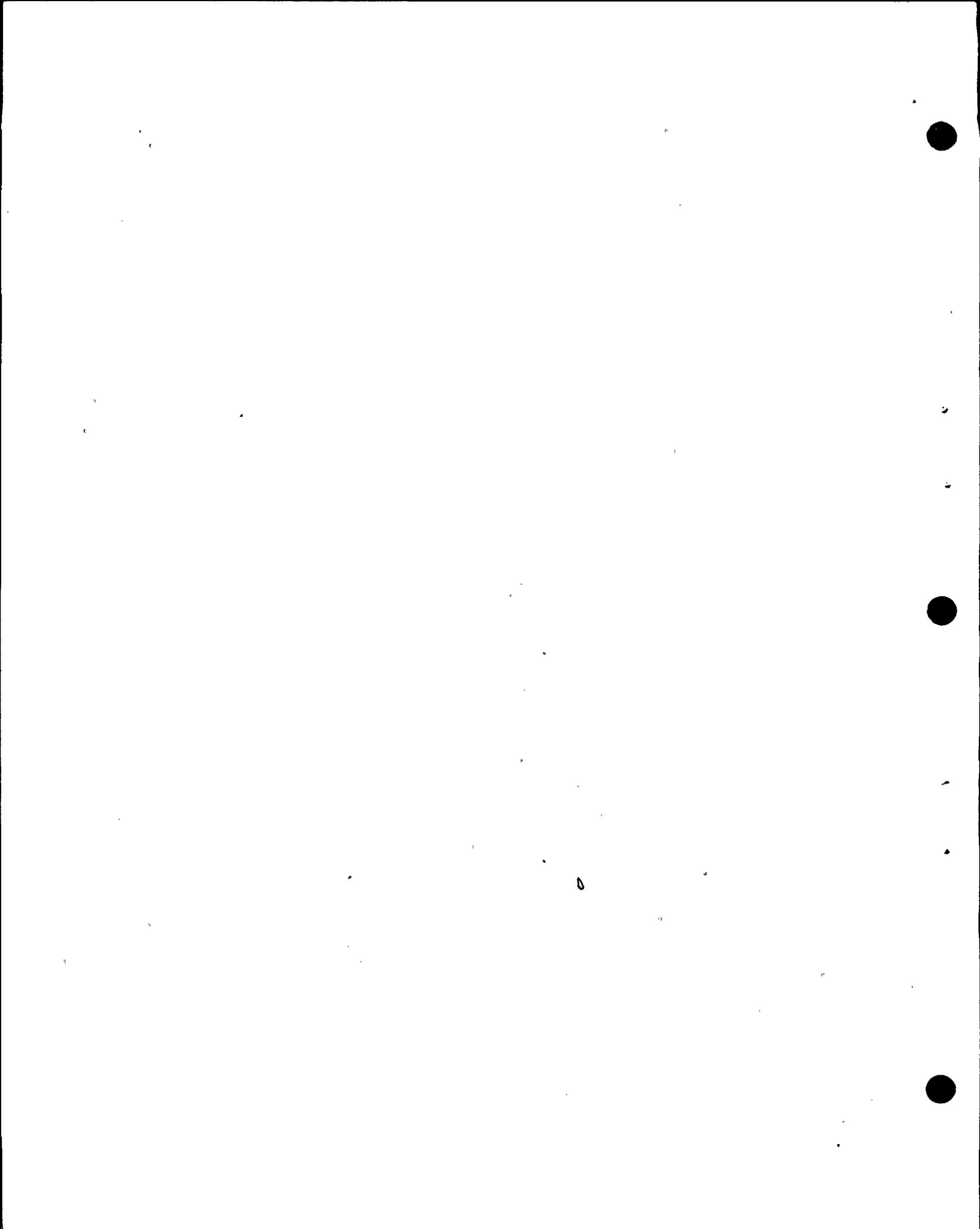


1 And we were, I'm afraid, less definitive in some of our
2 stratigraphic identifications, so that in fact in this
3 area of Jurassic and Cretaceous sedimentary rocks we did
4 in fact mis-identify that as younger Miocene age rock.
5 And Dr. Hall has since pointed that out to me, probably more
6 than two years ago. And we now certainly agree with and
7 accept his interpretation of that.

8 I think it doesn't really have significant
9 with respect either to age of movement or to correlation
10 of units between here and Point Sal. Nonetheless we cer-
11 tainly agree with him. And I think that it was somewhat
12 misleading to imply that we were somehow or other trying
13 to conceal that earlier mis-identification that we had
14 made of the rocks in this area.

15 One other point: Dr. Hall showed us one of his
16 slides yesterday, I think that it was Joint Intervenors'
17 Exhibit No. 103, a photograph of the fault where about
18 twelve inches of displacement of the 125,000 year old
19 terrace exists at about the point I've indicated on this
20 map.

21 Q Excuse me, Mr. Hamilton. I'm not sure precisely
22 what you said, but you said he showed a photograph which
23 indicated about twelve inches of displacement. Were you
24 referring to the photograph where I believe there was a
25 bunch of people standing, including yourself, and Mr. Seiders



1 was wearing a red hat? Is that the photograph?

2 A No, that's not the photograph. The particular
3 photograph that you're speaking of, I think, was in
4 another area. However I was in that photograph that I'm
5 speaking of. There were two figures in the left middle
6 distance of the picture. And shown in the photograph was
7 a view of the seacliff with the marine terrace.

8 Q My point is, though, in looking at that photo-
9 graph you cannot see a twelve-inch offset in that photo-
10 graph; is that correct?

11 A That's true. It shows the area.

12 Q All right.

13 The photograph didn't show the twelve-inch
14 offset, is what I'm trying to get at.

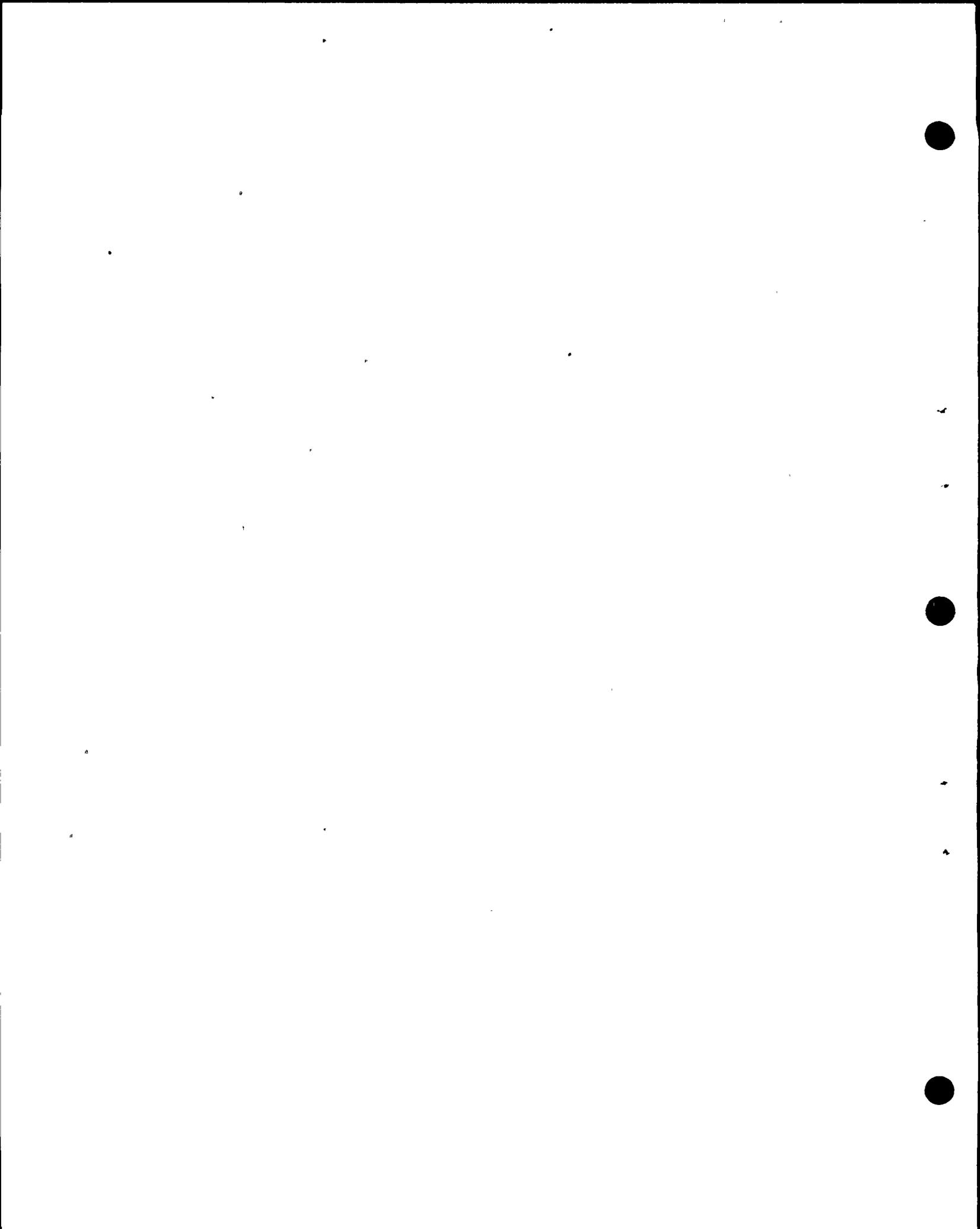
15 A Yes. I stand corrected on that.

16 Q All right.

17 A It shows the area where the twelve-inch offset
18 can be measured, and has been, by myself and Dr. Hall.

19 Q All right.

20 A The point I wanted to make with that was that
21 the reason Dr. Hall had me in the photograph was that we had
22 just guided him to that place. We had previously mapped the
23 faults and pointed out these two offsets which we had al-
24 ready located. And those are still the only two definitive
25 offsets that are known in this area here.



1 The last point that I want to refer to in this
2 map here is that from the color pattern you can see that
3 there are rather distinctively different slices of rock
4 types that exist within the slices of faults branching off
5 from the San Simeon fault. And, in general, they are
6 Franciscan rocks overlain by Monterey formation southwest
7 of the most southwesterly slice. Then there is ophiolite
8 overlain by Jurassic shale. And then there is ophiolite
9 overlain by Lospe formation. And then there is just
10 ophiolite.

11 So we do in fact, instead of having a single
12 package of rocks, if you will, we have fault-bounded
13 slices that separate both different basement rock types
14 and different basement rock types overlain by different,
15 younger Tertiary rock types.

16 Could we go on to the next slide, please?

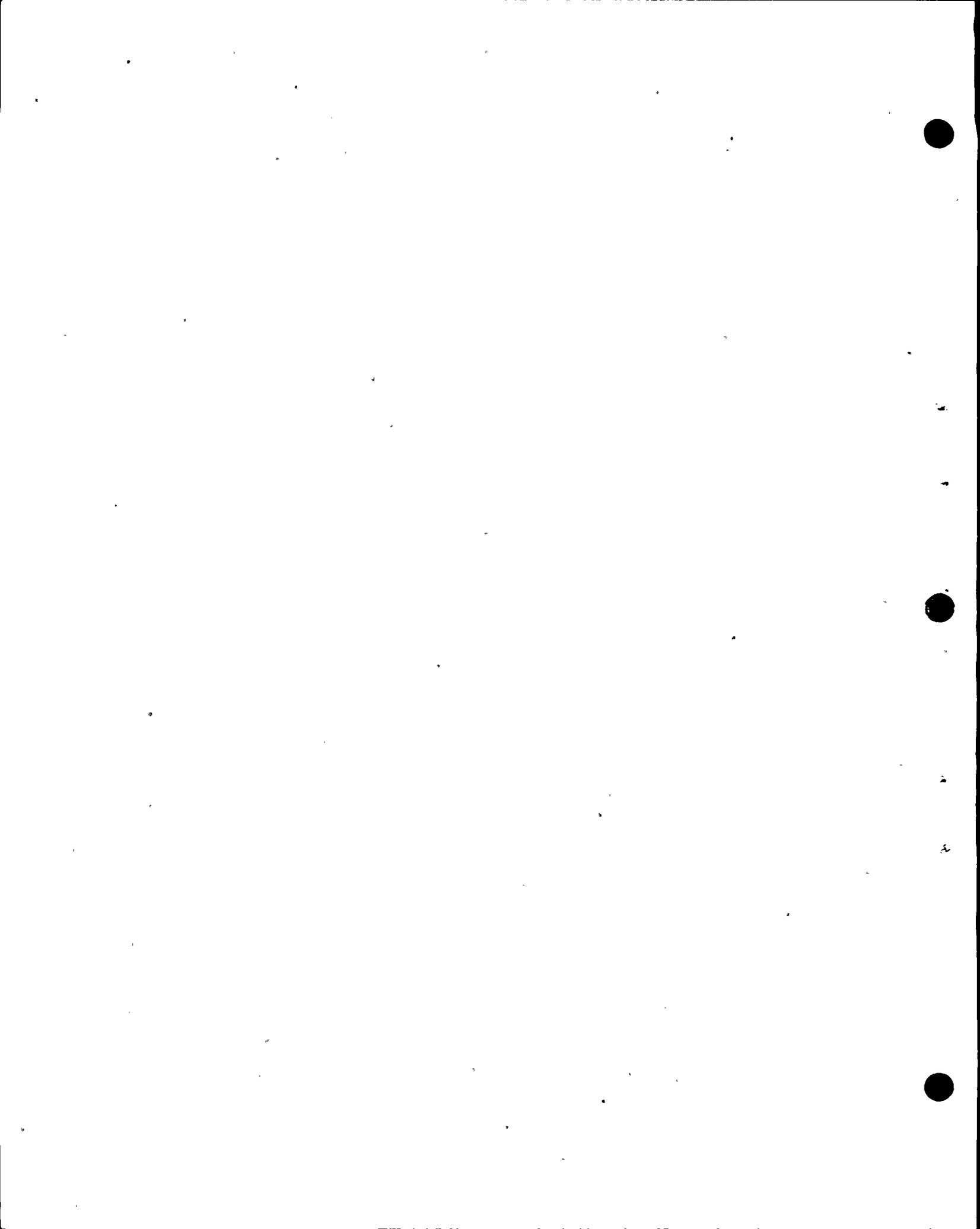
17 (Slide)

18 MR. NORTON: Excuse me. For identification
19 this is Applicant's Exhibit 60.

20 BY MR. NORTON:

21 Q Would you identify this, please?

22 A (Witness Hamilton) This will be my last slide.
23 It's a slide showing stratigraph sections that exist west of
24 the San Simeon fault in the San Simeon-Piedras Blancas
25 area, and stratigraph sections near Point Sal.



1 For the record, I want to correct a misspelling
2 that exists here. I didn't catch this drafting error;
3 but in the lower righthand corner, at the base of the sec-
4 tion that reads "Leoris Head-Point Sal Ridge," the word
5 reading "Leoris" should read "Lions," "Lions Head-Point Sal
6 Ridge."

7 On the left side of this collection of strati-
8 graphic sections I have three sections represented. And
9 those correspond to the rocks that are actually found within
10 the fault slices that exist in the San Simeon-Piedras
11 Blancas area. And as we proceed in the same sequence that
12 I refered to them in discussing the map, in the most
13 southwesterly area one has the Franciscan formation. That
14 is overlain by Monterey formation. The first is indicated
15 by the color green, the second is colored dark blue.
16 That in turn is overlain by Pismo or Sisquoc formation
17 sandstone. And included within the Monterey formation
18 is the kind of thin-bedded chert that is typical of the
19 Monterey formation in most all places where it's found.
20 And included within that are two massive chert lenses
21 that exist at one point along the seacoast about half a mile
22 north of Point San Simeon. That is the extent that I have
23 been able to ascertain that really massive chert exists
24 there. These lenses are respectively about ten inches and
25 about two feet in thickness. Each dies out along strike to
26



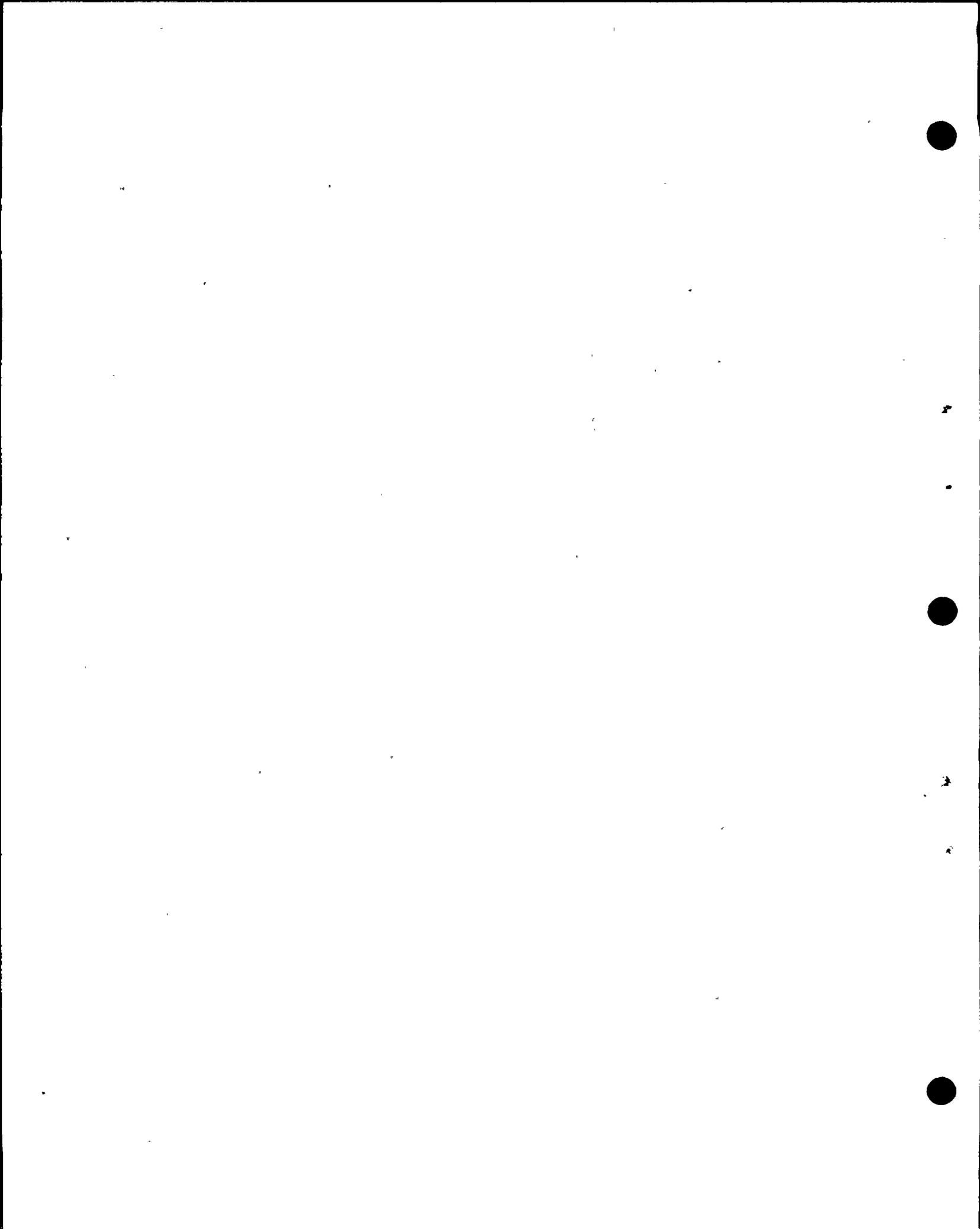
1 zero thickness within a distance of tens of feet.

WRB/wb25 2 Fault-bounded with this part of the section
3 is a section along the next fault which consists of
4 ophiolite basement rock overlain by Jurassic shale with
5 some chert, which I believe is typically a greenish color,
6 located right at the base of the Jurassic shale section.

7 Beyond that, farther north, there is, again,
8 ophiolite bedrock here overlain, instead of by Jurassic
9 shale, by the Lospe formation of which photographs have been
10 shown previously. It's a very distinctive looking rock
11 consisting of rough angular blocks of - derived from the
12 same ophiolite rock type in a finer grain matrix that appears
13 to have been formed as a mud flow or debris flow or a talus
14 kind of accumulation.

15 So these are the rocks that actually exist
16 at San Simeon and in the Piedras Blancas area as they have
17 been mapped on Dr. Hall's published map of the area.

18 On the right side of this figure I have, again,
19 two stratigraphic columns. The one on the right, which
20 should read "Lions Head-Point Sal Ridge" is one that is
21 taken from a publication by Woodring and Bramlett, their
22 USGS Professional Paper 222. That shows a general sequence
23 of rocks ranging from ophiolite in the basement to a section
24 of the Lospe formation that's about 3000 feet thick to
25 Point Sal formation to Monterey formation to Sisquoc

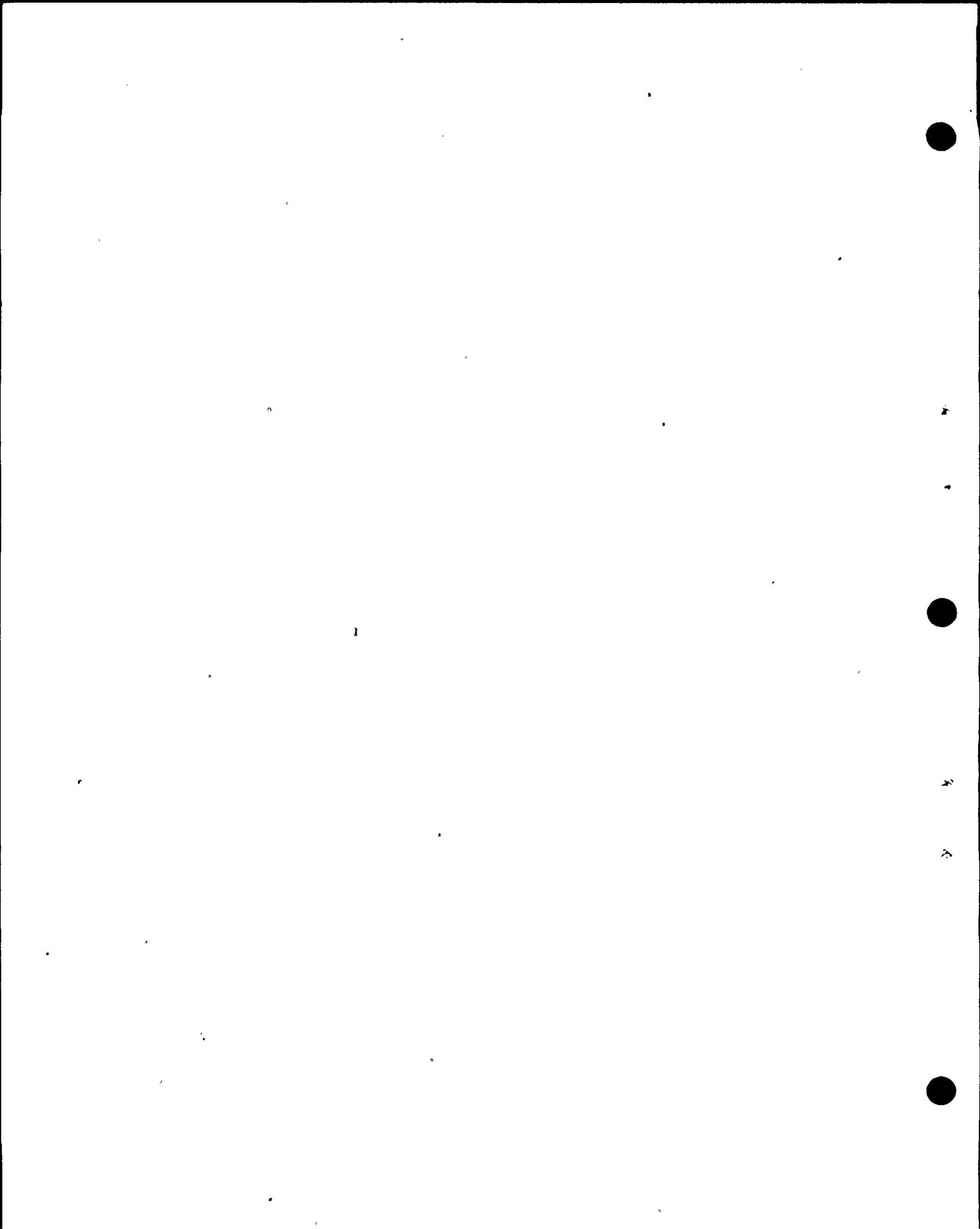


1 formation, and their section goes on up to younger units
2 even, including the Foxen and Cariaga formations.

3 Also shown in a shorter section from another
4 part of the Point Sal Ridge area called Coralillos Canyon
5 by them. There you have an ophiolite basement rock
6 overlain by Franciscan -- by Jurassic shale, and this
7 overlain again by a type of Lospe formation which is rather
8 different from that which exists in the Lions Head area
9 but looks somewhat more like that which rests directly on
10 the ophiolite near San Simeon.

11 The points here are partly to actually present
12 an illustration that shows what the sections look like that
13 are being compared between these two locations when one
14 sees the overall amount of rock that is present, and partly
15 to comment on some rather specific parts of these forma-
16 tions as briefly as I can.

17 First, the Lospe formation, which in the basal
18 part consists of generally quite well bedded sandstone with
19 interlayered sections of generally rounded fragments of
20 both ophiolite and Franciscan debris, contrasting with the
21 generally unbedded basal part of the section near San
22 Simeon. However, included within the Lospe formation at
23 Point Sal is an upper section a nearly 2000 feet thickness,
24 and this section includes, first, a massive to thick bedded
25 gray sandstone, and over that an even thicker section of



1 chipsiferrous gray-green mudstone of which there is no
2 trace in any of the rocks at San Simeon.

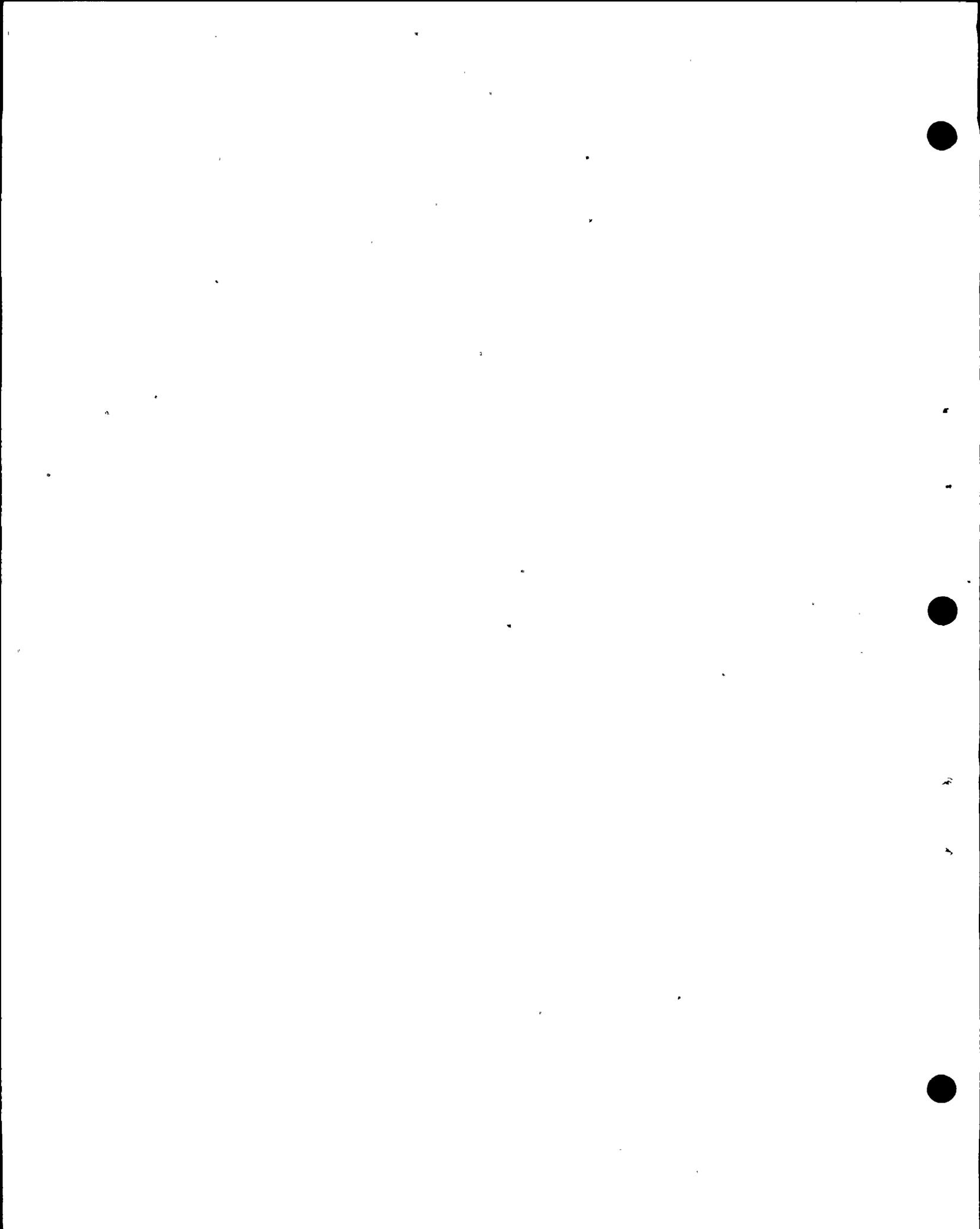
3 Now a point that has been made about these
4 rocks is that you can certainly take a photograph in each
5 place and you can find a piece of one that looks very much
6 like the other because they do contain similar kinds of
7 clasts derived from the underlying soil or basement rock.

8 Another point is that tuff sills, tuffaceous
9 rocks are present in both areas, and land slides are present
10 in both areas. And I think it is significant to note
11 where the tuff sills are and where the land slides are
12 located. Because the land slide in the case of San Simeon
13 is identified as the rocks right at the very base of the
14 section, just over the ophiolite. And that is rock which
15 I think might better be characterized as a mud flow deposit
16 than a land slide. But that's a matter of interpretation.

17 But at Point Sal what is identified as a land
18 slide in fact exists far up in this sandstone regime that
19 exists only at Point Sal, not at San Simeon.

20 So you're looking at very different parts of the
21 section and very different host rocks.

22 To insert geologic interpretation again, I
23 feel that the rocks called land slide at Point Sal are
24 in fact not a land slide but, rather, are a type of
25 intrusive body that is related to the location of the



1 tuffaceous rocks which also exist in a very different part
2 of the section, again not present at all at San Simeon.

3 So those are just some of the points that can
4 be made.

5 One can have, in fact, as Mr. Fleischaker has
6 indicated, probably thirty points, or thirty pages of items
7 of argument about the section here. But if you take the
8 rocks as they are mapped, they come out in a set of sections
9 that look as those on the left side of this figure. And
10 the mapped, or published record shows a section that looks
11 like that on the right side of the figure. And it's my
12 judgment that they offer no substantial basis for compari-
13 son; that if any conclusion can be drawn it is that the
14 rocks were not originally part of a contiguous package.

15 Q Excuse me, Dr. Hamilton. I take it, then,
16 that what we're looking at on the left side of the slide
17 the three rock formations are those found at San Simeon
18 within the different splays of the faulting at San Simeon?

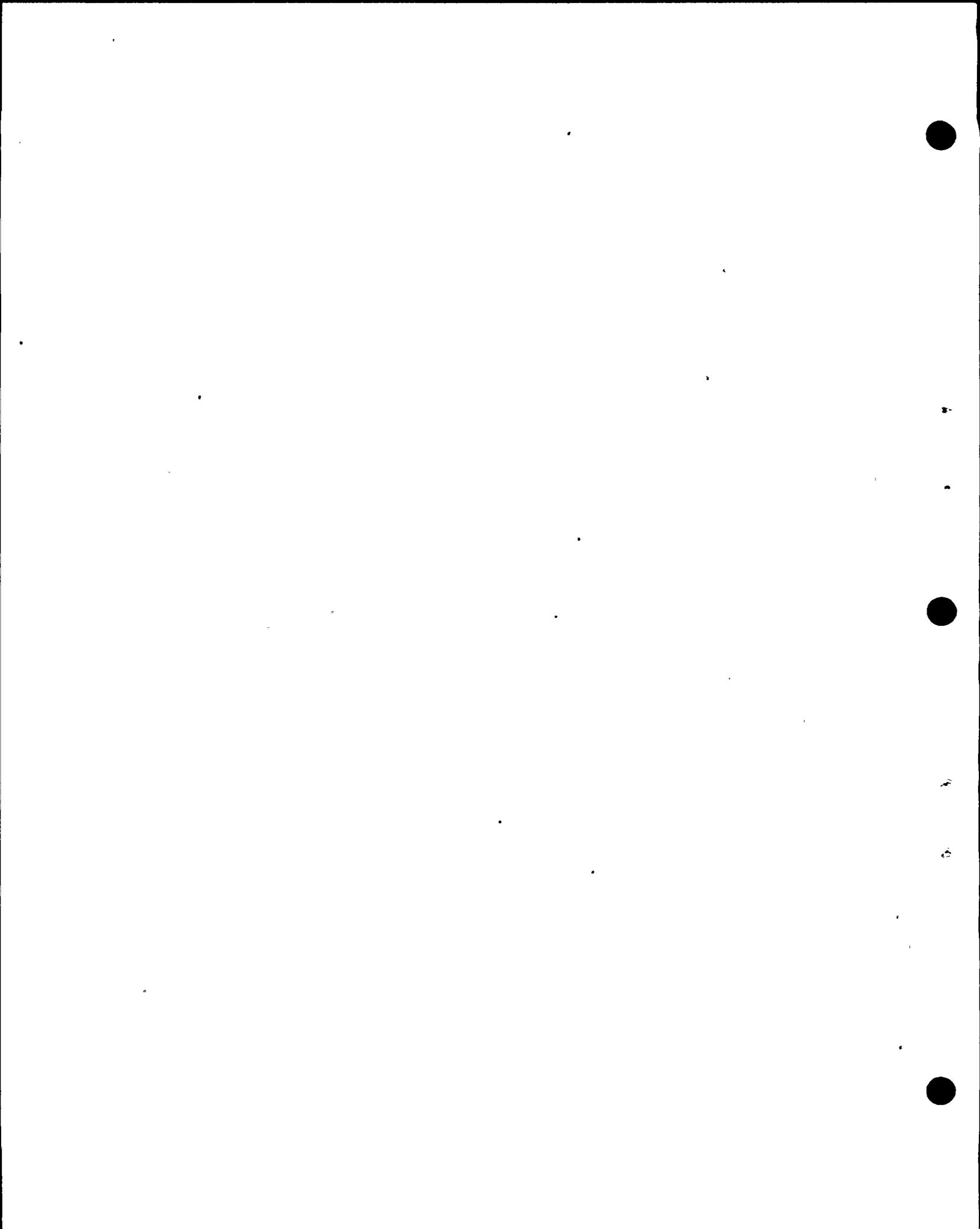
19 A That's true.

20 Q And that on the right is what one finds at
21 Point Sal?

22 A That's true.

23 Q All right.

24 And I take it, then, that in summing up all of
25 this description, that you are saying that the packages are



1 dissimilar; is that correct?

2 A Yes.

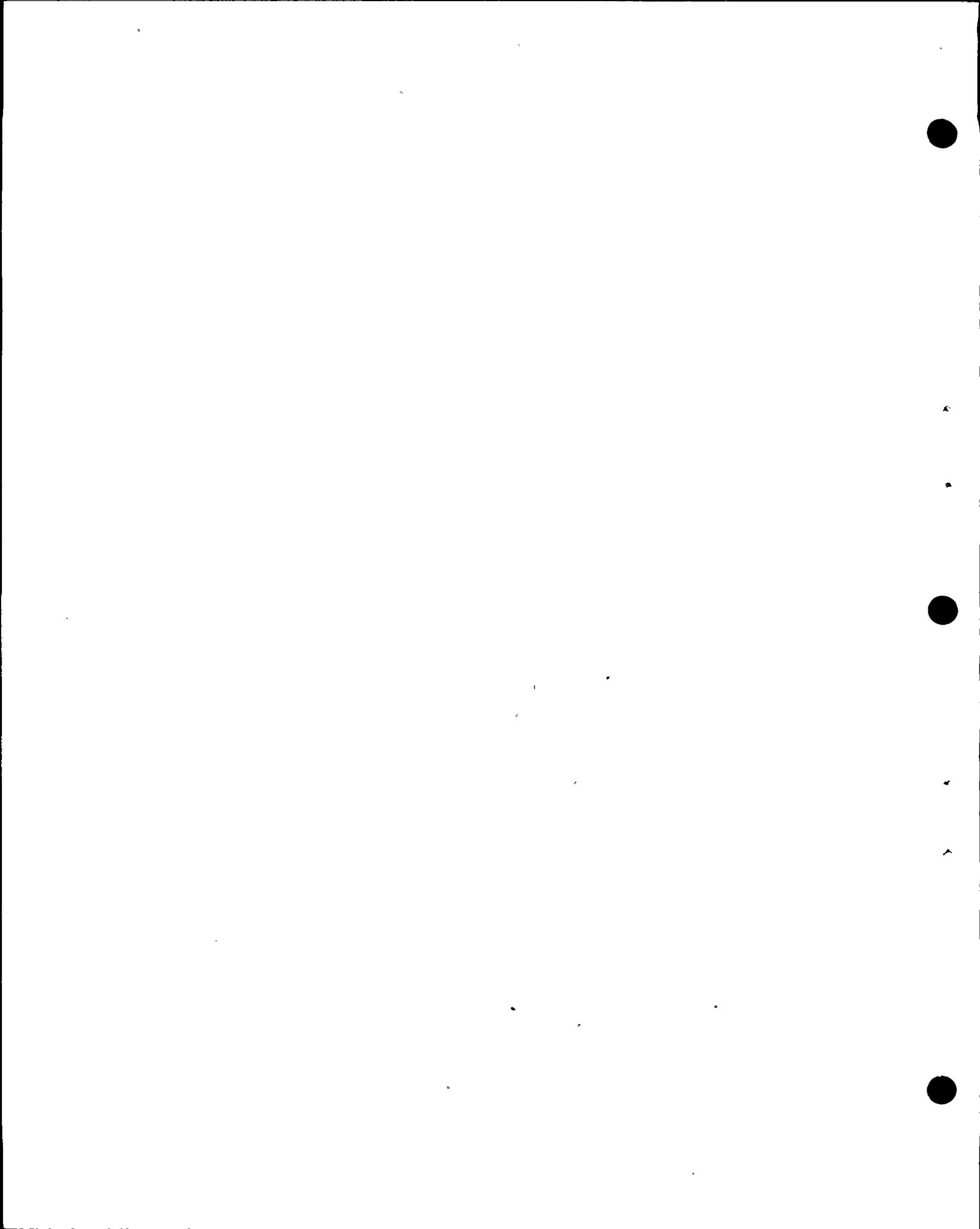
3 Q That is, the Hall Point Sal-San Simeon claimed
4 offset; is that correct?

5 A Yes, that's true.

6 A And would you describe these as complete
7 packages?

8 A The only part of the package that is missing
9 that I have not identified here would be the rock which
10 you might make an altogether separate section for, which
11 is the piece of Cariaga formation -- or, rather, the piece
12 of rock that Dr. Hall correlates with the Cariaga forma-
13 tion, which has dimensions that are roughly similar to
14 that of the Hearing Board's table, maybe twenty feet long,
15 say, that exists within the San Simeon fault zone at
16 San Simeon, and which is proposed as being correlative
17 with rock that would be far at the top of this section on
18 the far right side of the figure and located several kilo-
19 meters to the east from where these rocks are mapped near
20 Point Sal.

21 End WRBloom
22 WRZandon #15
23
24
25



2WEL 1
wel 1

1 Q So, then, you would say that in the complete
2 packaging they are dissimilar?

3 A That's my conclusion, yes.

4 Q Does that conclude your portion of this testimony?

5 A Yes, it does.

6 Q All right. Now, I would like to ask Dr. Jahns
7 a couple of questions.

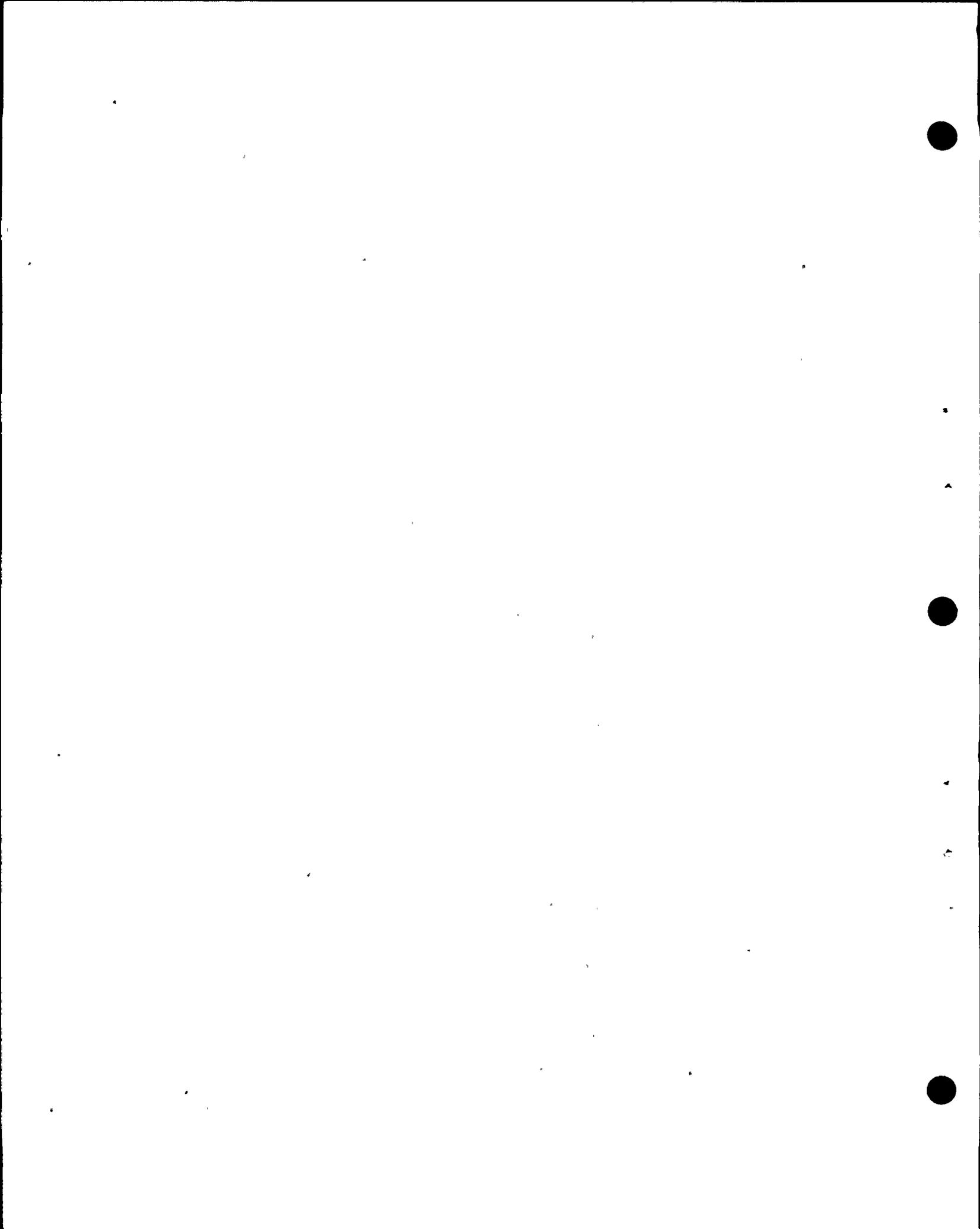
8 Dr. Jahns, Mr. Fleischaker a question of Dr. Hall --
9 I believe it's in the transcript dated February 13, at page
10 9557.

11 Let me find it for you, and read the question.

12 Excuse me. It started on the bottom of page 9556.
13 I'll read you the question, and then I'll read you the
14 answer.

15 "Q There's been considerable testimony regarding
16 the possibility or the lack of possibility -- strike
17 that.

18 There's been considerable testimony concerning
19 the difficulty of accommodating slip in the Transverse
20 Ranges, right lateral slip of the nature of 60 to 80 to
21 100 kilometers in the Transverse Ranges. And one of
22 the problems, or one of the difficulties that have
23 been raised is the geometry of the region, which has
24 been described, I think, by Dr. Jahns as a T, and
25 that the geometry of the region prevents the kind of



1 right lateral slip that you have postulated in your
2 article. Do you have an opinion on that matter?

3 A Yes, I have an opinion.

4 Q What is that opinion?"

5 The answer is -- and I will read that answer, and
6 there are more questions and answers that follow that, that
7 you have reviewed, Dr. Jahns, but I don't think they go to
8 that question. One could argue that they do.

9 In any event, you have read, I take it, this
10 section of the transcript following, is that right?

11 A (Witness Jahns) Yes, I have.

12 Q And didn't we in fact discuss it, and you under-
13 stand what the questions and answers are that follow this.
14 I want you to keep those in mind also in response to my
15 question, because it could be argued that that's a further
16 answer. So keep those questions and answers that follow
17 this in mind when responding to my question.

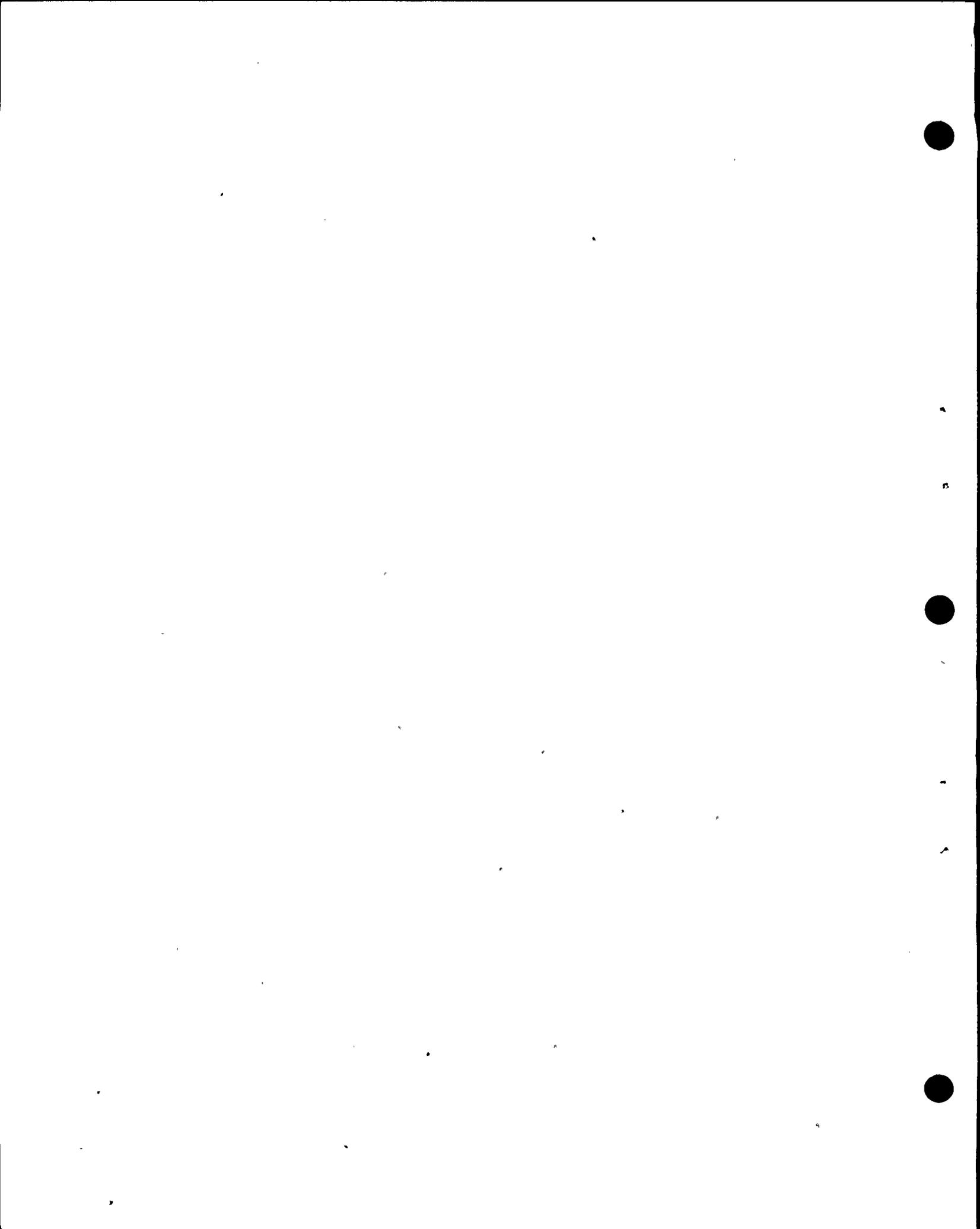
18 A Yes, I shall.

19 Q The answer to that question was:

20 "Well, if we look at Figure 107, we don't really
21 see a T that would be between the Transverse
22 Ranges, in that figure near and south of the
23 letters L..."

24 and it says "-F" but I think that's a typo. It's L-S, for
25 the Lompoc-Solvang Fault --

26 "...and near the circle with a B above it, which



wal 3 1

refers to Buelton, and we don't see, actually,
2 a T. We see a merging in, as was described by
3 Payne and others in the abstract..."

4 and he was referring to the abstract of the Fugro report
5 there, I believe --

6 "...traversing a cross-section and coming into
7 land at an angle. But in order to really
8 appreciate the geometry of the Transverse Ranges,
9 I think it's necessary to discuss the formation
10 of the pull-apart basin, because in large measure
11 the formation of the pull-apart basin gives us
12 an idea as to the time of movement along the
13 San Simeon-Hosgri Fault."

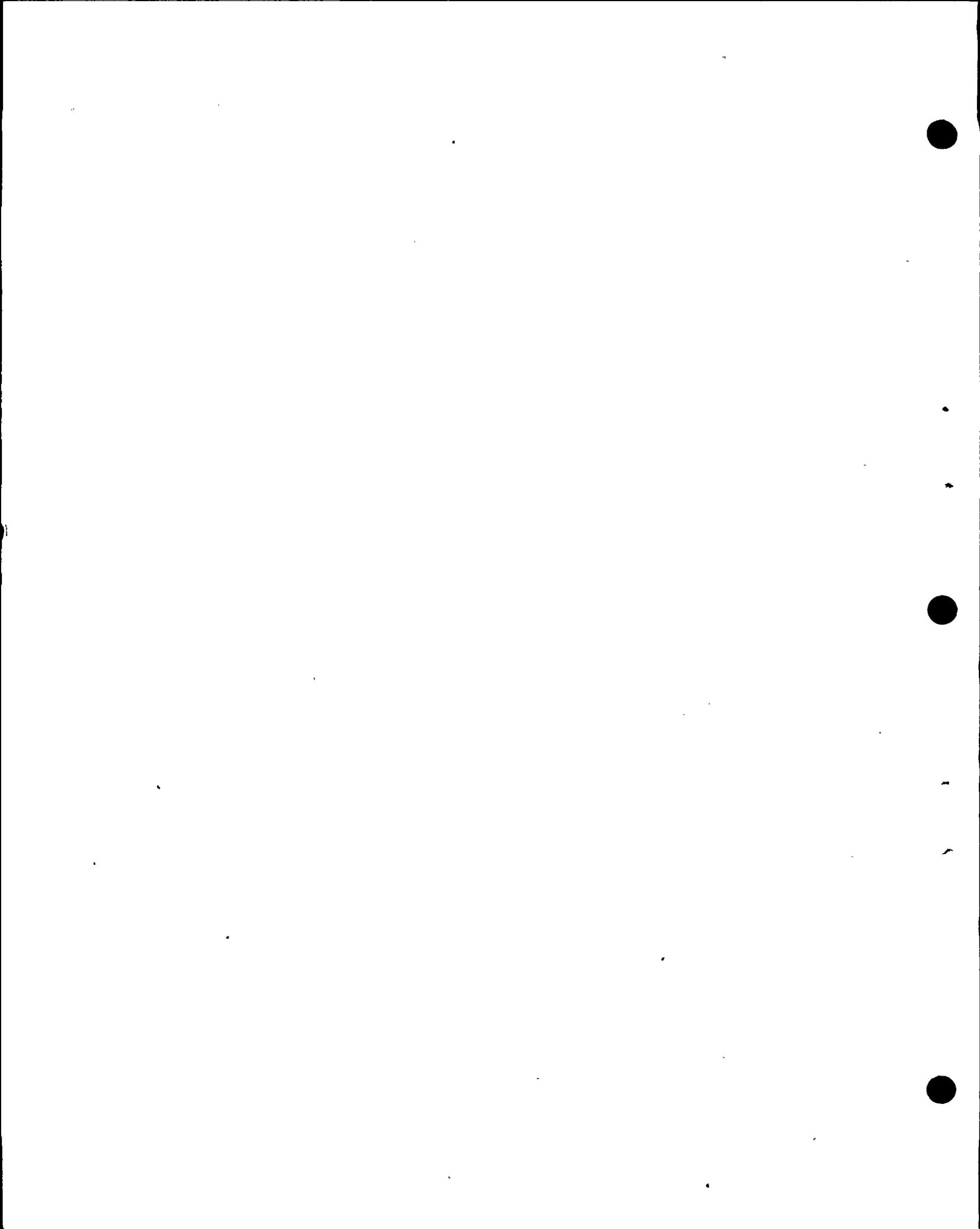
14 All right, I'll have several questions. First
15 of all, you heard all of Dr. Hall's testimony and cross-
16 examination here, did you not?

17 A Yes, I did.

18 Q And was it not his testimony that the movement
19 on the San Gregorio-San Simeon-Hosgri Fault zone occurred
20 following the formation of the pull-apart basin?

21 A That certainly is my understanding.

22 MR. FLEISCHAKER: I'd like to object to this
23 manner of proceeding, whereby Mr. Norton restates Dr. Hall's
24 testimony. Dr. Hall's testimony is in the
25 purposes of rebuttal, and Dr. Jahna has read transcript



wel 4

1 and was here during the testimony.

2 It seems to me that the proper way to proceed is
3 to ask Dr. Jahns whether he agrees with the opinion given
4 by Dr. Hall, and if so, why, and if not, why not. We don't
5 have to go through this restatement of Dr. Hall's opinion,
6 which is in black and white in the record.

7 MR. NORTON: Mrs. Bowers, it's very difficult for
8 me to ask the witness if he agrees with the testimony unless
9 I say what the testimony was.

10 MR. FLEISCHAKER: The testimony is in the record,
11 and --

12 MR. NORTON: And that's why I'm reading it.

13 MR. FLEISCHAKER: You're not reading it. You
14 were rephrasing it. It seems to me that --

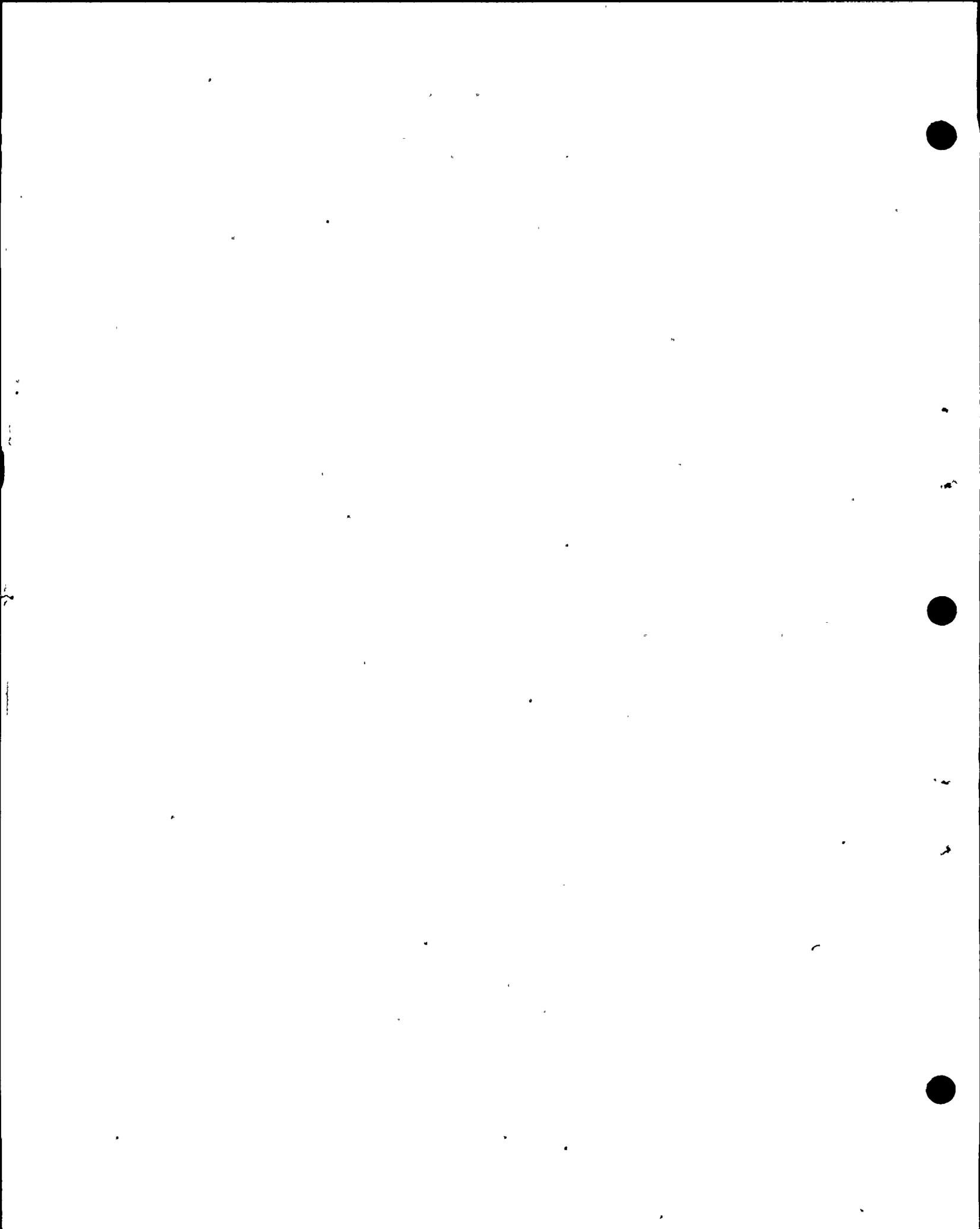
15 MRS. BOWERS: Were you reading it verbatim?

16 MR. NORTON: I was reading verbatim, obviously,
17 for a while, and then I asked him about the timing. And
18 that was gone into in a great many places, as to the timing.

19 I don't think there's anybody in this room, even
20 Mr. Fleischaker, who is saying I'm misstating that. I can
21 go find it in the transcript and read it on a number of
22 occasions.

23 But that's the context of my question, is the
24 timing, and this answer.

25 MR. FLEISCHAKER: Well, it is inappropriate for



wal 5

1 Mr. Norton to recast Dr. Hall's testimony. It's in there.
2 There are -- I don't know -- 50, 100 pages of explanations,
3 perhaps, as to why he believes that the geometry and the
4 timing of movement in the Transverse Ranges accommodates the
5 slip that he's postulated.

6 I don't know whether Dr. Jahns agrees or
7 disagrees with that, but certainly he can state his opinion
8 and give all of the reasons, without having Mr. Norton
9 paraphrase Dr. Hall's testimony.

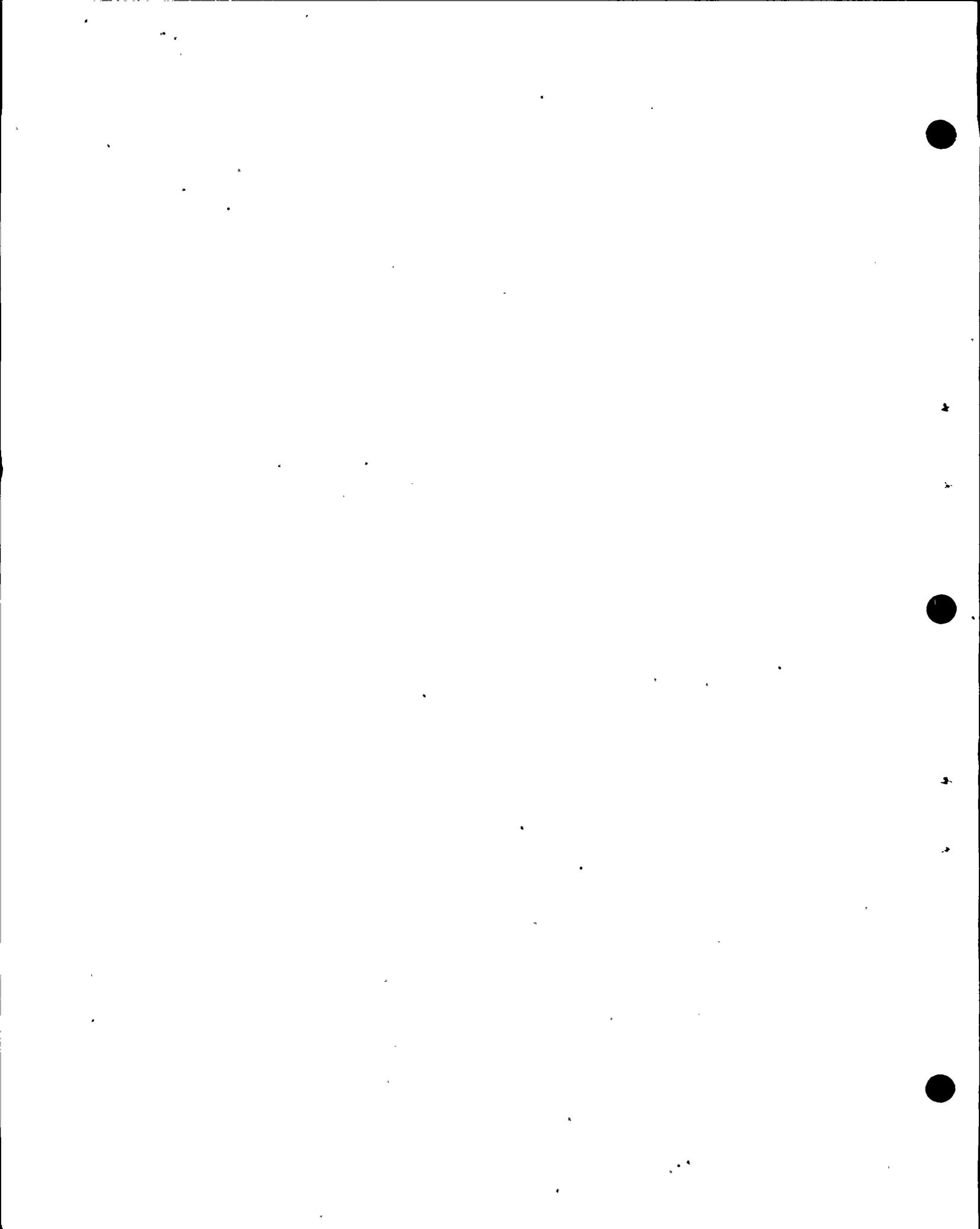
10 MR. NORTON: Mrs. Bowers, that's an absurd
11 objection. I don't understand the basis for it. May I
12 hear a legal basis for Mr. Fleischaker's objection, rather
13 than a speech as to how he would like to proceed?

14 MR. FLEISCHAKER: The objection goes to the form
15 of the question.

16 MR. NORTON: What's the basis? Form is a generic
17 category of objection. May I hear a specific basis for an
18 objection to my question so I can respond to it?

19 MR. FLEISCHAKER: The form of the question -- the
20 basis is that Dr. Hall's explanation of the pull-apart basin
21 takes up 10 or 15 -- I don't know how many pages, and Mr.
22 Norton, by rephrasing it, may, in the course of that
23 rephrasing of the testimony, misstate Dr. Hall's opinion.

24 MR. NORTON: Mrs. Bowers, whether I -- if I
25 misstate the evidence, then there is an objection called,



wel 6 1 "Object, misstates facts in evidence," or "assumes facts not
2 in evidence," actually.

3 If that's the basis of the objection, I submit
4 to the Board that I have not misstated the facts in evidence.
5 I have stated them correctly, that Dr. Hall stated that the
6 movement on the Hosgri occurred after formation of the
7 pull-apart structure.

8 And if we want a citation in the transcript,
9 I'll give it to you very quickly.

10 MR. FLEISCHAKER: Fine.

11 MRS. BOWERS: Mr. Staenberg?

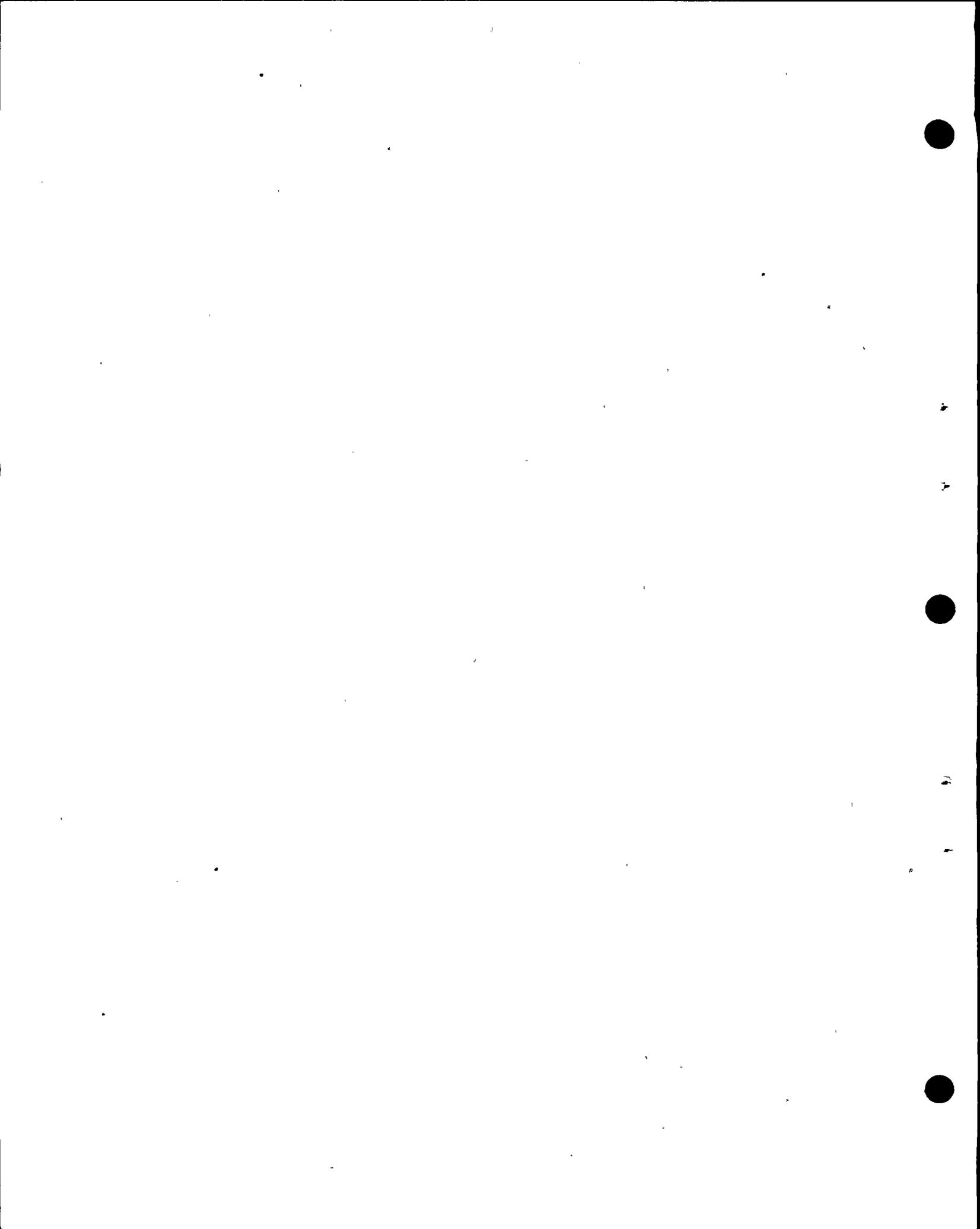
12 MR. STAENBERG: Applicant may wish to do that,
13 but it isn't really necessary.

14 Mr. Fleischaker is incorrect. Indeed, he says
15 that there are many, many, many pages of testimony by Dr.
16 Hall, and there really is no way to, without paraphrasing
17 some aspect of the testimony about which Applicant wishes
18 to ask questions, for them to ask specific and discrete
19 questions.

20 So it is without basis, the objection is without
21 basis.

22 MR. NORTON: Well, Mrs. Bowers, I found it in
23 one place. I just opened to it:

24 "Do you have an opinion as to the timing of
25 this movement along the Hosgri Fault?"



wel 7

1 This is at page 9578.

2 Answer:

3 "Yes, I think that based on the Pliocene rocks
4 in the San Simeon area and the dissimilarity of
5 those Pliocene rocks with any rocks on shore
6 nearby, the similarity of those rocks with rocks
7 in the Santa Maria Basin area, the similarity
8 of the fauna from that particular area, suggest
9 to me that the movement may have been prior --
10 I'm sorry -- following the formation of the basin
11 and sometime after 5 million years."

12 MR. FLEISCHAKER: Okay, we can proceed, point by
13 point.

14 MRS. BOWERS: You're withdrawing your objection,
15 is that correct?

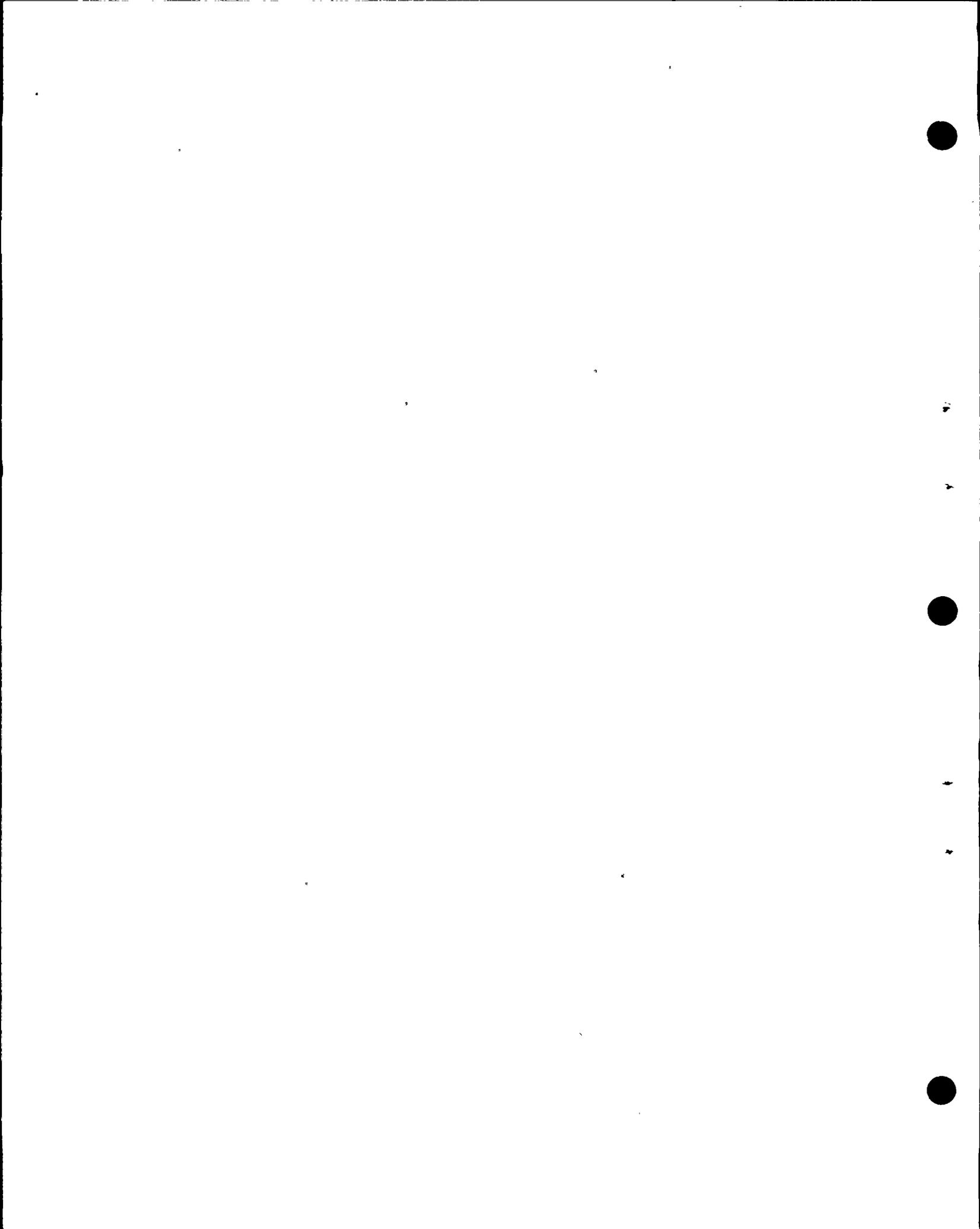
16 MR. FLEISCHAKER: As to this particular question.

17 BY MR. NORTON:

18 Q All right. Dr. Jahns, I've read the answer as to
19 his explaining away your problem with what you described as
20 the T.

21 Do you feel that the answer that is contained
22 there on page 9557 and the following questions and answers
23 of Dr. Hall, in any way explain away the geometric problems
24 that you have?

25 A (Witness Jahns) No, I don't. Frankly, the answer



wel 8

1 doesn't match the question. I don't believe that the
2 answers I heard or read in the transcript are truly respons-
3 ive to the question that Mr. Fleischaker addressed to Dr.
4 Hall.

5 Q Now, we're going to show on the screen Applicant's
6 Exhibit 43, which is Dr. Hall's, or Joint Intervenors'
7 original exhibit 107, which was referred to in the answer.
8 And the reason it's PG&E's Exhibit 43 is because we had Dr.
9 Hall make some markings on it. (Slide.)

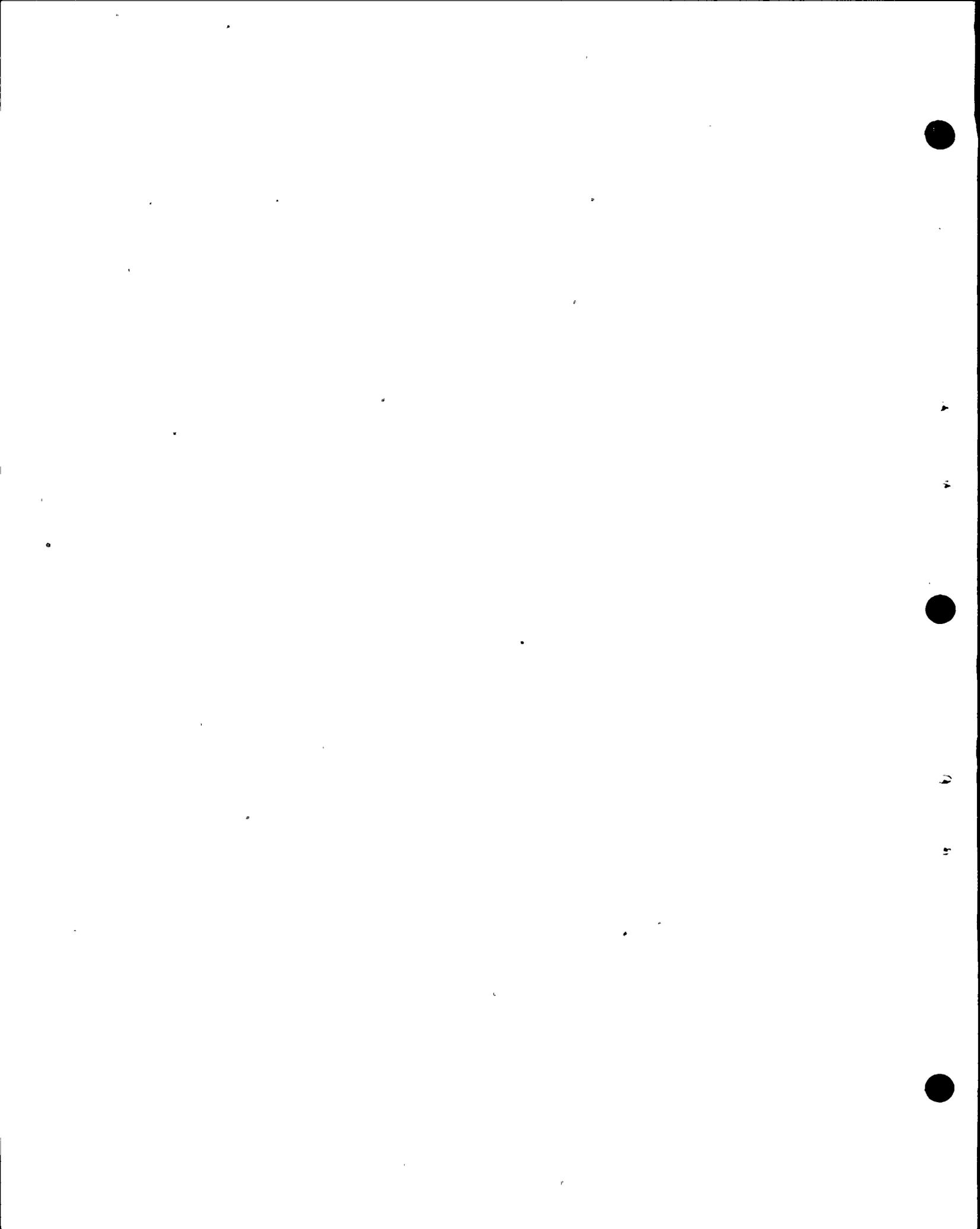
10 Let me ask you: Did you hear Dr. Graham's
11 answer to my question yesterday regarding the movement of
12 the land mass east of Buelton and north of the Lompoc-Solvang
13 Fault into the so-called pie wedge, which is the Y of the
14 Lompoc-Solvang Fault? Did you hear my question and his
15 answer to my question about how could it geologically move
16 there? Did you hear that?

17 A Yes, I did.

18 Q Did you feel that that answer answered the
19 question of how it moved there?

20 A No, not really. I would interpret it more as an
21 attempt, similar to the attempt that several of us made, who
22 were involved in listening to understand what Dr. Hall was
23 driving at.

24 Q All right. Could you as a -- I guess the Dean
25 of the Geologists at these proceedings -- explain to me
26



wel 9 1 how you can move a land mass, which Dr. Hall has indicated
2 by the arrow marked "P", which is east of Buelton, across
3 the Hosgri Fault into that pie-shaped wedge in the last
4 five million years, or for any period of time? Is that
5 physically or geologically possible?

6 A Well, on the face of it, it's physically and
7 geologically quite impossible.

8 The problem here being dealt with was the
9 necessity for Dr. Hall to derive this material from the
10 basin area shown here in the cross-hatched area, and
11 identified as to position by "P".

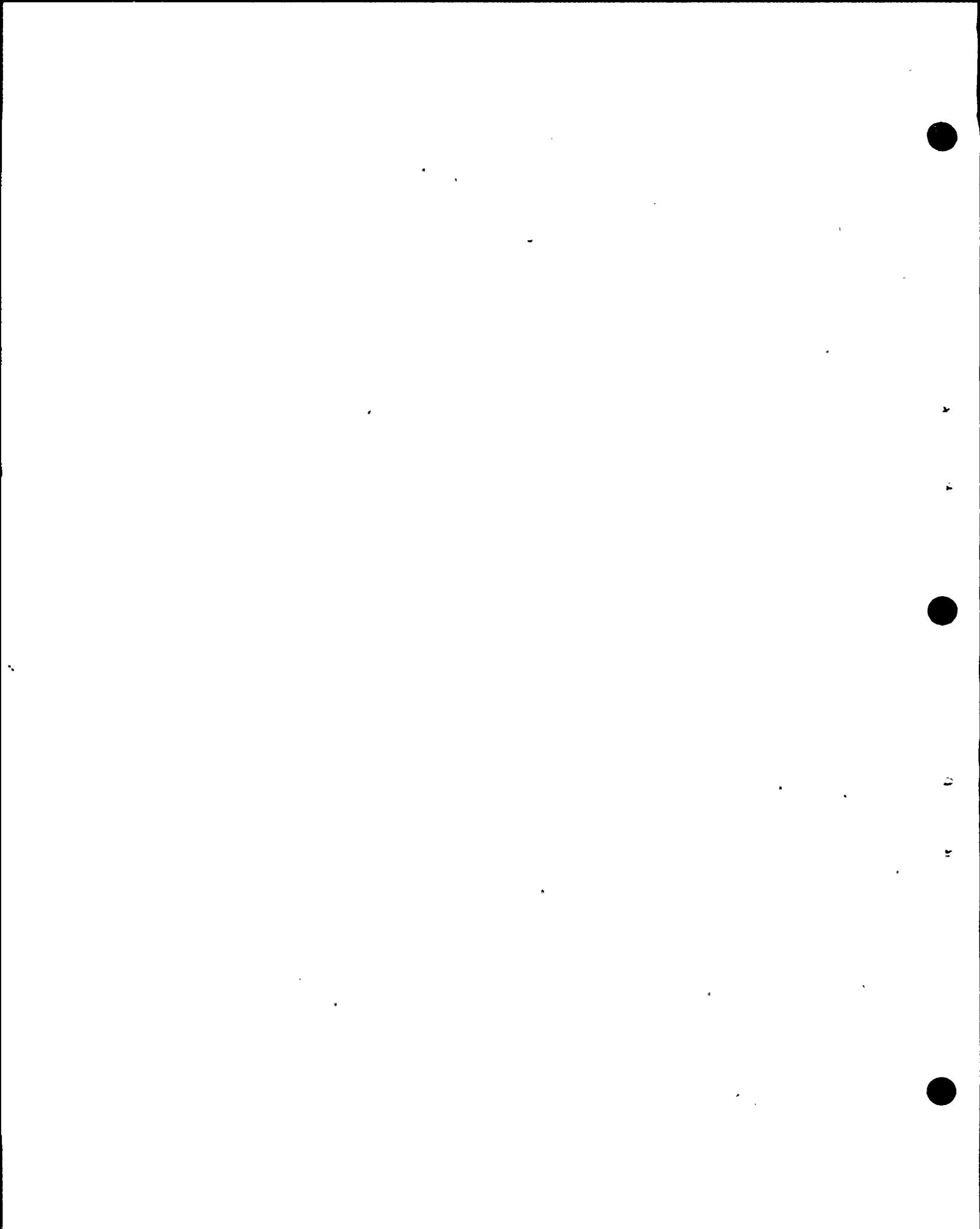
12 In order to do that, he indicated it on this
13 base as that point. Well, unfortunately, that point is
14 then on the wrong side of the fault.

15 So, in order to accomplish the geometric restoration
16 about which he was being questioned, he would have to have
17 point "P" on the south side of the fault, rather than on
18 the north, or basinal side.

19 Q If he had it on the south side of the fault, where,
20 incidentally, in his response he initially put it and then
21 changed his mind and said, no, it has to be in the basin so
22 it has to be north of the Lompoc-Solvang Fault --

23 A Yes.

24 Q -- if it were on the south side, is there any
25 physical or geologic way to get it across the Lompoc-Solvang



wel 10

1 Fault into the pie?

2 A You can't very well get it across a fault. You
3 can't, in other words, skip or leap-frog from one side of
4 the fault to the other. It's a geometric impossibility.

5 Q All right.

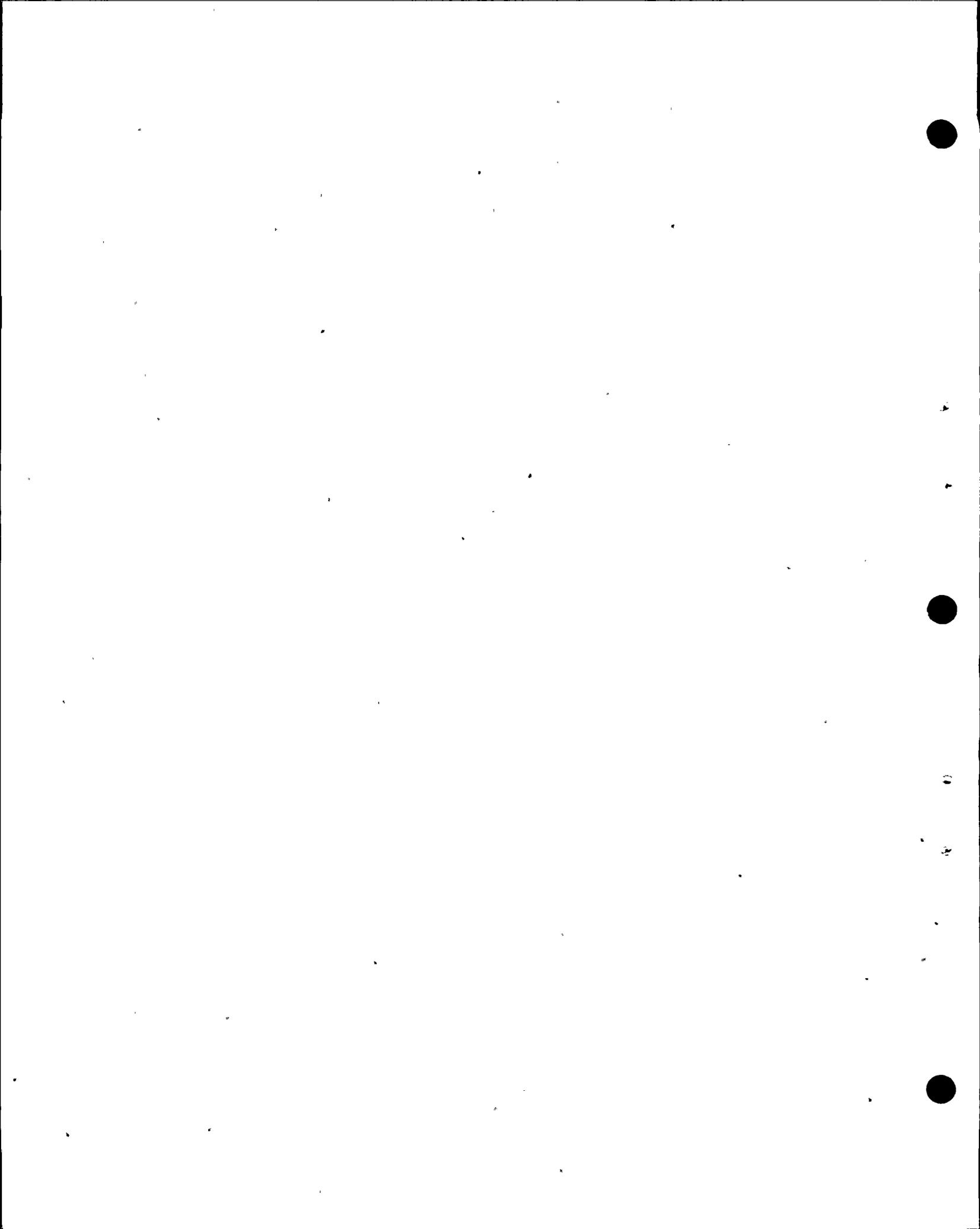
6 Now, this is the figure that Dr. Hall refers to
7 in response to Mr. Fleischaker's question, which I just
8 asked you about, as to, can you explain Dr. Jahns' problem
9 with the T. And this is the figure he says explains that.

10 Now, looking at that figure, it's indicated where
11 the Point Sal-San Simeon offset is, of, we now find, 50 to
12 80 kilometers, and you heard the testimony where x^1 has
13 remained constant since the formation of the basin, is there
14 any way you can explain how that offset could occur by
15 looking at that figure, Dr. Jahns?

16 A No. No way.

17 Q Do you still have all those geometrical problems
18 that you had the first few days we were here in these
19 hearings back in December?

20 A Yes. I must say, indeed I do. And to make things
21 perhaps a little clearer, it may have been that Dr. Hall
22 didn't fully understand what I had in mind in referring to
23 the inverted T. That was only a frame of simple reference
24 in order to make clearer the geometric difficulties that I
25 was having in applying his theory to what's known about the



wel 11

1 geology of this region.

2 And simply to review in a few words the stem of
3 the T would correspond, for reference, to the Hosgri Fault
4 zone offshore on this map, and the head of the T, which
5 would be at the bottom of the diagram, because it's inverted,
6 would be the north edge of the Transverse Ranges, and that
7 the T is distorted, or that there is geometric complication
8 at the junction of its cap and its stem is really incidental.
9 It's only a frame of reference.

10 Q All right.

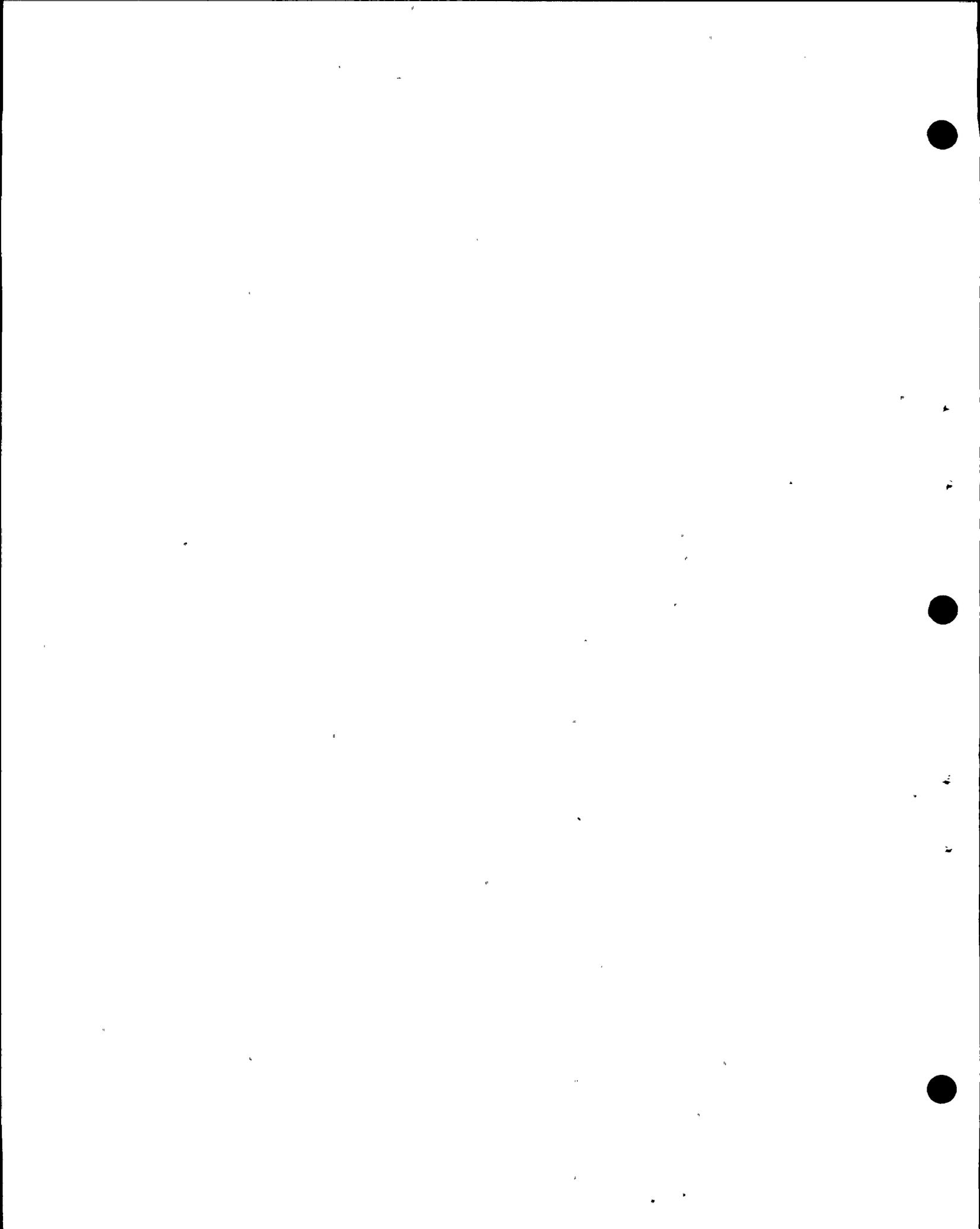
11 Would you agree that Dr. Hall has the same
12 geometric problems you do when you watched him trying to
13 show where the existing land that's in the pie today came
14 from?

15 A Yes. And this is an understandable thing,
16 because Dr. Hall has made, I think, a very important
17 contribution in style of thinking when he emphasizes the
18 role of packages in attempting to make correlations and make
19 interpretations.

20 It's far more impressive if one can correlate
21 firmly packages of two or three or more units across a
22 fault, for example, as he has attempted to do.

23 That's particularly true if the packages are,
24 indeed, identical.

25 I think one of the problems with the very



vel 12

1 interesting theory of the kind that Dr. Hall has proposed
2 is that we tend not to think of it in terms of a package,
3 which it really is.

4 In other words, when we examine the theory
5 critically, or when we examine its applications, we look at
6 two or perhaps three factors at that time. We don't look
7 at all of the interrelated factors.

8 In this instance, we must look, it seems to me,
9 at at least five of these factors, and they are simply these:

10 A fault, the Hosgri, along which there's been
11 right slip. That's factor number one.

12 Right slip along the Hosgri amounting to 80
13 kilometers. That's point two.

14 Factor three is right slip of 80 kilometers during
15 the past five million years. That's point three.

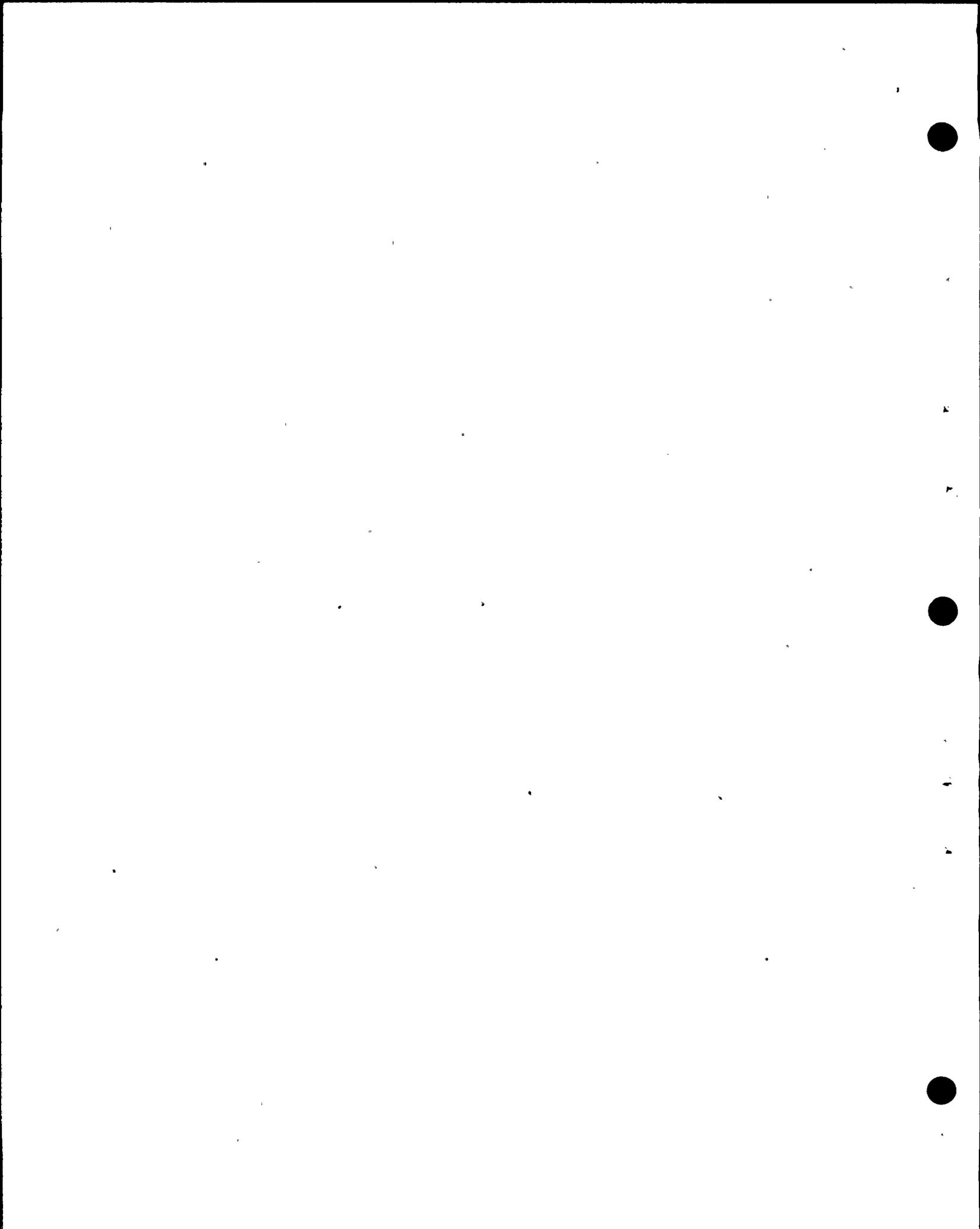
16 The other two factors are very important, but
17 we can't do much about them, because they're there, and we
18 can't change what we know about them.

19 These are:

20 First, the geologic situation on either side of
21 the Hosgri north of the Transverse Ranges; and

22 Second, the geologic situation on either side
23 of the north edge of the Transverse Ranges.

24 Now, my point, and the reason for my making a
25 very unusual -- unusual in the sense that it was pretty



wel 13

1 doggone definite -- statement in earlier testimony, that the
2 geometry of the northern Transverse Ranges is fatal to the
3 Hall theory, is simply tied up in the package approach.

4 If we attempt to place these five factors in a
5 package, we cannot wrap up the package. That's what it
6 amounts. Because at least one of those factors is incompatible
7 with the others.

8 I think I can show that in just a few minutes with
9 another diagram, if we could put Figure 8 back on the screen
10 from the Applicant's original direct geologic testimony.

11 Q This was Figure 8 from the prepared testimony of
12 yourself and Mr. Hamilton, is that correct?

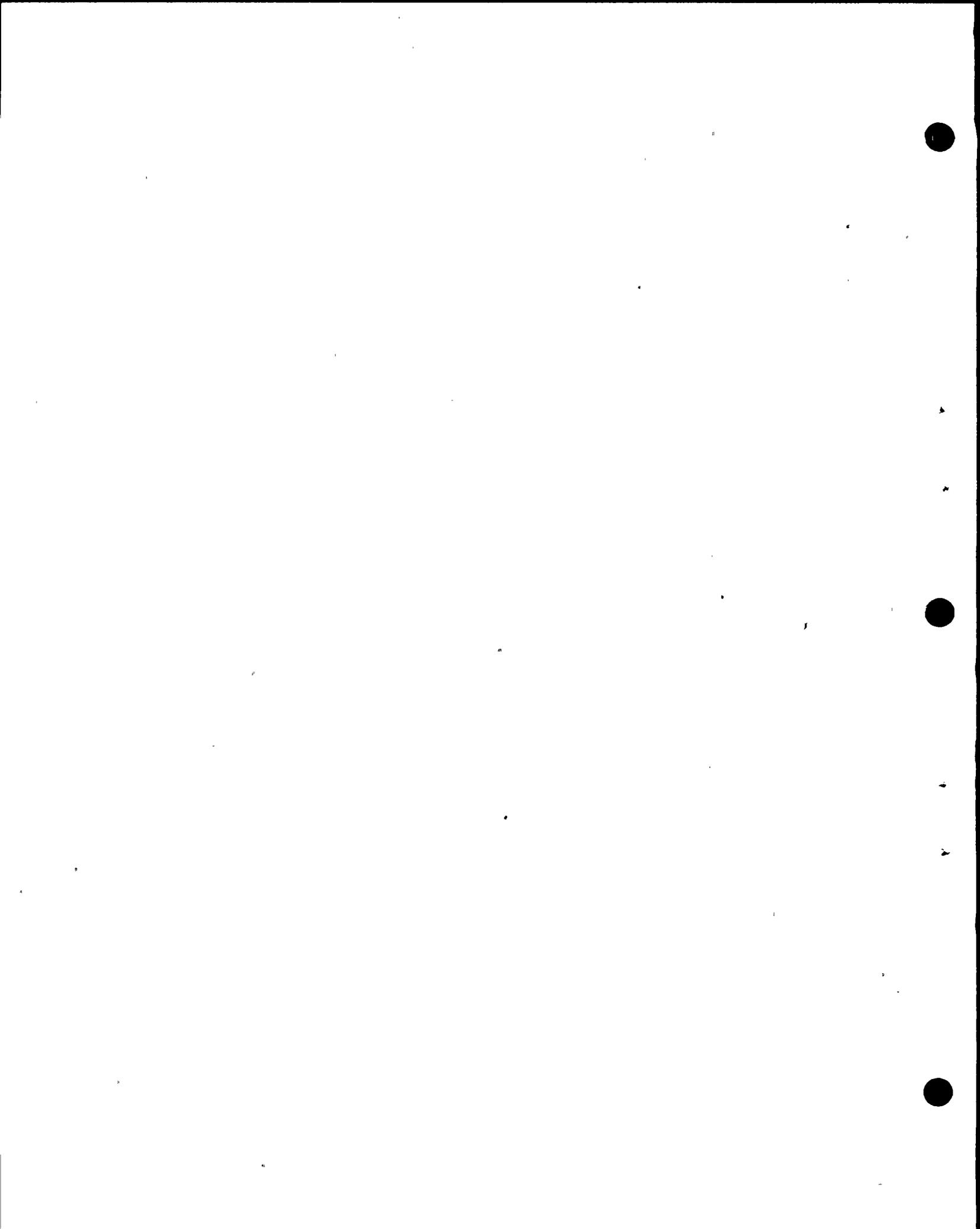
13 A Yes, that's correct.

14 (Slide.)

15 Now, the problem I'd like to indicate here in
16 proper scale and in the context of all five of these factors,
17 and these five factors don't represent all the ones that are
18 pertinent, but they do represent the ones most pertinent, to
19 the problems here.

20 It's simply this matter:

21 Referring to the figure here, which is Figure 8,
22 we can see plotted on it the Hosgri Fault offshore, and
23 coming to an end in the offshore area. We can, if we wish,
24 assume for purposes of argument here, that it doesn't end.
25 The evidence does not suggest that. But we can assume th at



wel 14

1 it doesn't end, and, instead, makes a landfall, as Dr. Hall
2 indicated, and somehow joins up with some of the typical
3 Transverse Ranges breaks.

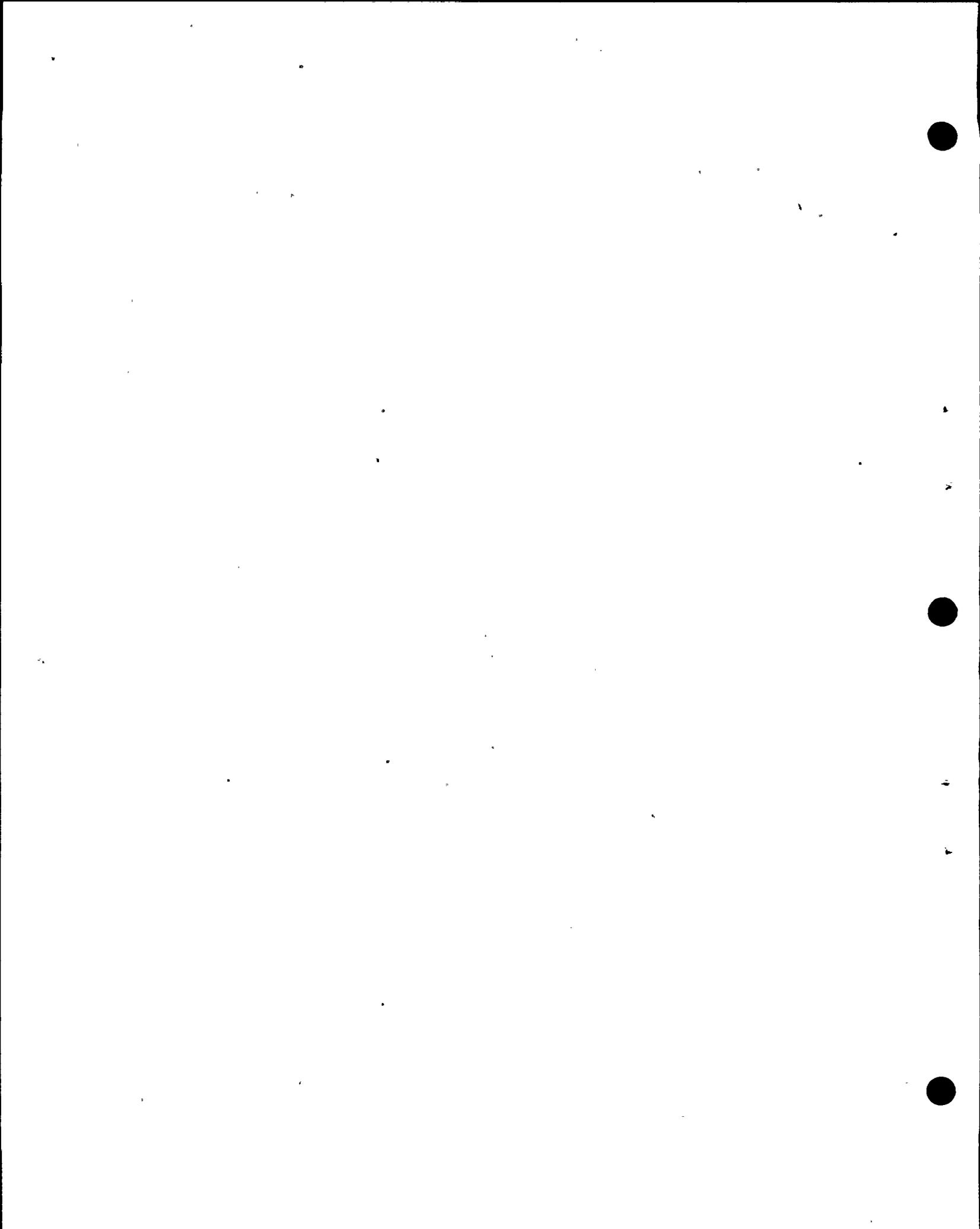
4 But in terms of this theory, we are stuck with
5 certain things, and one of these is the combination of, in
6 effect, getting rid of 80 kilometers worth of crust on the
7 east side of the Hcsgrri Fault, and north of the Transverse
8 Ranges, during the past five million years.

9 This is the reason why I don't regard Dr. Hall's
10 answer to Mr. Fleischaker's question as responsive, because
11 he referred everything to the pull-apart basin in this
12 general area of the curved breaks at the north end of the
13 Transverse Ranges on either side of the present coast.

14 He referred to that basin as a kind of
15 explanation, and yet that basin, by his own testimony -- and
16 with good evidence -- was developed sometime in the period
17 let's say 7 million to 17 million years ago.

18 But the problem we are addressing is what has
19 been happening during the past five million years, a time
20 interval quite different from the one involved in the basin.

21 So I suggest we look at that last five million
22 years, and ask ourselves how we can possibly get rid of
23 80 kilometers of crust -- and to get rid of it is in quotes,
24 because we don't get rid of it, really, but we must account
25 for it. We can focus on the crust north of the Transverse



wel 15

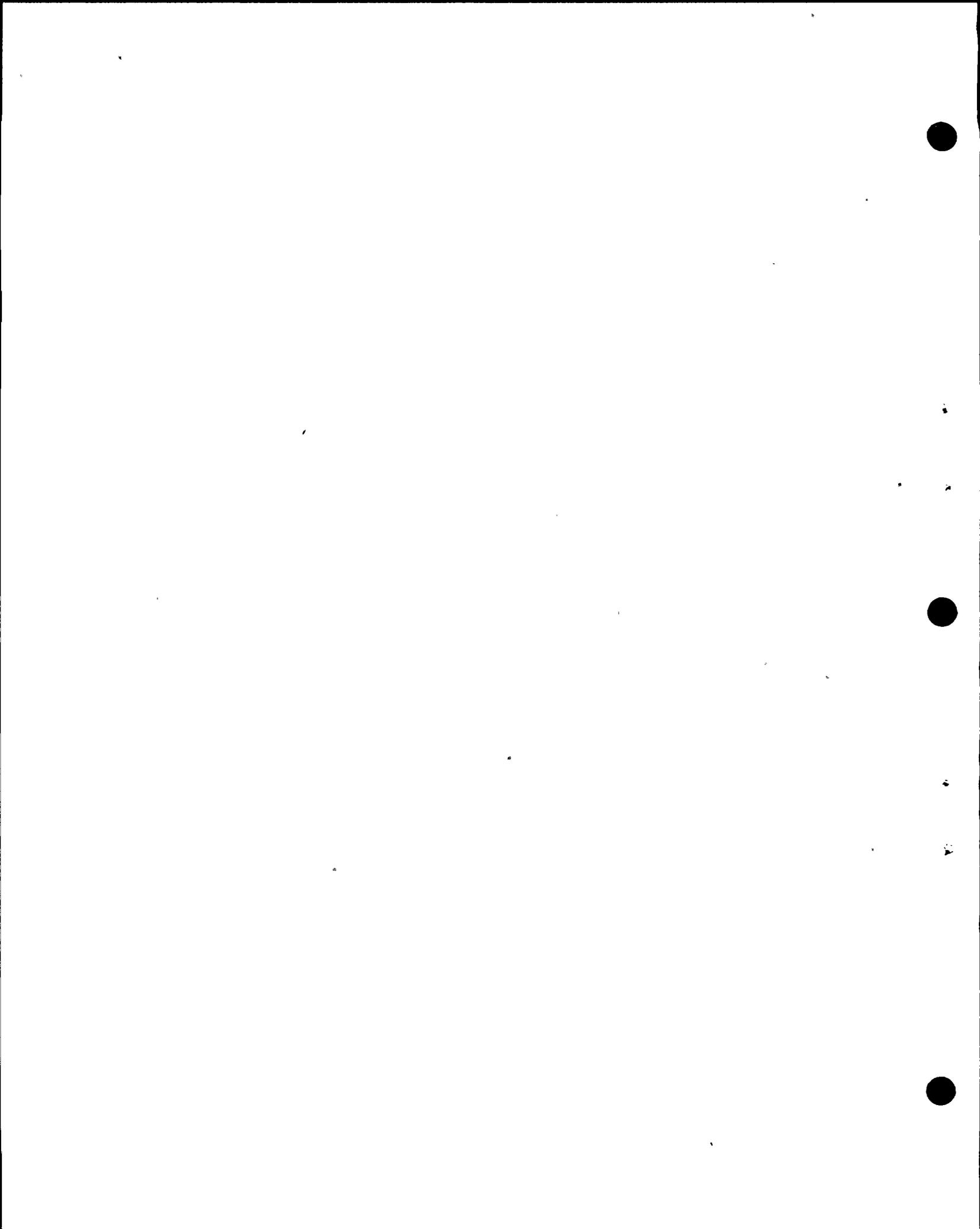
1 Ranges and east of the Hosgri, or we can flip the problem
2 around and consider that part of the system stationary with
3 relative movement on the opposite side of the Hosgri, in
4 which case we have kind of a mirror image, dynamically
5 looking at it, where we have to effect some movement in
6 the opposite direction on the opposite side of the Hosgri.

7 Now we can focus on what amounts to the impossibil-
8 ity, recalling that the comments made by several people,
9 including Dr. Hall, about the Santa Maria Basin, however
10 it was formed, are really not pertinent here, because that
11 formation occurred prior to the time interval we're consider-
12 ing.

13 That time interval, incidentally, is the one
14 that's really pertinent to the basic subject of these
15 hearings, which involved matters of engineering and geology,
16 and so on, that depend largely on the more immediate geologic
17 past.

18 All right. Let's focus, for the sake of
19 simplicity, on the block of ground north of the Transverse
20 Ranges, and to get things in proper scale, let me just
21 scale off here approximately 80 kilometers with the pointer.
22 I'll take it right off the scale, and it's about this
23 (indicating) on the pointer.

24 If we scale this off from the north edge of the
25 Transverse Ranges, we can see here, just to give ourselves



wel 16

1 a physical idea of what's involved, that we're talking about
2 a length of coast line essentially equivalent to the distance
3 between Point Conception and Morro Bay. That's a lot of
4 ground.

5 So we have to do something with that ground
6 during the last five million years, as dictated by the theory.

7 Clearly, the Hosgri Fault, or any other fault for
8 that matter, does not pass through the Transverse Ranges in
9 the manner that the San Andreas does farther east. So we
10 can't get rid of it by lateral movement of that kind.

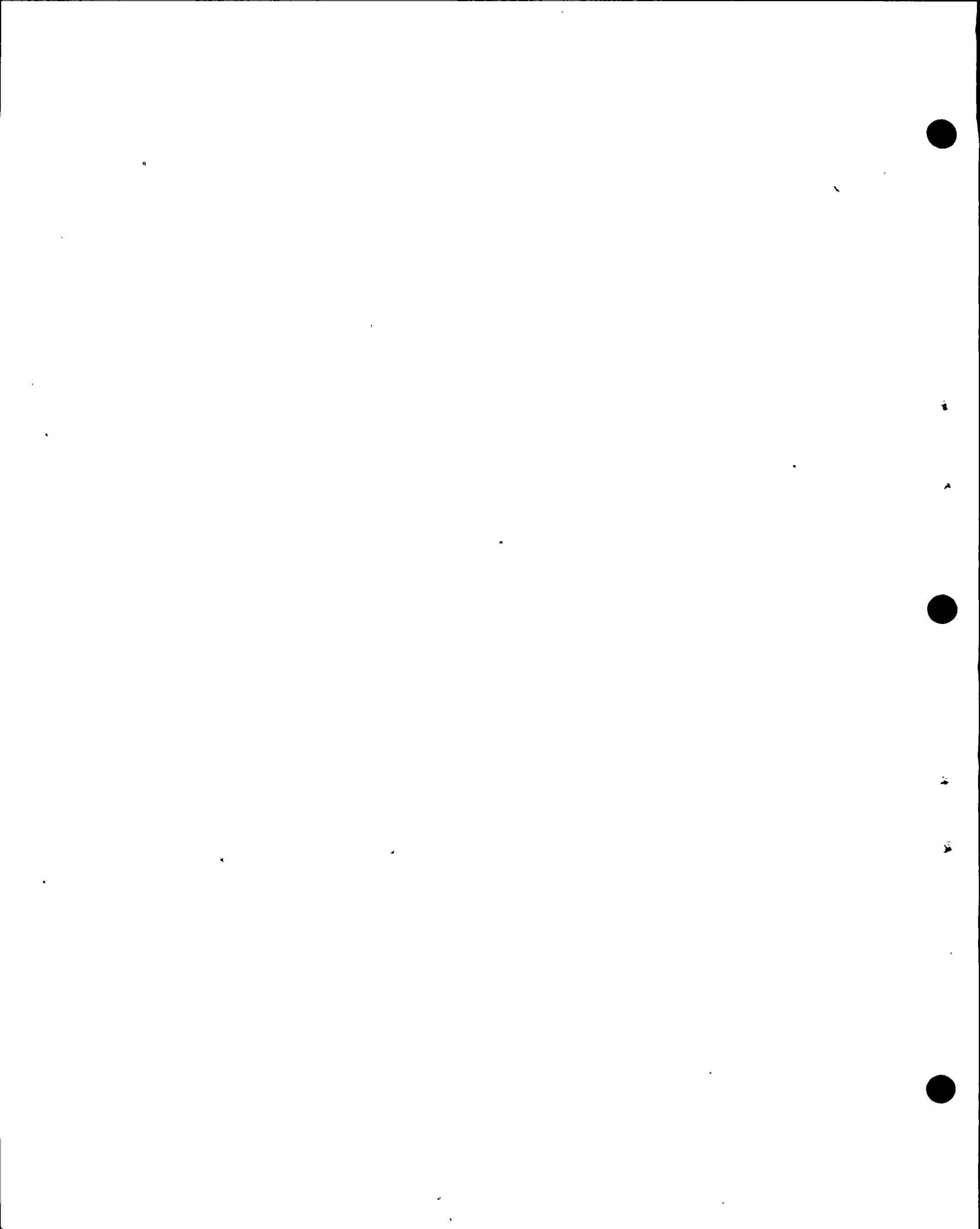
11 Moreover, none of the reference features with
12 east-west trend in the Transverse Ranges reflect that kind
13 of lateral movement.

14 It has been suggested by Dr. Hall -- and very
15 reasonably so, in my view -- that some movement of the kind
16 we're talking about could be accommodated by crustal shorten-
17 ing in the Transverse Ranges. In other words, by folding and
18 by thrust faulting.

19 But that, at most, can account for only a small
20 percentage of the total requirement for two kinds of reasons:

21 In the first place, there's a primary constraint,
22 the crust is only so thick. And the thickness of the crust
23 in this part of the world is only on the order of 20 miles,
24 and that's a fairly generous estimate.

25 In the second place, there is no major difference



wel 17

1 in the amount of shortening or the general style of folding
2 and thrust faulting in the Transverse Ranges on opposite
3 sides, east or west, of the southward projection of the
4 Hosgri Fault.

5 We would certainly expect -- indeed, demand -- some
6 major difference if we were trying to account for selective
7 southward migration of a huge mass of crust on the east side
8 of the fault versus the west. There should be a correspond-
9 ing difference if much or all of that were taken up by
10 shortening in here.

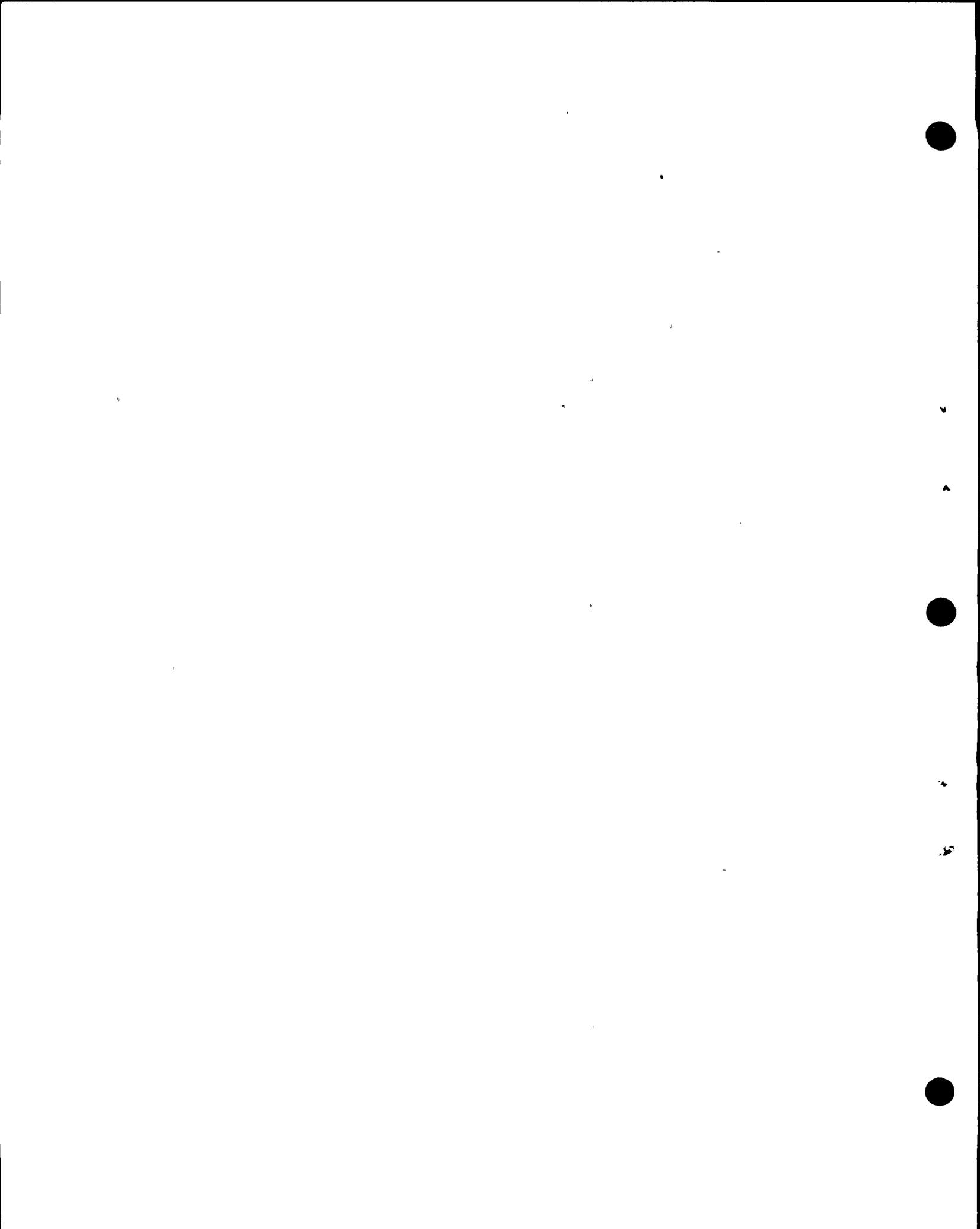
11 Now, it's interesting to point out on this score
12 that that kind of thing does appear on opposite sides of
13 the San Andrea Fault, so that some of us have actually made
14 estimates of how much of the San Andreas type slip has been
15 absorbed, so to speak, in the Transverse Ranges by this
16 kind of crustal shortening.

17 But perhaps the biggest difficulty of all is the
18 fact that if one thinks in terms of turning the corner, so
19 to speak, and assuming for the moment that the crust is
20 either sufficiently flexible or sufficiently broken up so
21 that it can negotiate that sharp bend -- which, incidentally,
22 is considerably sharper than the big bend of the San Andreas--

23 Q Excuse me, Dr. Jahns, for interrupting.

24 A Surely.

25 Q You've considered turning the bend, but let me ask



1 you this question:

2 Doesn't Dr. Hall's statement that X¹ on Applicant's
3 Exhibit 43 has not moved any appreciable distance in the
4 last five million years dispel that possibility, under his
5 theory?

6 A It would certainly seem to.

7 Q I mean if X¹, the rocks at X¹, which is at the
8 shoulder of the basin, haven't moved appreciably in the last
9 five million years, then you can't account for the 80
10 kilometers of offset by turning the corner, so to speak?
11 Is that correct?

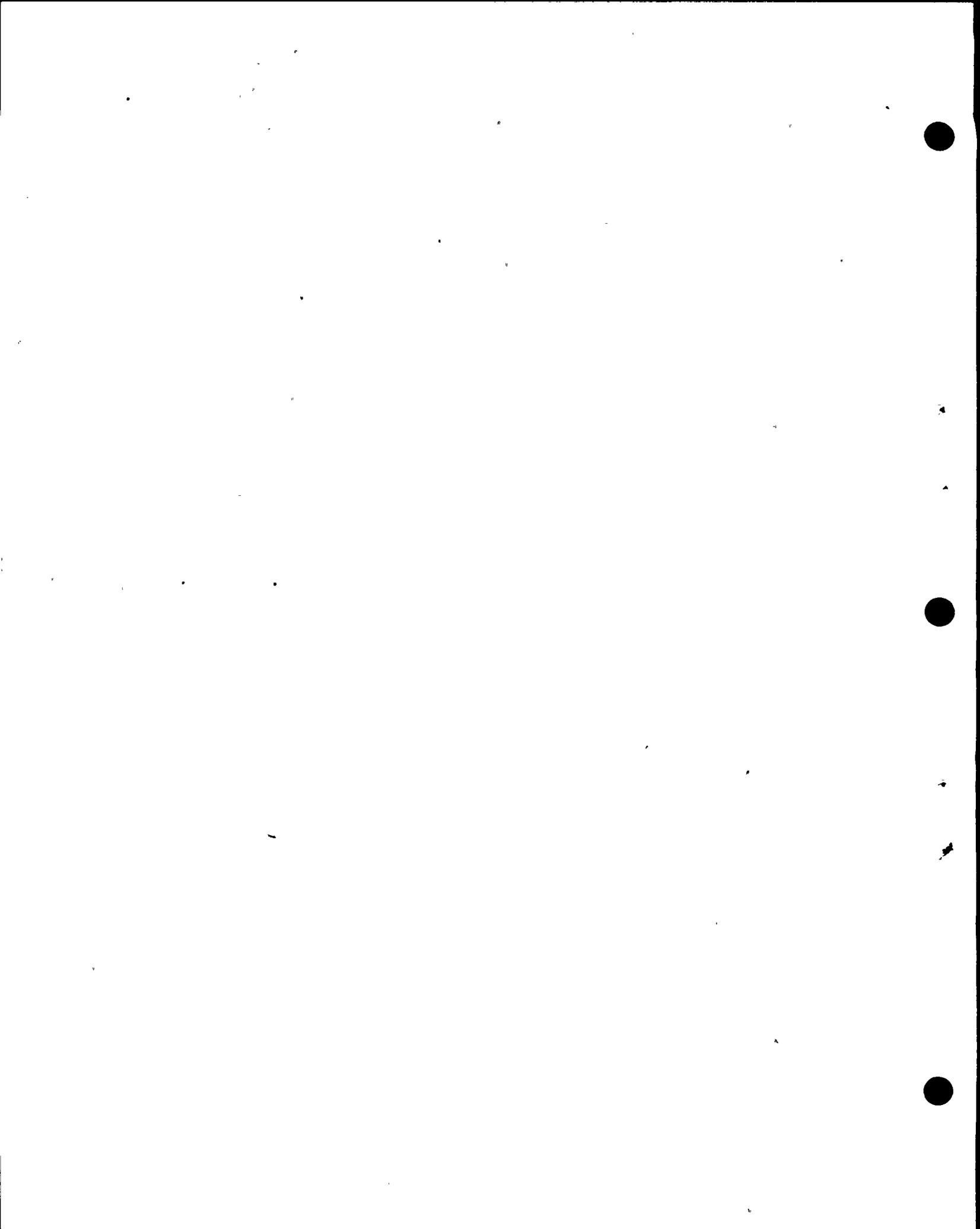
12 A That's right.

13 Q Okay. But please proceed with that hypothesis, in
14 any event.

15 A All right.

16 The major problem which I think, by implication,
17 has been recognized by Dr. Hall and his comment that you
18 just quoted, Mr. Norton, is a case in point here, is that
19 everything we know and can reasonably infer about the east-
20 west faults on the north side of the Transverse Ranges east
21 of the projection of the Hosgri Fault, indicates that during
22 the last five million years the predominant sense of movement
23 has been thrusting and left-hand slip, not right-hand slip.

24 So the sense of movement along these faults -- and
25 this is a matter of just data input -- is opposite to what



wal 19

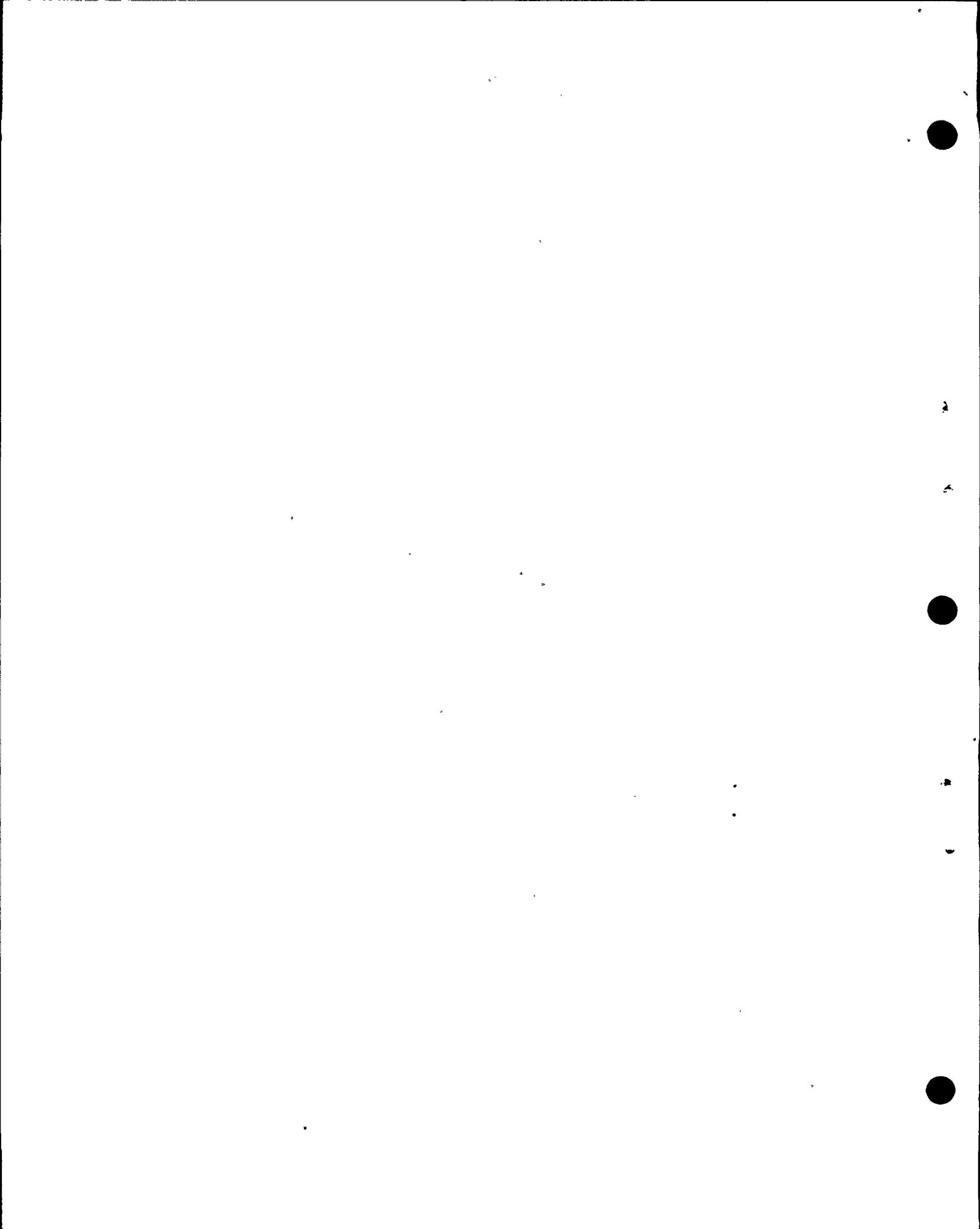
1 would be required if we attempted to dissipate any of this
2 inferred Hosgri movement via eastward migration of the ground
3 north of the Transverse Ranges.

4 So in effect we are almost left with the
5 possibility -- and here we almost have to grab at straws --
6 of getting rid of some of this crust, either by shoving it
7 downward into the mantle beneath the crust as an active plate
8 boundary -- which I think any geologist familiar with this
9 region would consider absurd on the face of it, because
10 there is no active plate boundary here, the only one is the
11 San Andreas, which is a boundary of a totally different
12 kind -- or, conceivably, we could shove it up in the air,
13 a la the Himalaya Mountains in Asia, and get rid of the
14 excess by erosion.

15 This also is untenable, because we're dealing
16 across the north part of the Transverse Ranges in that region
17 with rocks, with stratigraphic units that are roughly the
18 same general level.

19 So there is no evidence of profound vertical
20 adjustments of the kind that would be required.

21 My conclusion, therefore, is that if we examined
22 this theory as a package -- which we should do if we expect
23 to derive a critical view of it, either in terms of
24 aggravation or rejection, if we examine all the pertinent
25 factors, there is at least one and more likely two of the



wel 20.

1 five that I indicated that are fundamentally incompatible,
2 either we must conclude that there has been markedly less
3 accumulated slip along the Hosgri system, or we must conclude
4 that the slip of the kind suggested has occurred over a much
5 greater length of time, far, far farther back in time than
6 five million years, or both.

7 And this is stated strictly in terms of the kinds
8 of evidence I've indicated here and does not consider the
9 many other kinds of evidence that have been cited by several
10 parties, including the Applicant's geologists, on direct
11 testimony.

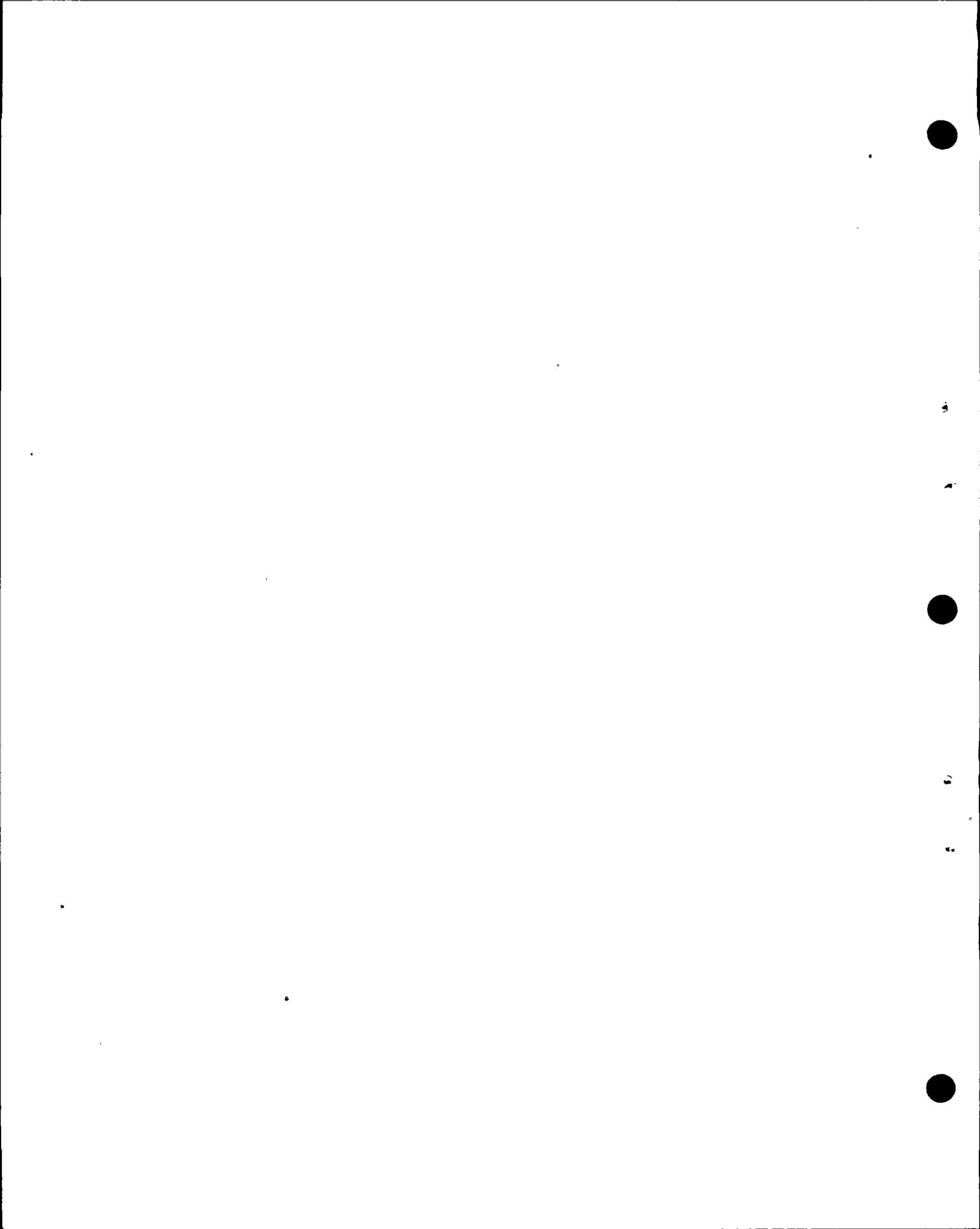
12 This is one reason, frankly, why it has been our
13 conclusion that the Hosgri ends offshore, and that, further,
14 it ends in the southeasterly direction through dissipation
15 into zones of folding and minor faulting.

16 To do this, one can accommodate 10 kilometers, or
17 perhaps at the very most, 20. But certainly nothing
18 approaching 80.

19 MRS. BOWERS: Mr. Norton, I think we're going to
20 have to break for lunch.

21 MR. NORTON: I think that concludes our rebuttal
22 with the geology panel, which is a very appropriate place to
23 break for lunch.

24 MRS. BOWERS: We see Mr. Devine in the back of
25 the room. Mr. Bright has a question of explanation on a



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1 legend on the front of the Seiders paper. Perhaps we could
2 have you on the stand for just half a second.

3 (Geology panel witnesses temporarily excused.)

4 The record will show that Mr. Devine has previously
5 been sworn.

6 Whereupon,

7 JAMES F. DEVINE

8 was called as a witness on behalf of the Board, and, having
9 been previously duly sworn, was examined and testified
10 further as follows:

11 EXAMINATION BY THE BOARD

12 BY MR. BRIGHT:

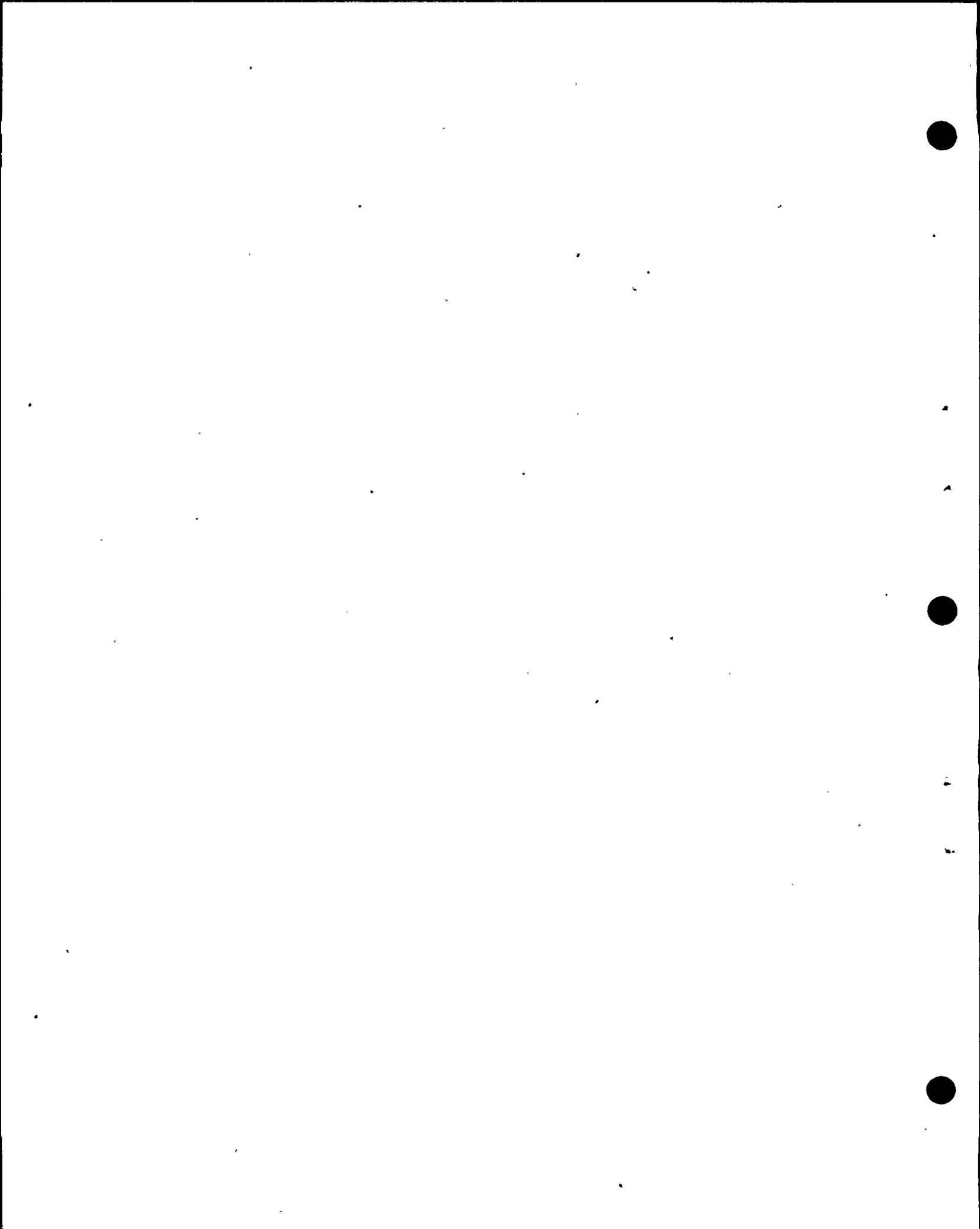
13 Q I'm merely interested in what this disclaimer
14 actually means. I don't want to interpret it myself. I
15 want the USGS to interpret it for me.

16 MR. STAENBERG: Mr. Devine, could you please
17 read that disclaimer into the record?

18 WITNESS DEVINE: The statement I've been asked
19 to read is as follows:

20 "This report is preliminary. It has not
21 been edited or reviewed for conformity with
22 the Geological Survey standards and nomen-
23 clature."

24 This statement, or ones very close to it,
25 frequently show up on papers produced by researchers for the



wal 22

1 Geological Survey to indicate that it has not gone through
2 the standard total and complete review process of the Survey,
3 which frequently gets referred to by people as a major
4 stumbling block to prevent the publication of data that
5 people are interested in.

6 So that ponderous process has not been applied
7 to this paper at this stage. So it has not been reviewed
8 by all the colleagues and gone through the standard review
9 process that's necessary for a final publication of the
10 Geological Survey.

11 BY MR. BRIGHT:

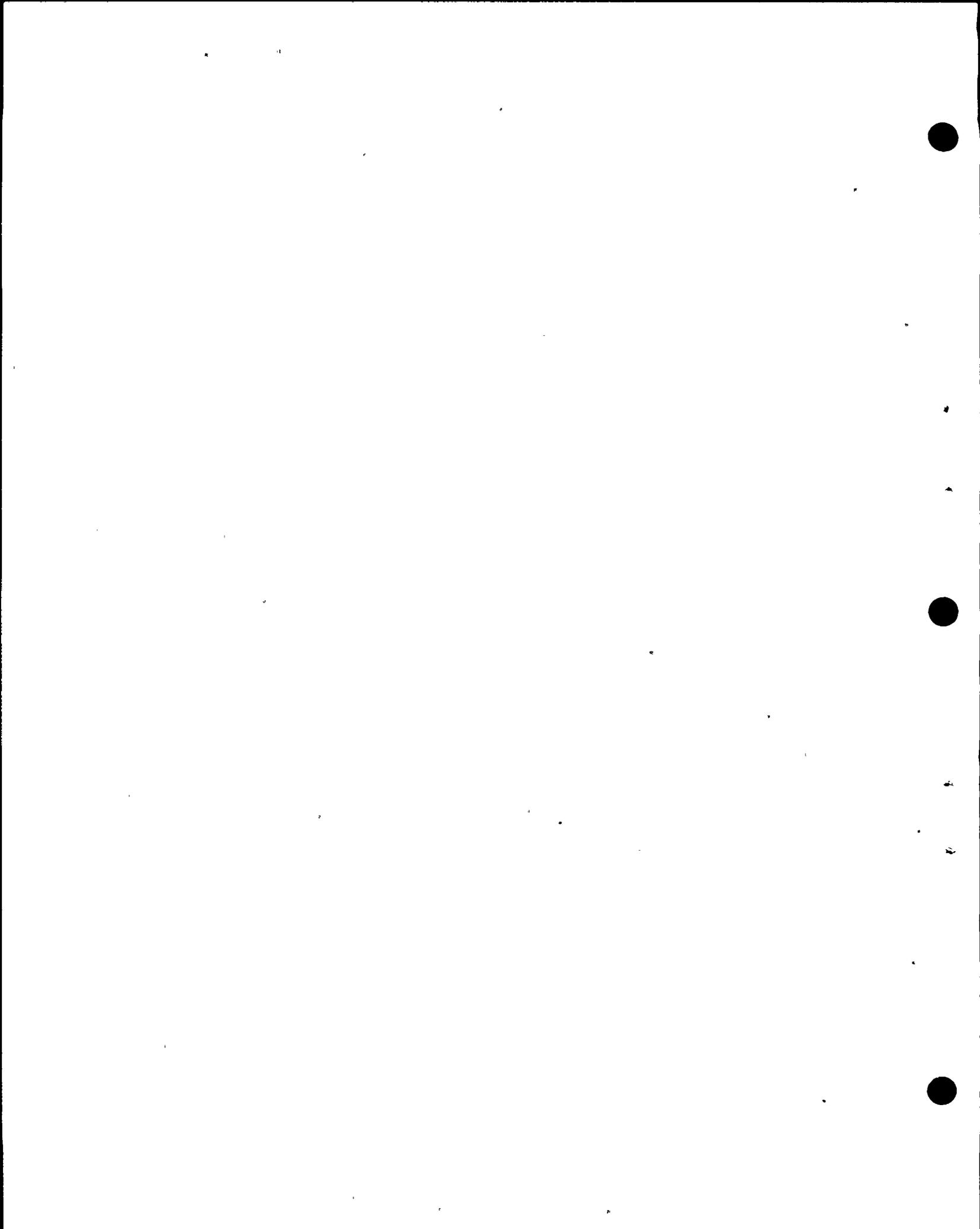
12 Q Does this mean, then, that the paper does not
13 represent the USGS position on whatever it contains?

14 A Yes, that's true. But I think it takes more than
15 that to answer the question, Dr. Bright.

16 That is that very few publications of the Survey
17 represent the -- quote -- Survey position -- unquote.

18 The Geological Survey is a research organization,
19 and its scientists publish the papers with their names on
20 it as their research. And in most cases, it does not
21 necessarily represent the Survey position.

22 So that's not unusual. However, letters such as
23 the ones we submit to the Nuclear Regulatory Commission,
24 signed by the Director himself, do, indeed, represent the
25 Survey position. So there is a considerable difference in



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1 that.

2 Q Would this disclaimer indicate that the paper had
3 not received peer review?

4 A Not necessarily. It means it's not received the
5 complete review that goes into a final publication of the
6 Survey as a professional paper that the Survey would have.

7 For example, this could have had -- and I don't
8 know for sure the status of this paper specifically -- but
9 this could have had some peer review by this stage, but not
10 the complete review, including editorial review, that would
11 be required for this to be published without this statement
12 on it.

13 MRS. BOWERS: Mr. Devine, do you plan to be here
14 after lunch at 1:00 o'clock, or are you leaving?

15 WITNESS DEVINE: I can be here.

16 MR. BRIGHT: I think that's all I have.

17 MRS. BOWERS: Well, there may be questions by
18 the parties.

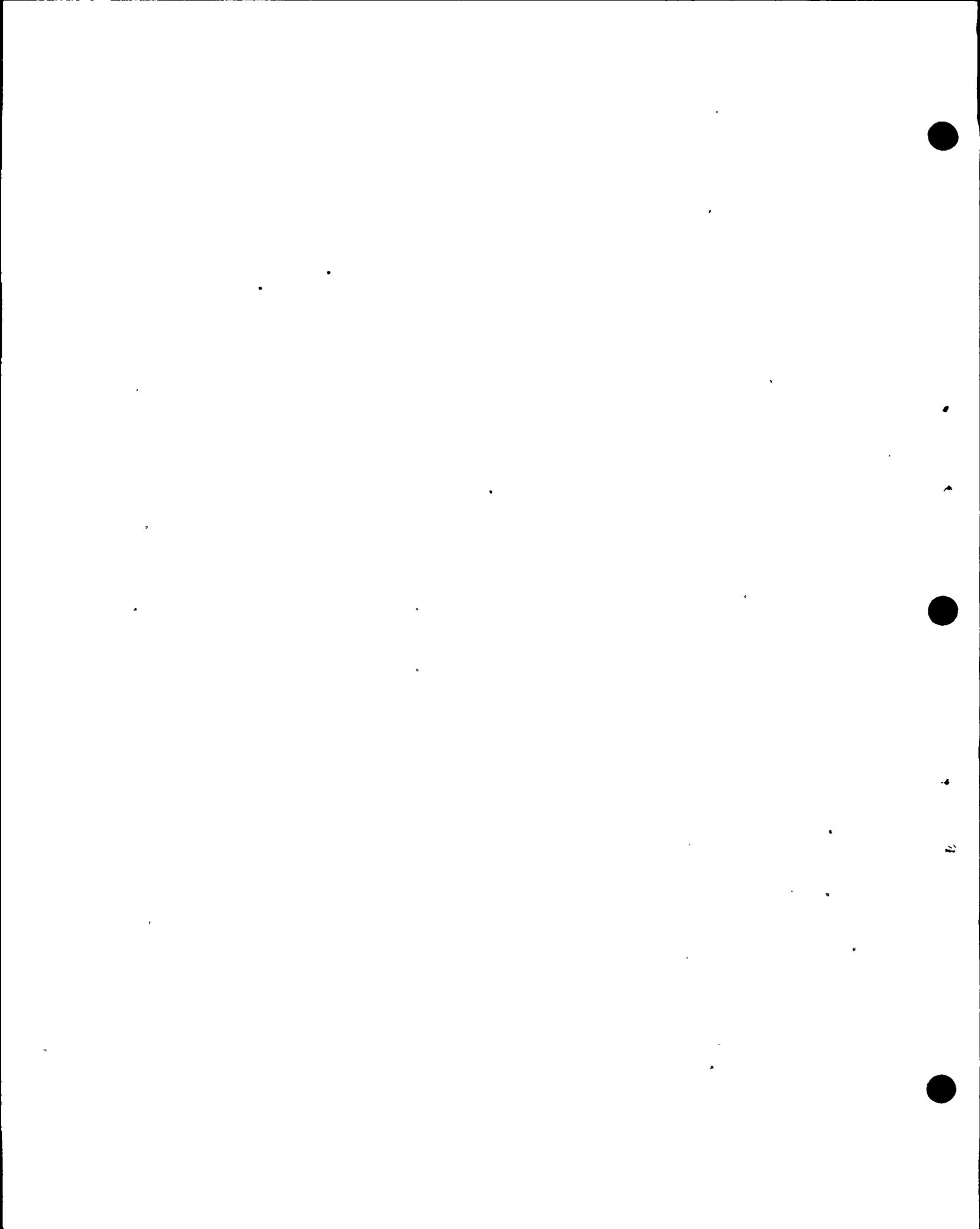
19 CROSS-EXAMINATION ON BOARD QUESTIONS

20 BY MR. NORTON:

21 Q I take it, then, that any paper that's a USGS
22 open file report that has an author's name on it, that does
23 not mean that it's the USGS position?

24 A That's correct.

25 Q In other words, the only thing that's a USGS



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position is that which is signed by the Director of USGS?

2

A By and large, that's correct. There may be some exceptions. But certainly, by and large, that's correct.

3

4

Q And when this paper goes through the process and is published as a final USGS open file report, it still won't be the USGS position, it'll just be the position of the author of that paper?

5

6

7

A That's correct. We frequently have papers on the same subject with conflicting conclusions.

8

MR. NORTON: Thank you.

9

MRS. BOWERS: Let me check with the parties.

10

Mr. Fleischaker?

11

MR. FLEISCHAKER: I don't have any questions.

12

MRS. BOWERS: Mr. Staenberg?

13

MR. STAENBERG: Following Applicant's questions, Staff now has no questions.

14

MRS. BOWERS: Thank you very much, Mr. Devine.

15

That's what you get for coming into the back of the room.

16

17

(Laughter.)

18

(Witness excused.)

19

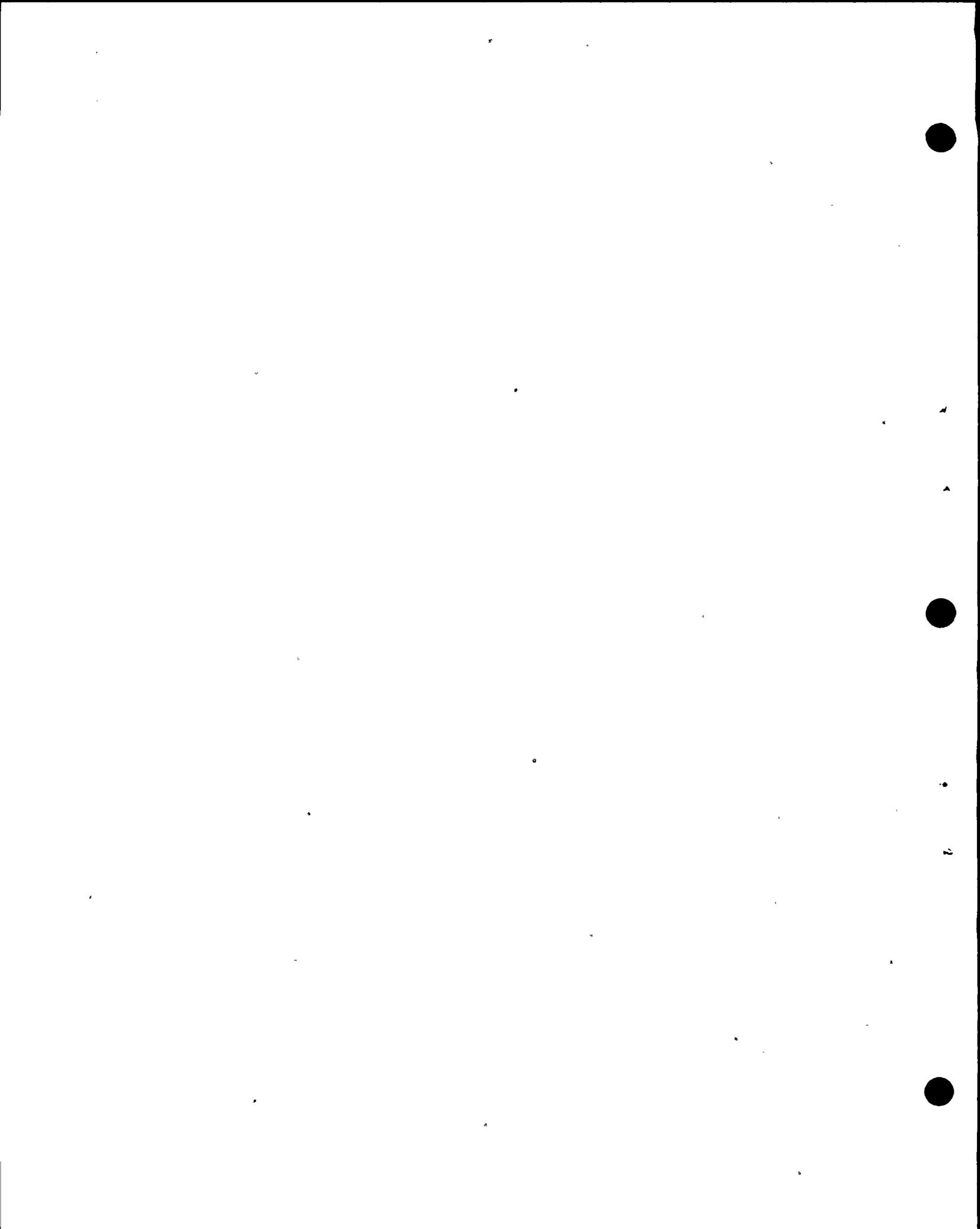
We will recess for lunch, and reconvene at 1:00 o'clock.

20

21

(Whereupon, at 12:05 p.m., the hearing was recessed, to reconvene at 1:00 p.m., this same day.)

22



AFTERNOON SESSION

(1:15 p.m.)

MRS. BOWERS: Are we ready to resume?

Whereupon,

RICHARD H. JAHNS,

DOUGLAS H. HAMILTON,

and

C. RICHARD WILLINGHAM

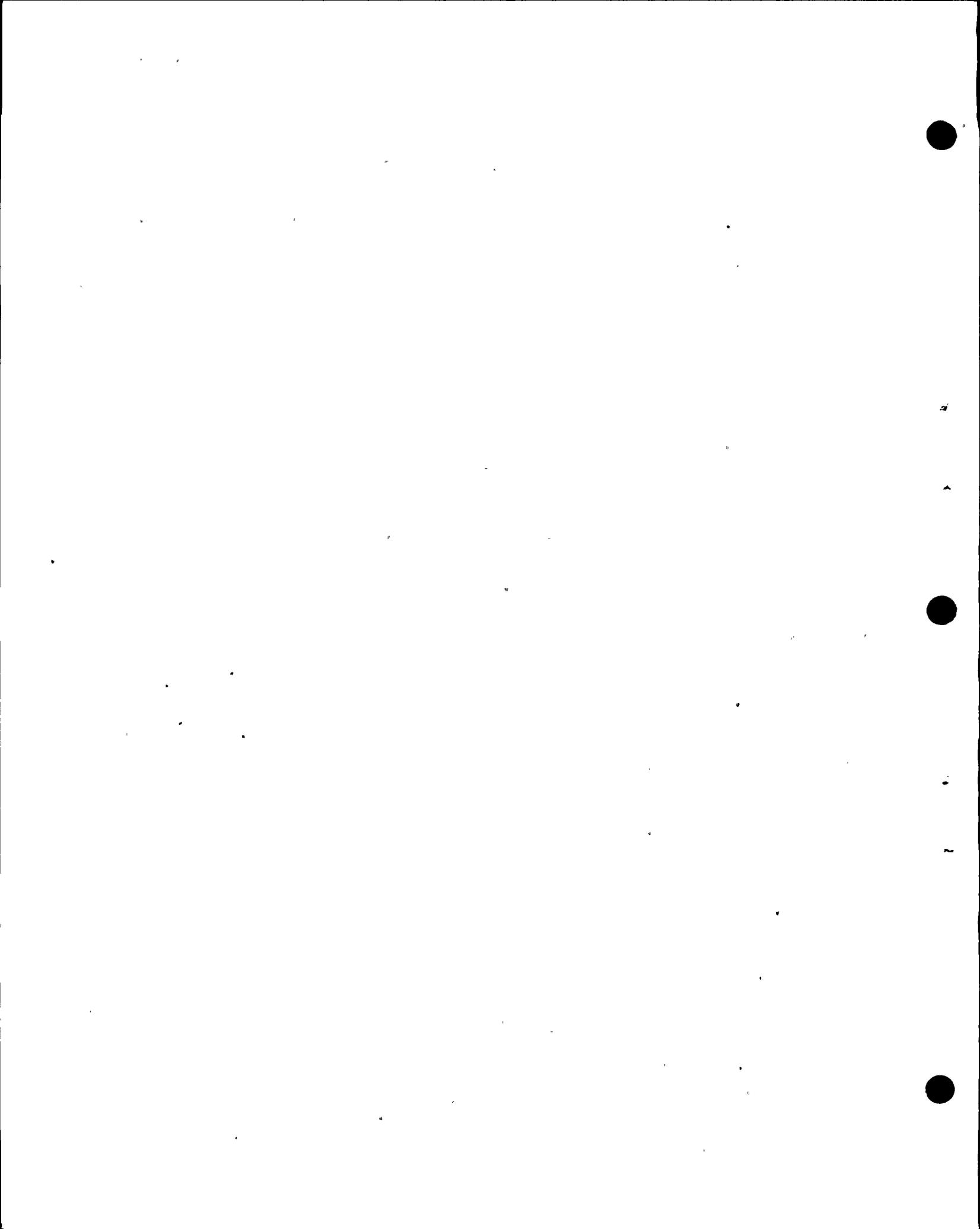
resumed the stand as witnesses on behalf of the Applicant, and, having been previously duly sworn, were examined and testified further as follows:

MRS. BOWERS: I think first we should go back for a few minutes to the generic safety issue question.

We had an opportunity at the luncheon break to consider the matter before us, and also to review the appeal board decision in North Anna.

We think that the appeal board decision does not mandate an evidentiary hearing, but on the other hand, it makes it permissible under certain circumstances. And so what we intend to do is to carefully review the submittal by the Staff, and by the end of next week issue an order. And that order will set out the way we intend to proceed.

And of course, there are several options. One would be that we say the affidavits are satisfactory, the written submittal. The parties, of course, would have an



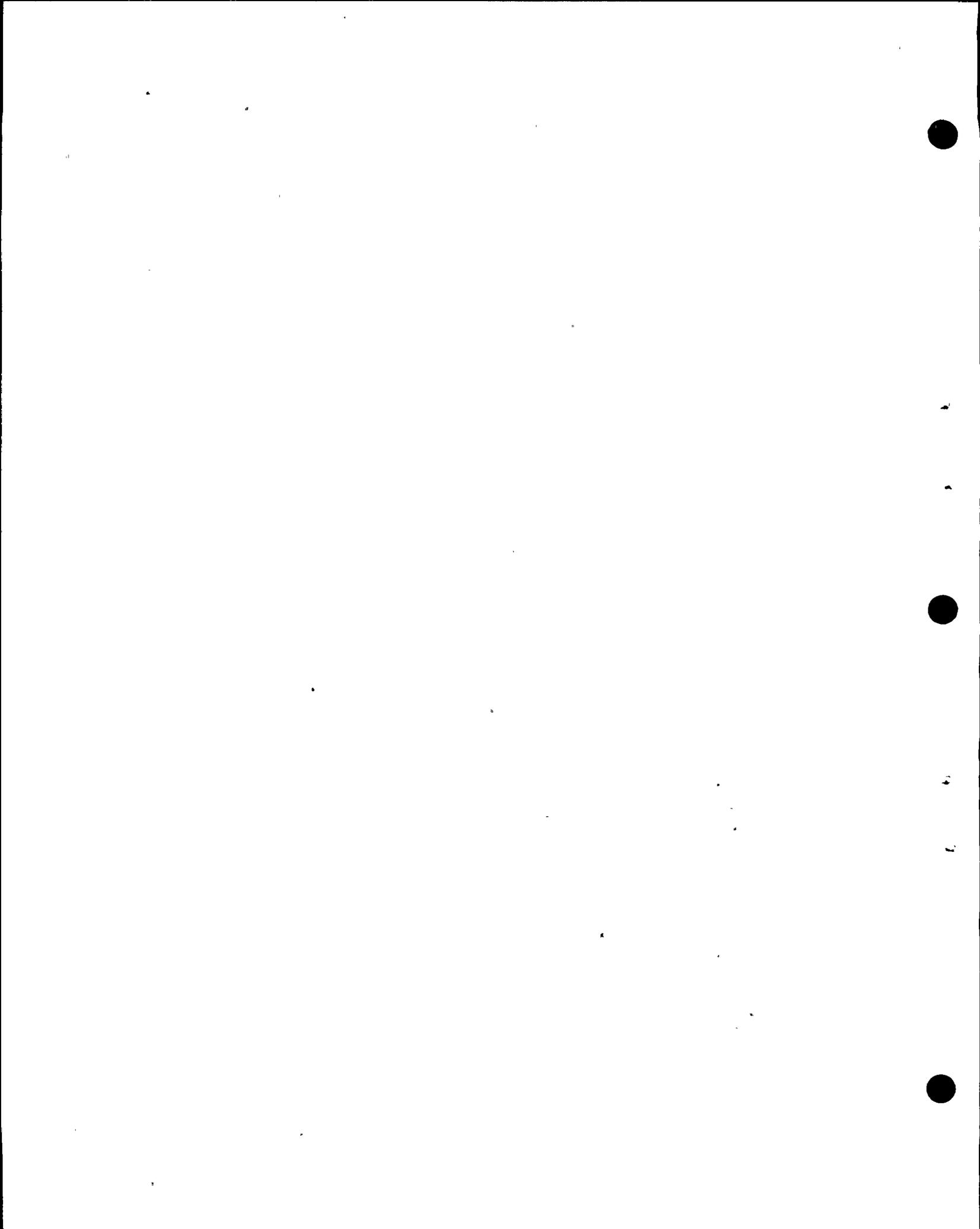
mpb2 1 opportunity to comment. And then, of course, another option:
2 we might determine that there should be an evidentiary hear-
3 ing. But we just don't feel we're in a position to make that
4 decision until we have the entire file in front of us and
5 have an opportunity to carefully consider it.

6 And at the same time, if we do determine that
7 there should be an evidentiary hearing, we will, of course,
8 indicate the place, the location.

9 And I might also say, while I'm on the record,
10 we're in our eighth week of this segment of the Diablo Canyon
11 hearing, this segment dealing with seismic issues. And
12 while we have had a few people from time to time from the
13 general public be here in the hearing room, there have only
14 been a few from time to time.

15 There has not been the continued local interest
16 that sometimes prevails in some hearings. So there hasn't
17 been a great show of participation as audience by local
18 people. And that's one thing that might well influence our
19 thinking if we do feel that there has to be an evidentiary
20 hearing as far as location.

21 MR. FLEISCHAKER: I just want to say one thing:
22 I agree with the Board's counting of numbers.
23 But I also want to point out that there is almost always --
24 there isn't today, I think it's the first day -- been at
25 least one to three representatives from the Mothers for Peace



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here.

And there is almost always one here, because they come up and report to me and ask if they can do anything. And that's all.

MR. NORTON: Well, I would like to -- as usual, Mr. Fleischaker and I see the world through different eyes. And I would agree that during the course of a day maybe one of his clients is here for a short period of time. But I don't think there has been a situation where the clients have been here all day long on any occasion.

MR. FLEISCHAKER: Well, okay. Just one response:

That's wrong. It has been the case almost without exception up until this last reconvening that the Mothers for Peace have as a matter of practice assigned one person to be in this hearing room all day to assist us in whatever we needed, and we could always turn around and count on that person to assist us in tasks.

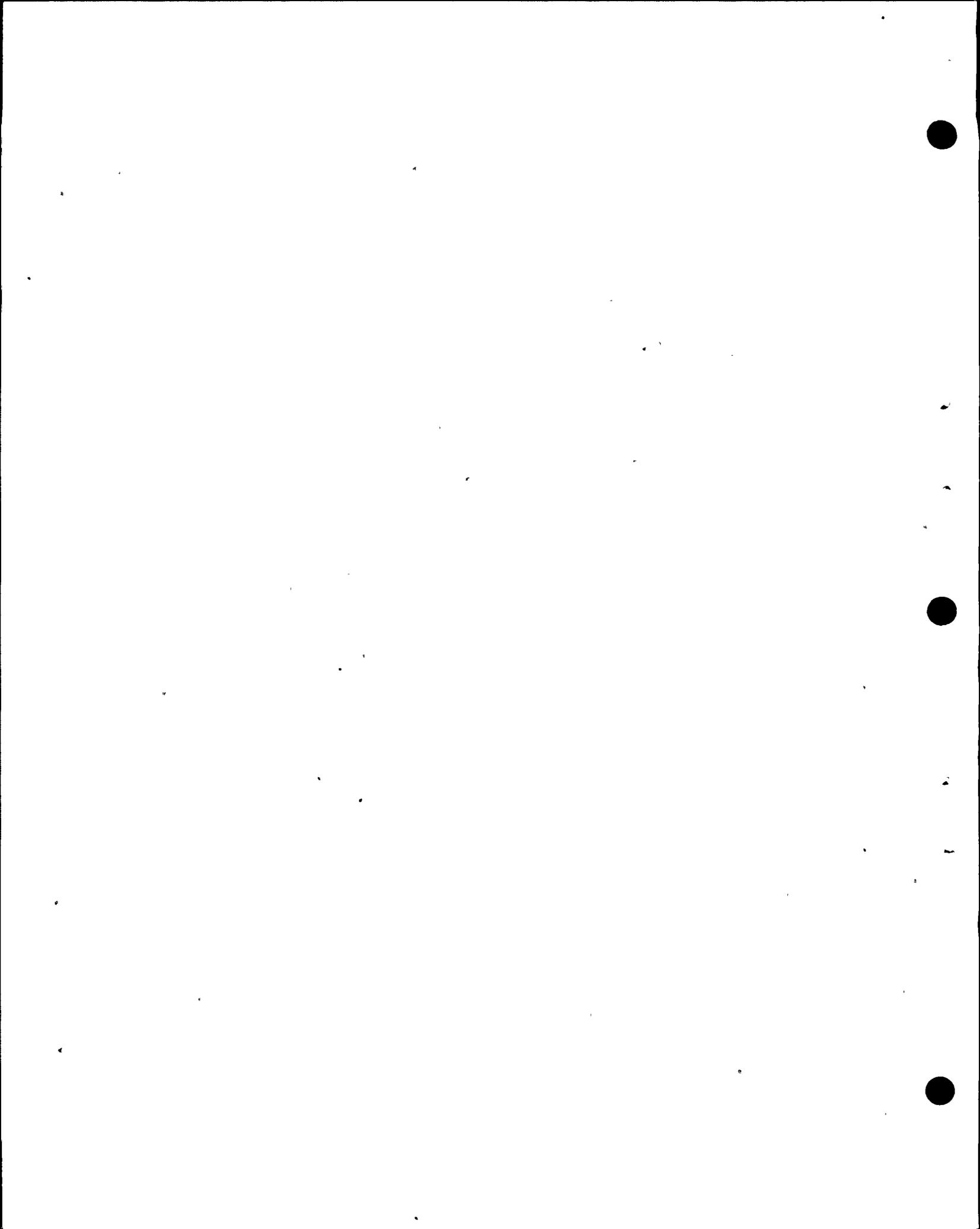
So there was almost as a matter of standard operating procedure one person here.

MRS. BOWERS: Well, we just reported what we've observed.

Now can we resume where we were?

MR. NORTON: Well, we can resume, but we have a slight interruption.

At this time we are going to file with the Board



mpb4

1 a motion, and I will turn over to Mr. Furbush that motion.

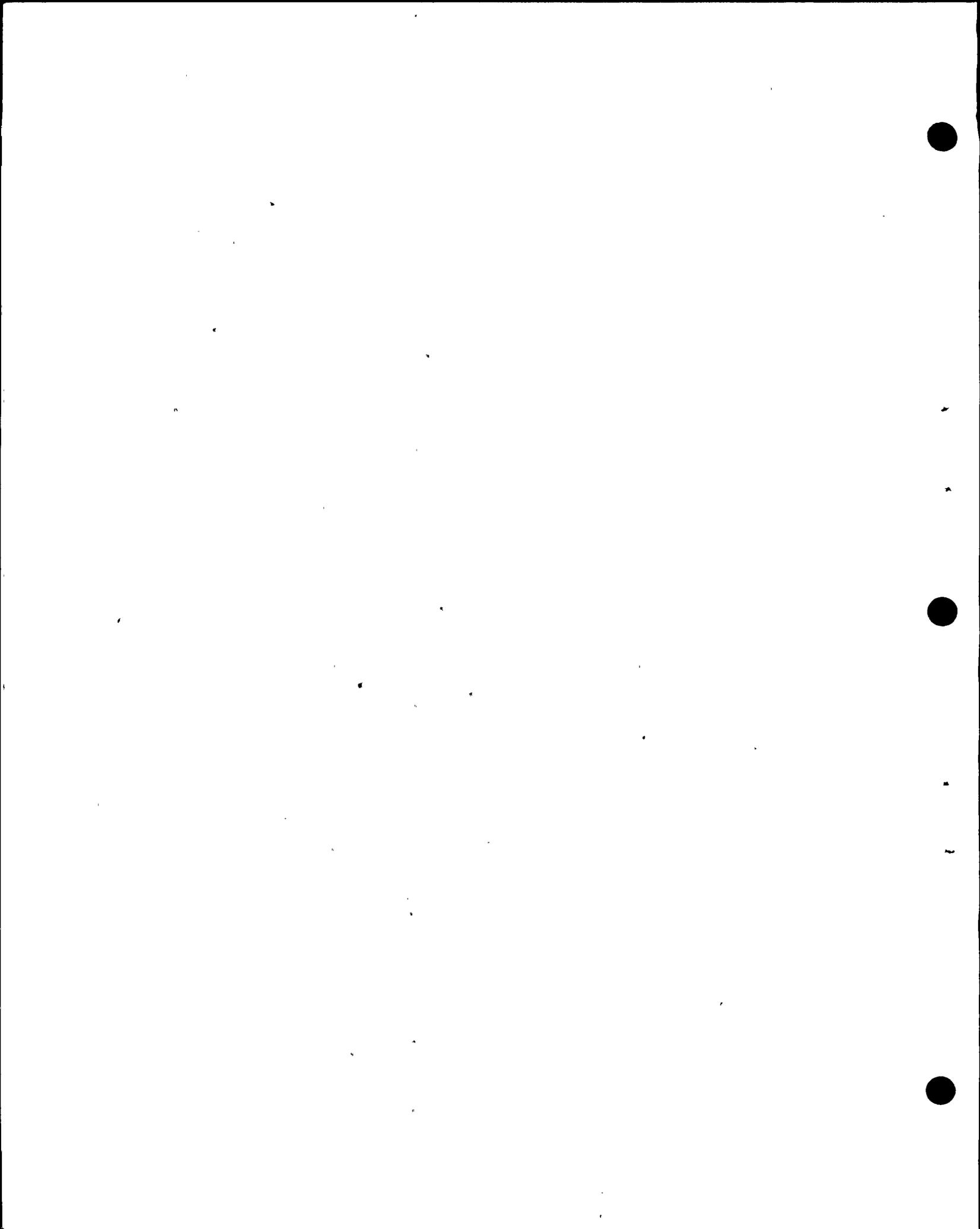
2 I'll pass the mike and let him make his presentation.

3 MR. FURBUSH: Mrs. Bowers, we have here a motion
4 which we intend to file with the Board for a license author-
5 izing low power testing of Unit number 1.

6 Now I want to give you the background of why
7 we're making this request. We actually feel compelled to
8 make it at this time because our survey and estimate of our
9 resources for this summer indicate that if we have a normal
10 rain year, water year, for the rest of this season, and if
11 we can work out an arrangement with the CVP -- that's the
12 Central Valley Project -- on the amount of power that will
13 be available from that project, we will have a 7.5 percent
14 cushion, if you will, or margin on our peak day requirements
15 during the months of July and August with the facilities
16 that we have.

17 We've also been told from the people in the
18 Northwest, Pacific Northwest, that we should not expect any
19 excess energy from them, surplus energy from them this year
20 inasmuch as they have had a very dry water year. And the
21 energy that they provide comes to us from hydroelectric
22 generation.

23 Now that just has to do with the capacity avail-
24 able to us. But there is a growing concern that we have
25 that the fuel to supply the plants we have, namely our



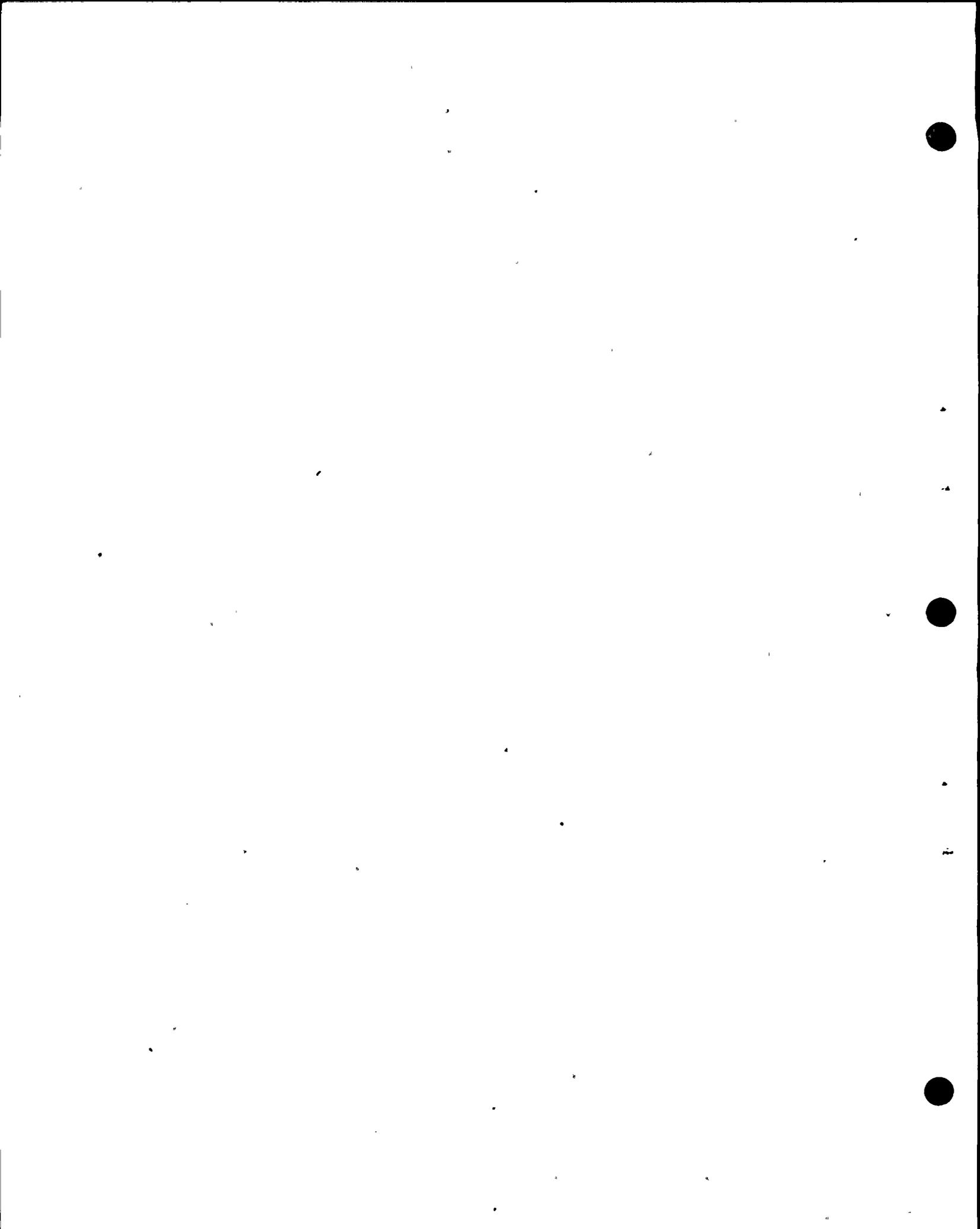
mpb5 1 thermal plants, our fossil fuel plants, may not be forth-
2 coming in the months ahead.

3 To give you some idea of our needs, our esti-
4 mate of our fossil fuel requirements this year are the
5 equivalent of 35 million barrels of oil. A considerable
6 amount of that can be made up of gas, natural gas when
7 natural gas is available. The rest of it has to be provided
8 by oil.

9 We have long term contracts with what we consider
10 to be very reliable major suppliers, one of the largest of
11 which tells us that they can give us -- and we have contracts.
12 But their delivery commitments after June are something
13 which they cannot estimate at the present time.

14 Now the effect of the Iranian oil situation is
15 of course what's causing this problem, coupled with one thing
16 more. This has been a very very cold winter in the entire
17 northern hemisphere, Western Europe as well as the United
18 States. As a consequence, before the Iranian problem came
19 to pass and became as acute as it is today, there was a
20 shortage of oil which began in the month of December. And
21 it was very difficult for us to get firm commitments from
22 our suppliers at that time, and we understand it's a very
23 tight situation throughout the world.

24 Now with this background, it's necessary for us,
25 I believe, to acquit our responsibility to our customers to



mpb6

1 be in a position to place the Diablo Power Plant in opera-
2 tion as soon as possible upon, hopefully, a favorable deci-
3 sion from this Board.

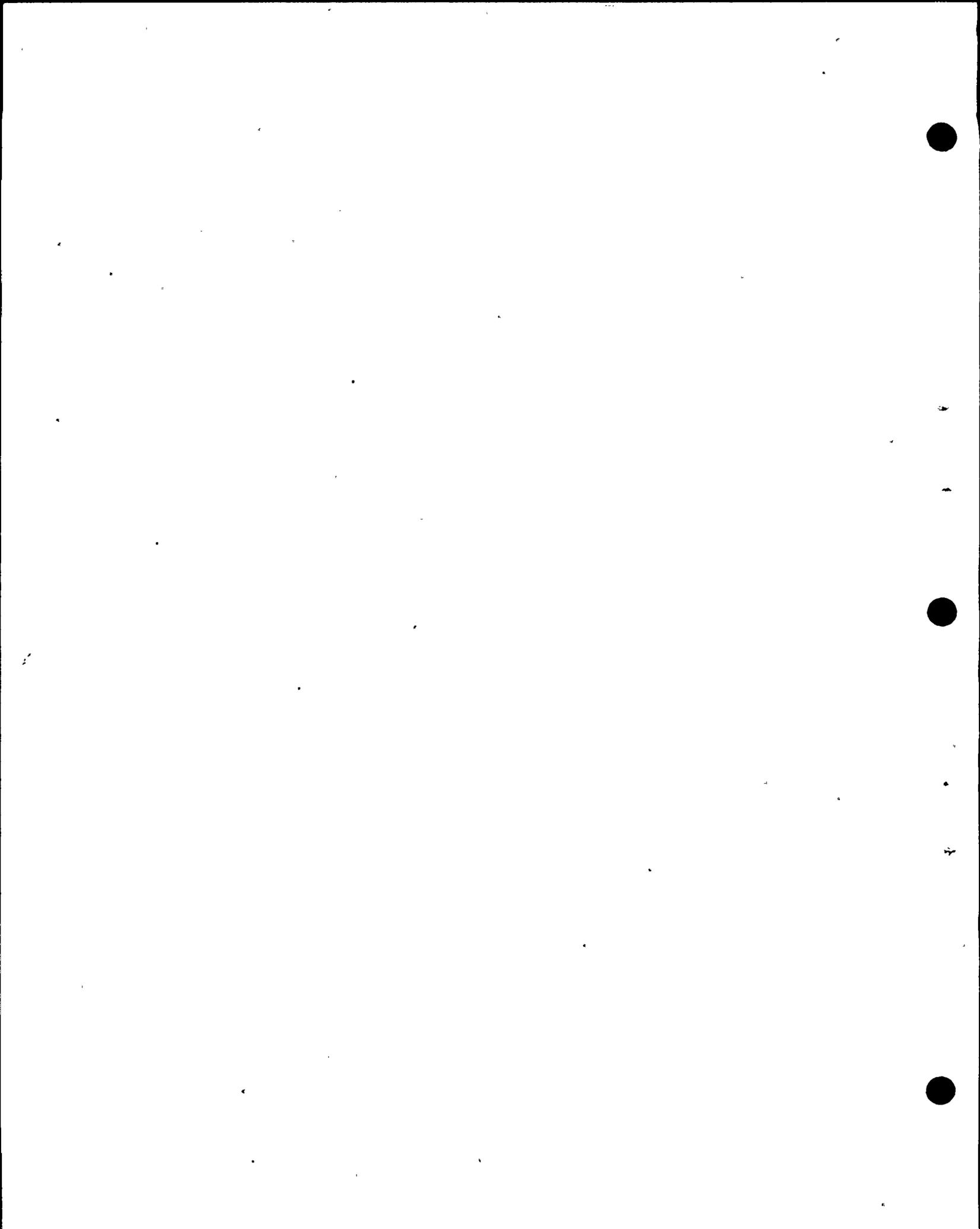
4 Now there is a delay, naturally, after we have
5 an operating license because of the necessity of having low
6 power testing. Now what we would like to be able to do would
7 be to be able to have completed that by the time we receive
8 the hoped for license.

9 Now there are problems with a motion of this
10 nature, namely in terms of time. The burden on the Board,
11 and the burden where it falls most heavily would be on the
12 Staff of the Commission.

13 Now we do not make this motion with any thought
14 that it would in any way change the course of events and
15 activities of the Staff from what it would be in the absence
16 of our making the motion. In other words, all of those duties
17 which they must perform in order to be in a position to permit
18 us to implement an operating license when received, we would
19 hope would go forward and would not in any way be affected
20 by this motion.

21 And only after they have completed those functions
22 would they turn their thoughts to the factors which are
23 required in order to permit us to do the low power -- to
24 do the fuel loading and the low power operation.

25 Now I assume that Mr. Fleischaker has the rules



mpb7 1 with him and will make up his own decision on what the
2 course of conduct should be for the Intervenor. I am
3 obviously making a plea to everyone, including the
4 Intervenor, that this is a sensible course for us to take.

5 One thought which I think should be very clear-
6 ly stated, and that is this:

7 That this presents no risk in any way. It would
8 present additional burdens to us if we did not receive
9 a license. But it does not present any danger or risk to
10 any facility or the public in any way.

11 Before I proceed, I would like to have some
12 response from the Staff and the Intervenor to this, because
13 naturally what they have to say will have some bearing on
14 what I have to say in terms of what my request is on the
15 implementation of this motion.

16 MRS. BOWERS: Are you ready, Mr. Fleischaker,
17 to respond?

18 MR. FLEISCHAKER: Can I have one moment?

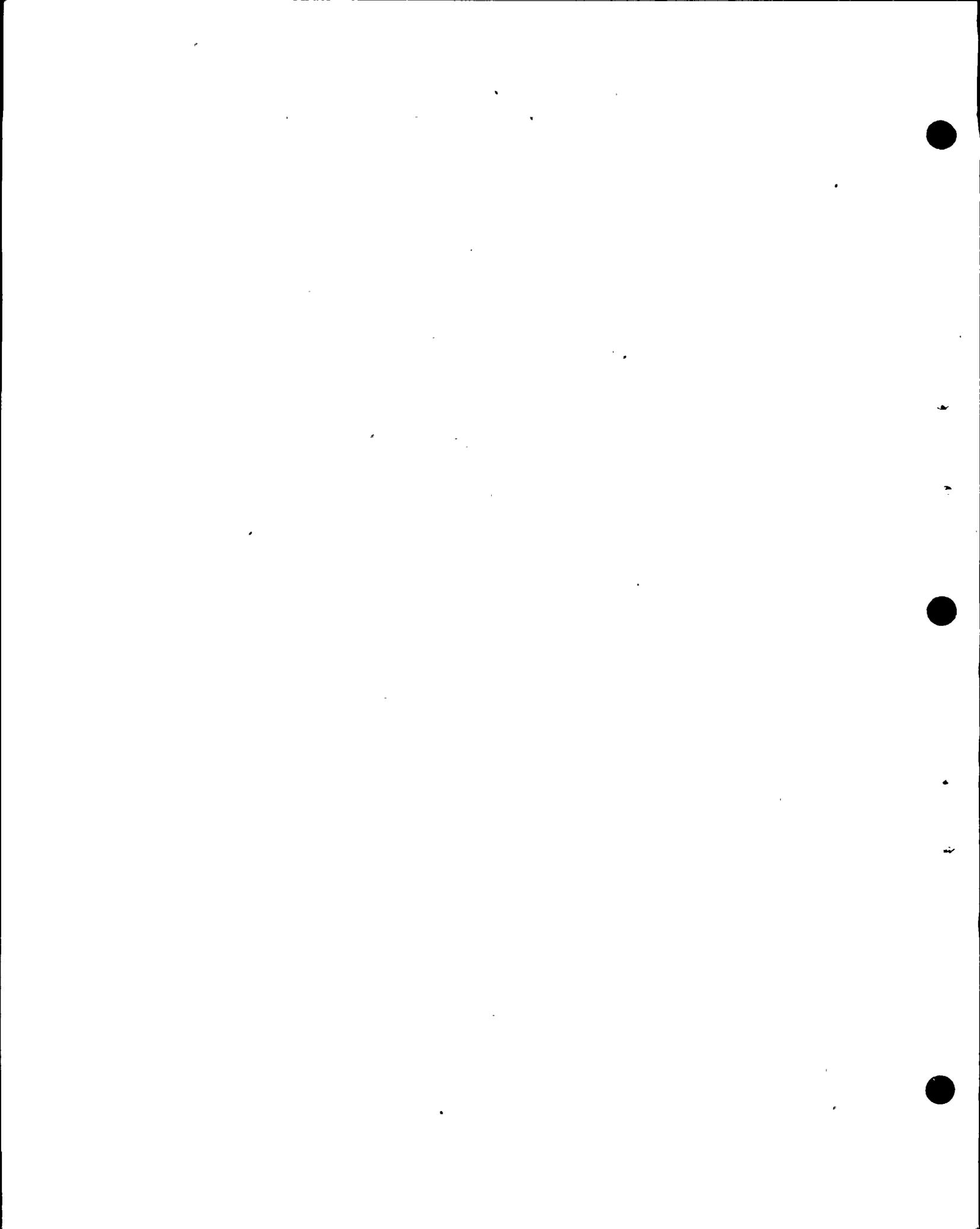
19 (Pause.)

20 MR. FLEISCHAKER: If Mr. Ketchen wants to respond
21 before I do, that's fine.

22 MR. KETCHEN: No, thanks.

23 (Pause.)

24 MRS. BOWERS: Mr. Fleischaker, if you'd like to
25 defer ---



mpb8

1 MR. FLEISCHAKER: No. I like surprises. It
2 keeps me in practice.

3 Let me deal with some procedural questions
4 that occur to me first, and then get down to the substance --
5 to the response substantively.

6 This is the first time I've had an opportunity
7 to see this motion, and I think that under the rules, given
8 the important issues that are raised by a motion of this
9 nature, that we ought to have, as the rules provide, five
10 days to respond. And I would respond in writing.

11 I think the 22nd of February would be the five
12 days that the rules would --

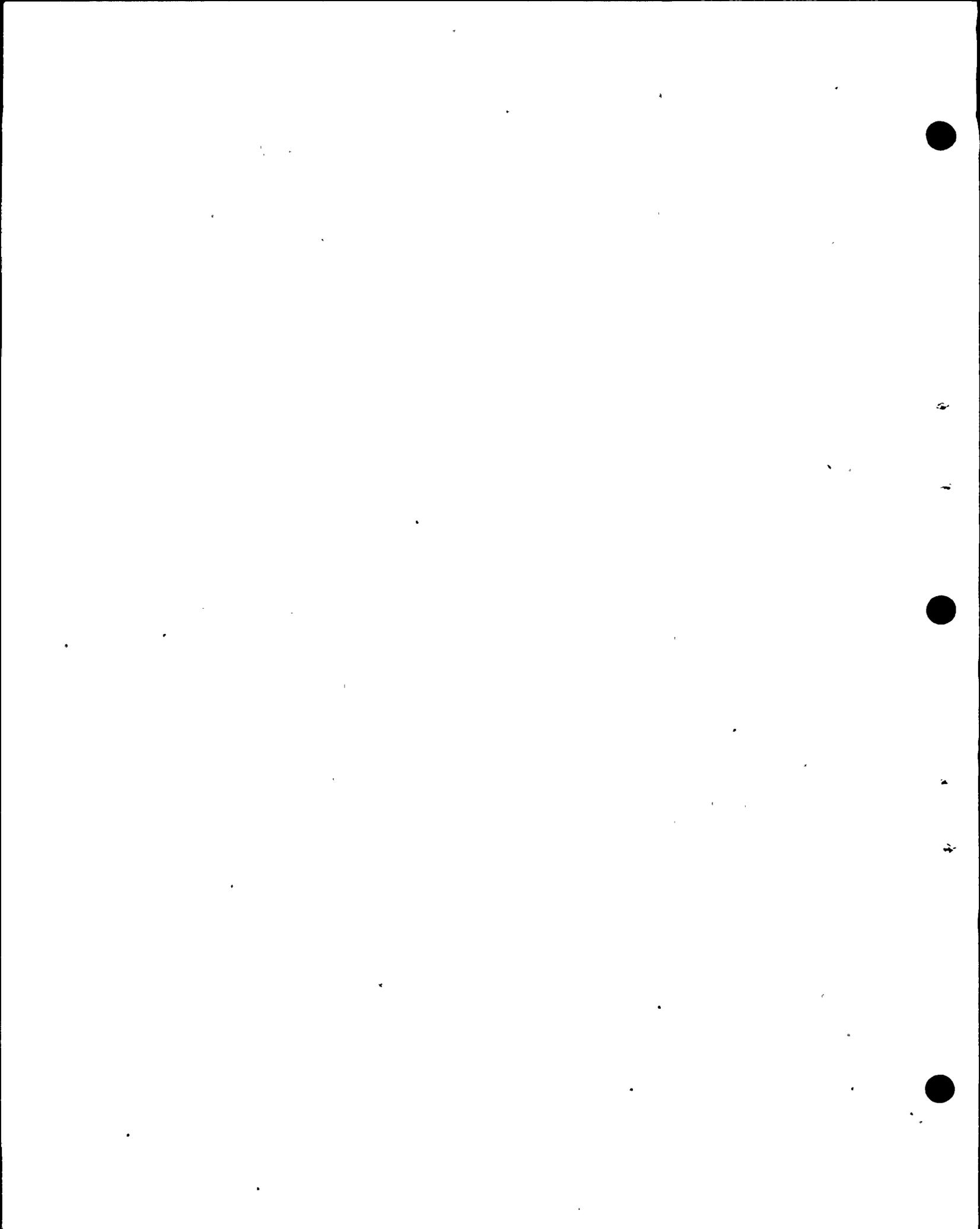
13 MR. KETCHEN: Excuse me.

14 It's now ten days.

15 MR. FLEISCHAKER: Well, ten days to respond to
16 this question.

17 And I do think that exceptional -- this is an
18 exceptional request because in a sense it requests that the
19 Board issue the permit to the Applicant to operate this plant
20 perhaps in advance of its making its definitive finding of
21 safety.

22 So that the first problem I'm having is that
23 I am making a request to be permitted to respond in writing
24 if the Board wishes to consider this motion further, and
25 that we be given the full time permitted under the rules.



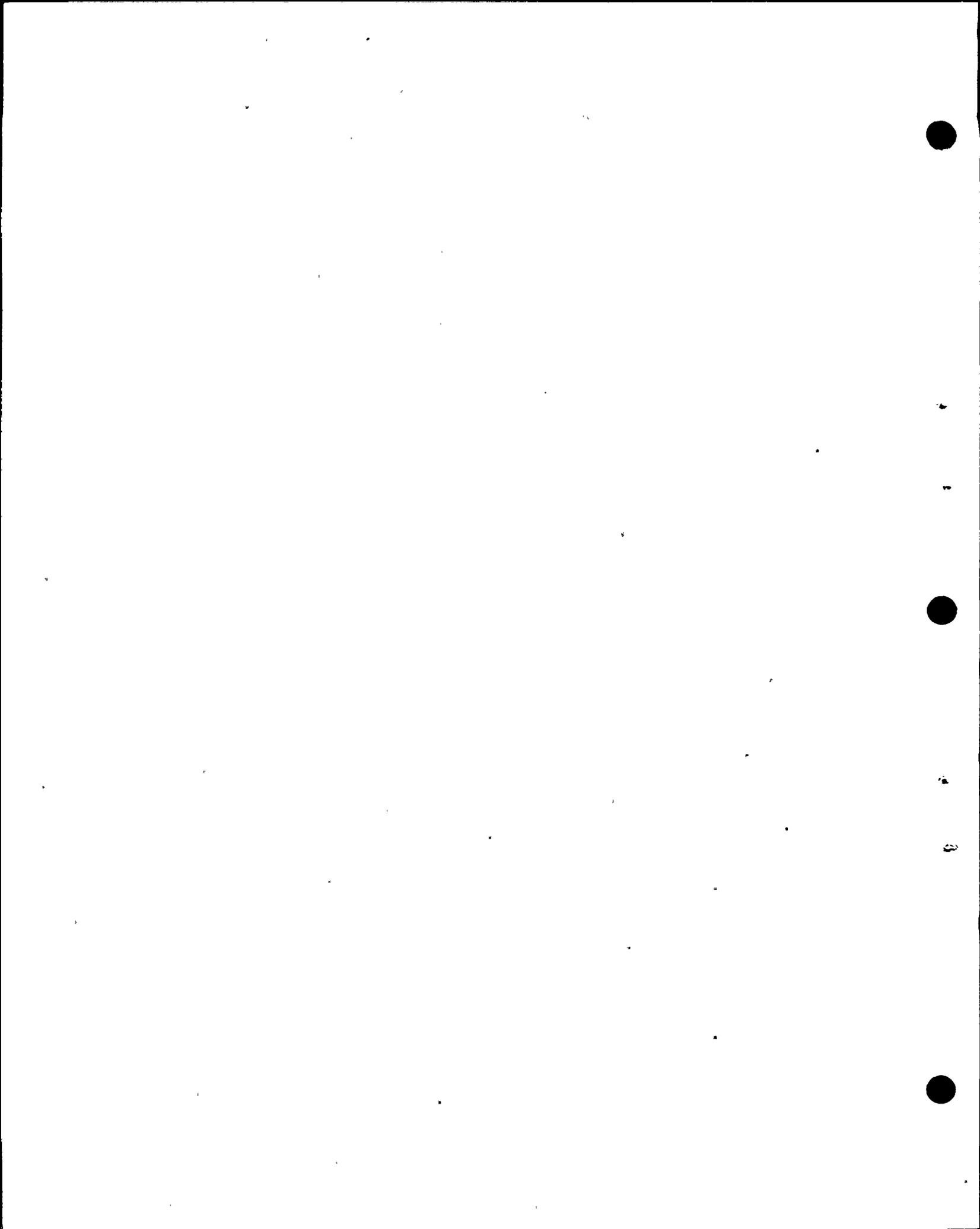
mpb9 1 The second thing is that I think that the motion
2 on its face is insufficient. The motion is supported by
3 several statements by Mr. Furbush. But there is no affi-
4 davit attached in support of the motion.

5 Mr. Furbush has stated that the company is facing
6 essentially two problems, one of them having to do with
7 reserve capacity and the other having to do with the un-
8 availability of fuel for its other generating facilities,
9 mainly oil-fired, perhaps and coal-fired facilities.

10 I think at a minimum that there should be affi-
11 davits from people who have primary responsibilities within
12 the company that establish a record, a factual record, for
13 this Board to make a decision on.

14 I'm particularly concerned about that because
15 when we withdrew this question of reserve capacity in
16 connection with the application for an interim operating
17 license, I know that at that time the California Energy
18 Commission had a very different view of this company's
19 reserve capacity than the company portrayed. So that I
20 believe that at a minimum there should be affidavits.

21 And perhaps upon viewing those affidavits and
22 the long discussion with knowledgeable people, we might
23 request a hearing to determine whether there is a sufficient
24 factual basis to grant the kind of exceptional relief that
25 is requested in this motion.



mpb10 1

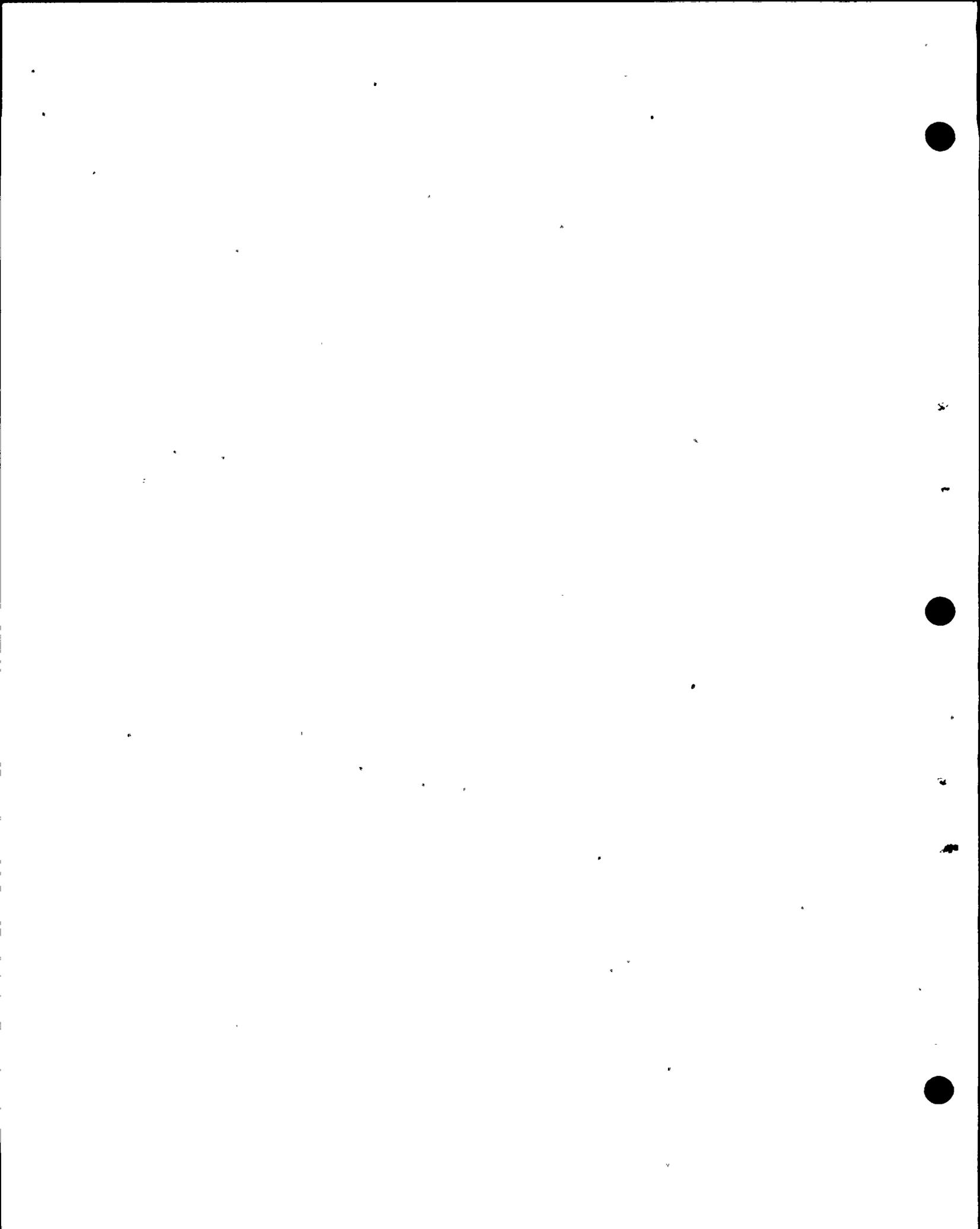
2 Finally, substantively, without looking in
3 detail into this, without even researching in the law, the
4 most fundamental problem I see here goes back to a cardinal
5 principle of the Atomic Energy Act, and that is that plants
6 will not operate -- applications for operating licenses will
7 not be granted by Licensing Boards unless and until that
8 licensing board has made a definitive finding of safety.

9 This Board has before it an issue that goes
10 right to the core of safety: the adequacy of the seismic
11 design of the facility. And until proposed findings of
12 fact and conclusions of law have been written and submitted,
13 and until the Board has had an opportunity to consider those,
14 and until the Board has written a reasoned decision, I do not
15 believe that any authorization should be given to the
16 Applicant that would permit it to let this plant go critical.

17 Once the plant goes critical it creates
18 enormous problems for modifications, which is one of the
19 issues that is closely tied to the adequacy of the seismic
20 design of the facility.

21 So that in a minimum is -- well, that's an out-
22 line of my response. And I simply close by saying that
23 before the Board reaches any decision on this matter, that
24 we would like to have the time permitted by the rules to
25 respond in writing to this motion.

MR. FURBUSH: Mrs. Bowers, I would have to say

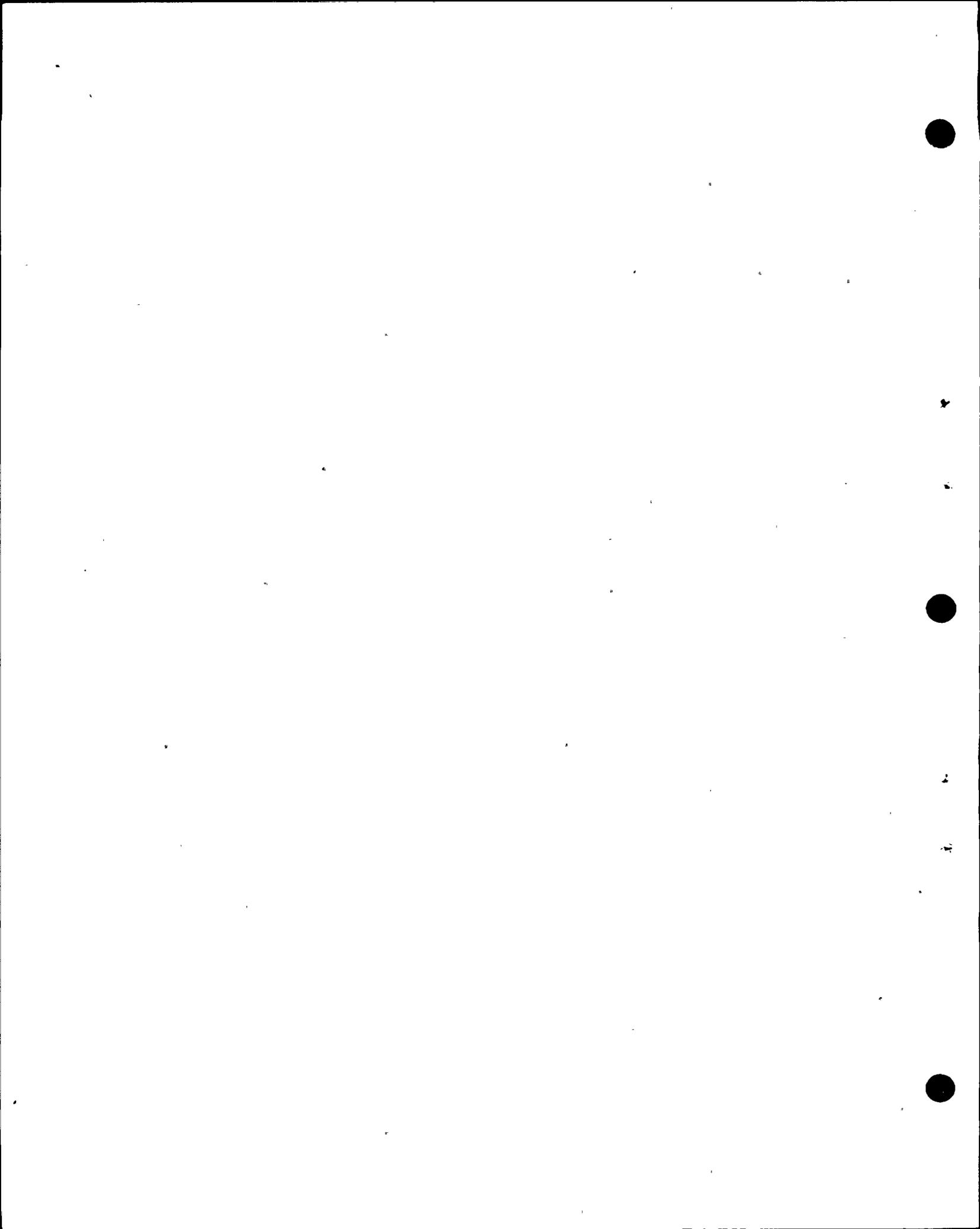


mpbl 1 that I disagree with some of the statements Mr. Fleischaker
2 has made. But I take it he is stating that he would oppose
3 the motion.

4 And if that's the case then I want to have the
5 record very clear on this point: that I made the statements
6 I've made as the reason for our filing the motion -- the
7 motion doesn't require us to give all the reasons I gave.
8 That was the reason why we are filing the motion which in
9 and of itself stands on its own feet.

10 But they are facts, nevertheless. And if we
11 have a period of time this summer when we are unable to
12 meet the load on our system, I think the public should
13 know that it's the fault of the Intervenor in this case.
14 If we had that plant licensed and could place it into effect 1
15 month earlier than otherwise possible because we were not
16 able to have fuel loading and low power testing, it's
17 entirely their fault because they have control of this
18 situation for this reason.

19 I am not going to push this motion if it
20 requires any burden on the Board. By that I mean any atten-
21 tion the Board has to put to it which would take your atten-
22 tion away from the primary goal we have here of pursuing
23 our licensing proceeding to an end as quickly as possible.
24 For that reason it's quite obvious that under the regulation
25 that if there is -- inasmuch as it's quite obvious under the



mpbl2 1 regulations -- that if there is opposition of any party
2 the Board cannot sign it over to the Director of Nuclear
3 Reactor Regulation to make the findings, but the Board it-
4 self would have to make the findings and give the Intervenors
5 a chance to respond to them.

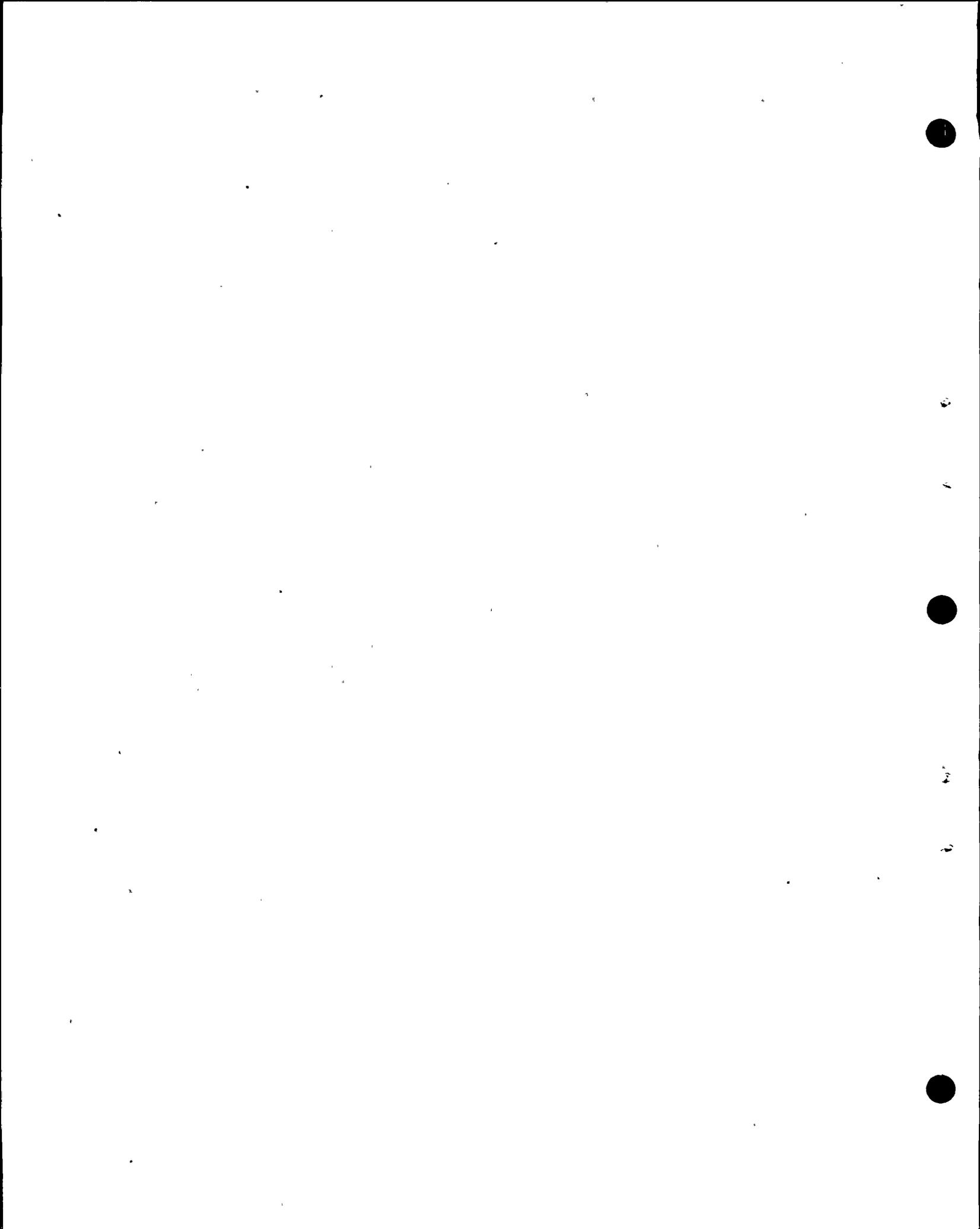
6 That being the case, I do not want to pursue
7 this motion at this time. I would like to have the motion
8 on file, but that no action be taken on it until we request
9 that action be taken, because I certainly don't want to --
10 and I'm reiterating myself -- add any greater burden to the
11 Board which would in any way interfere with their considera-
12 tion of the full record in this case and the consideration of
13 our application for an operating license.

14 But the time may come in the future when it
15 becomes important again for us to do what we can to get
16 this plant in a position to be able to perform the function
17 for which it was constructed: to serve the people in our
18 area.

19 And for that reason I would say that probably
20 any further comments are moot. We are not requesting that
21 this be pursued at this time. But that if we have a shortage
22 of electricity, we know who's at fault.

23 MR. FLEISCHAKER: May I respond to that?

24 Even if I had my prop glasses, I don't think
25 I'd break them because I'm not really indignant; I'm just sad



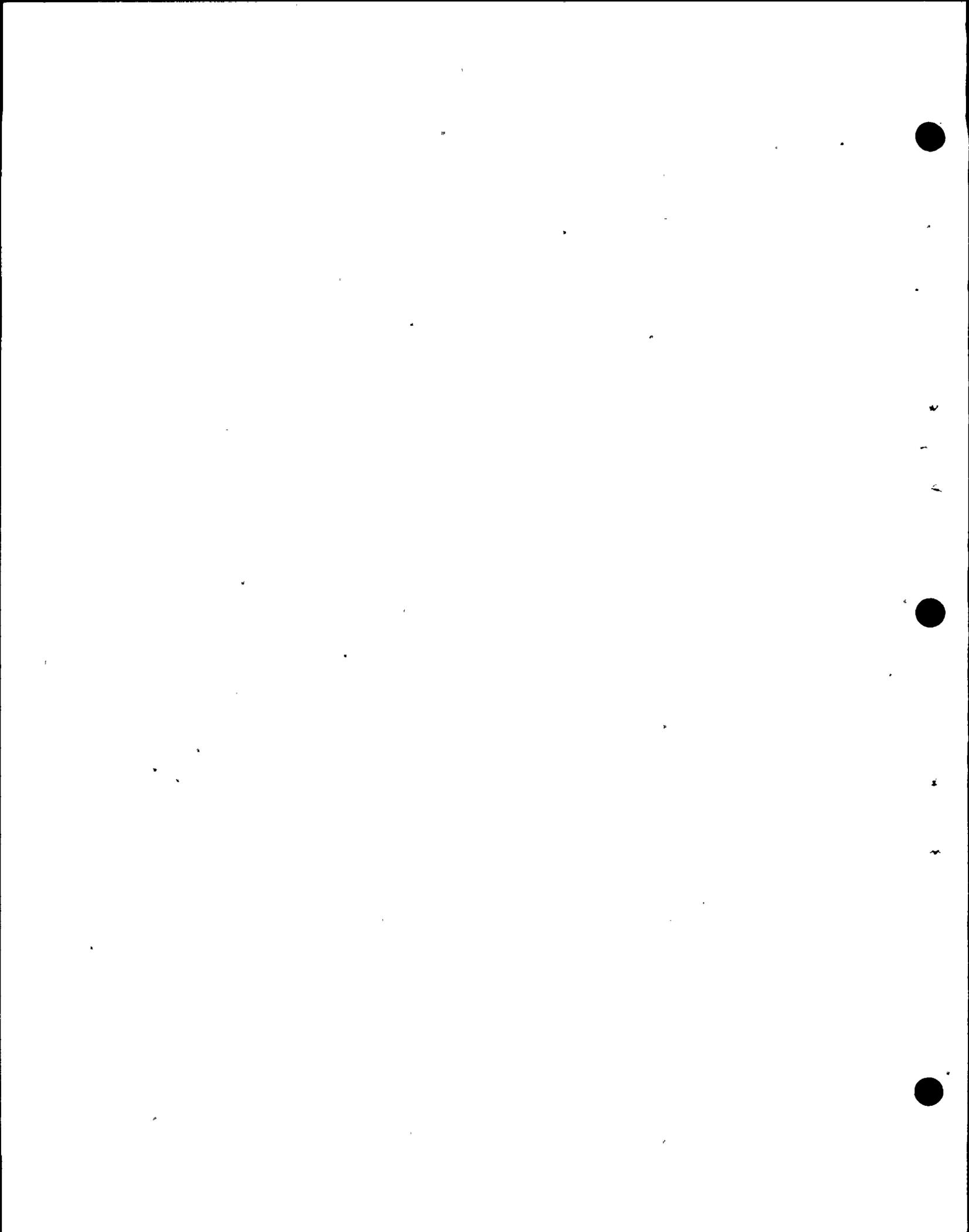
mpb13 1 that the company feels compelled to try to make a scapegoat
2 out of citizens who are exercising their rights, rights
3 clearly set out under the law, who are concerned about
4 safety and who have participated in a responsible way in
5 this proceeding.

6 And I'm sad that the company finds it necessary
7 to try to make a scapegoat out of those citizens. The fact
8 is that if there weren't a single Intervenor in this proceed-
9 ing, if I weren't here, if Mr. Hubbard weren't here, if this
10 table were gone, this Board would still have the responsibility
11 to make a definitive finding of safety. This Board would
12 still have the responsibility to hear from the Applicant
13 witnesses and to hear from the Staff witnesses; even if we
14 weren't here the issue would exist and the safety ques-
15 tions would exist.

16 So it's not the Intervenor's fault that we're
17 here. We're here because Congress has passed a law and
18 established a system for resolution of these questions.
19 We are participating in it clearly within our rights. And
20 I really don't think that --

21 MR. FURBUSH: Mrs. Bowers, I really don't want
22 to belabor the point, but that is a mischaracterization
23 of the regulation. I mean, it's just absolutely wrong.

24 MR. FLEISCHAKER: I really don't have any further
25 comments on this. I really don't think it's worth belaboring.



mpbl4 1

2 MR. FURBUSH: Well, I think you should retract
3 your misrepresentation to the Board that that's what the
4 regulation provides. I mean, at least you have an obliga-
5 tion to do that.

6 MR. NORTON: Mrs. Bowers, this is fascinating.
7 Counsel has just argued what the law is, that the law
8 provides that even if he weren't here the Board would have
9 to have the hearing on whether low power testing could
10 commence. That is just absolutely wrong.

11 MR. FLEISCHAKER: I said definitive findings of
12 safety.

13 MR. NORTON: And you said they would have to have
14 an examination to make definitive findings of safety.

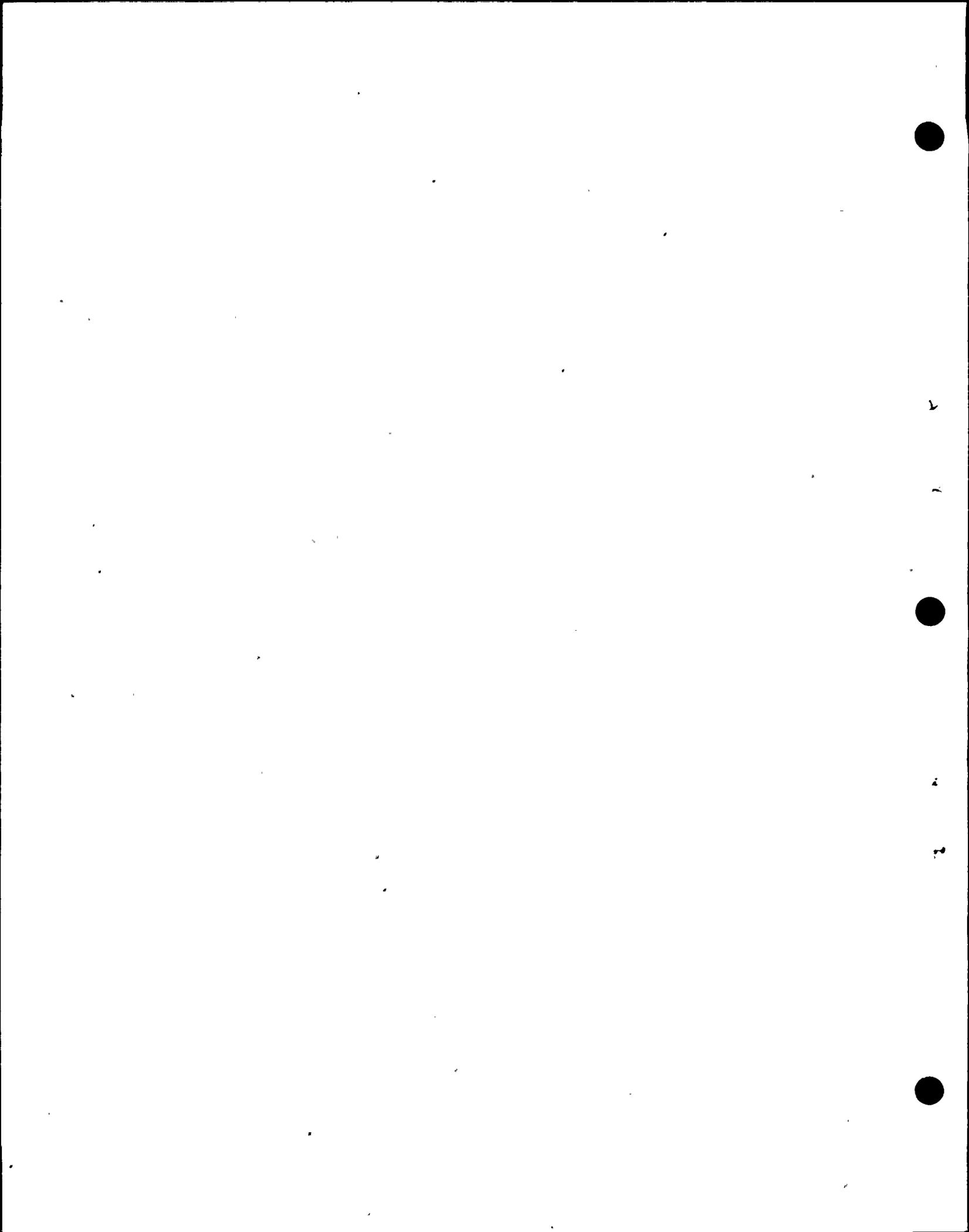
15 I respectfully request that you read the regula-
16 tion before you say what it says, Mr. Fleischaker, because
17 that is not what it says.

18 Your reporter friend just ran out to report to
19 the paper what the law says, and I'm afraid he's got a very
20 wrong idea of what it says.

21 MRS. BOWERS: Well, the regulation says:

22 "Prior to taking any action" -- and, of course,
23 this is referring to low power testing:

24 "...on such motion which any party opposes,
25 the Presiding Officer shall make findings on the
matters specified in Paragraph A of this Section



npb15 1

2 in which there is a controversy in the form of
3 an initial decision with respect to the contested
4 activity sought to be authorized. The Director of
5 Nuclear Regulatory Regulation will make findings
6 on all other matters specified in Paragraph A."

6 MR. NORTON: Keep reading.

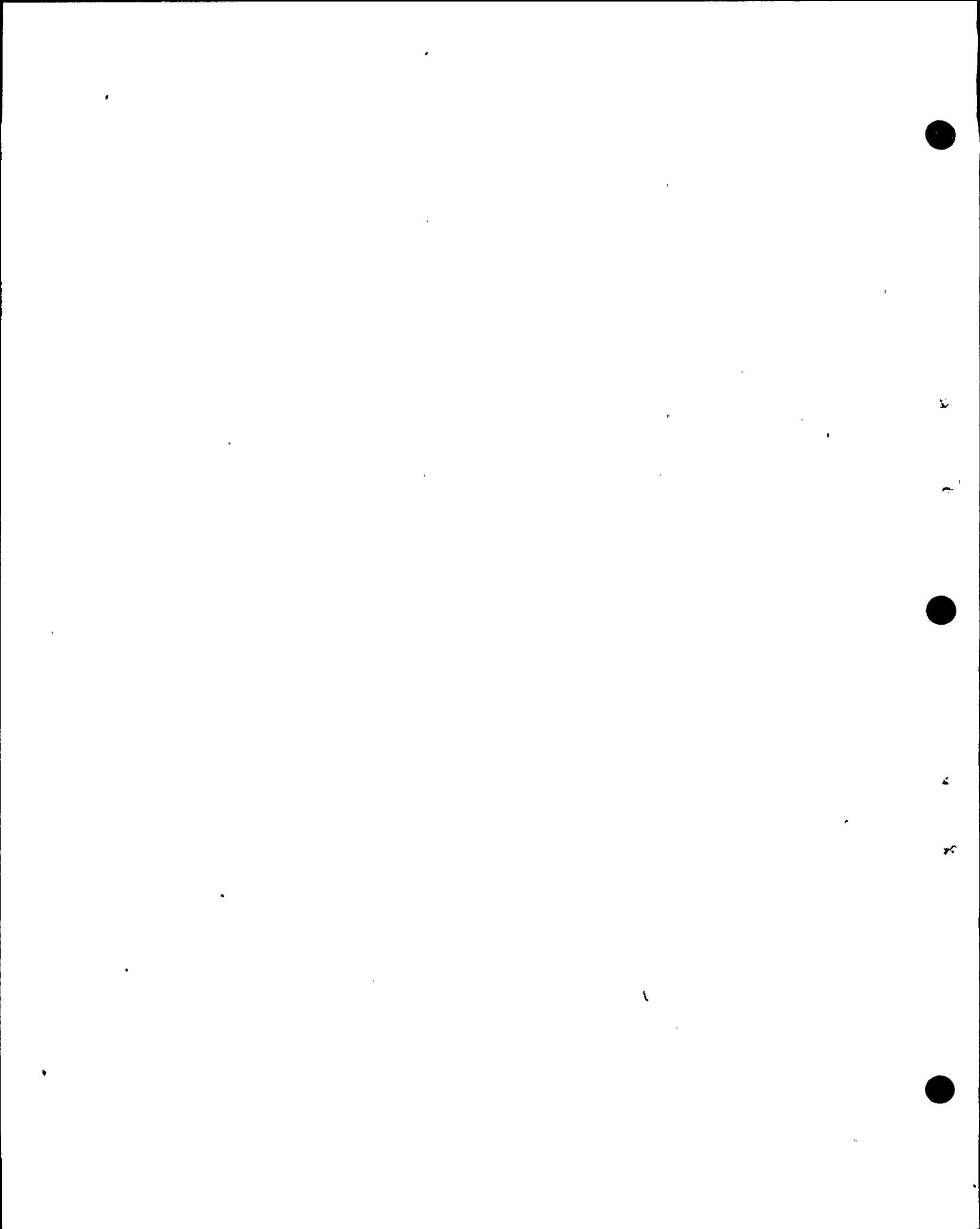
7 MRS. BOWERS: "If no party opposes the
8 motion, the Presiding Officer will issue an order
9 pursuant to 2.730E of this Chapter authorizing
10 the Director of Nuclear Reactor Regulation to
11 make appropriate findings on the matters speci-
12 fied in Paragraph A of this Section and to issue
13 a license for the requested operation."

14 MR. NORTON: Yes, Mrs. Bowers, that's just our
15 point:

16 "If no party opposes the motion, the
17 Presiding Officer" -- being yourself -- "would
18 issue an order pursuant to 2.730E of this
19 Chapter authorizing the Director of Nuclear
20 Reactor Regulation to make appropriate findings..."

21 So the opposition from Mr. Fleischaker indeed
22 precludes that.

23 MR. FLEISCHAKER: I'd be happy to litigate any
24 time, any place, anywhere the question of whether that
25 reactor can go critical without there being a finding of



mpbl6 1 safety made. That's what I'm saying.

2 MR. FURBUSH: Well --

3 MRS. BOWERS: Well, we'd like to hear from the

4 Staff on this, and then go on to other matters.

5 MR. NORTON: Excuse me, Mrs. Bowers.

6 As I understand the position right now, the

7 motion is not being pursued --

8 MRS. BOWERS: That's right.

9 MR. NORTON: -- because of the opposition. And

10 I don't see any point of belaboring it further unless the

11 Staff wants to say something for some other reason.

12 MR. KETCHEN: For posterity, or whatever.

13 I would like to figure out the procedure. I
14 don't understand it. I don't understand the nature of what
15 the motion is.

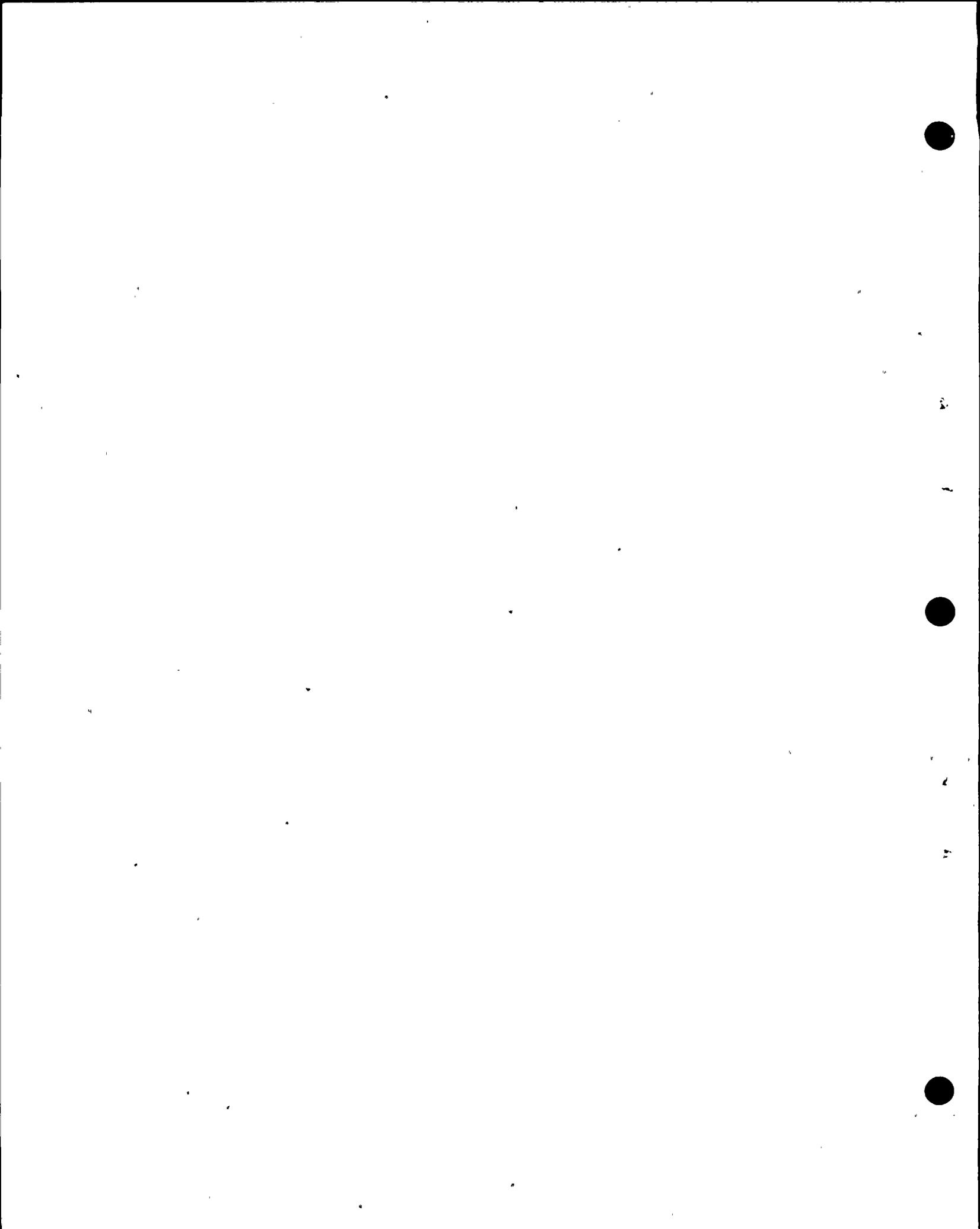
16 A written motion is filed. One party in the
17 proceeding is heard from. It's not withdrawn, but it's put
18 in some sort of limbo to drop out of the sky at some later
19 time when something happens.

20 I don't understand that at all. So where is it?

21 My initial reaction to it is that it is not a
22 proper procedure. It is either a motion or it is not a
23 motion.

24 MR. NORTON: All right.

25 The motion was made in hopes that what was



mpbl7 1. being requested, low power testing, up to one percent,
2 pursuant to 50.57C, if that motion were not opposed by
3 Intervenor or Staff, then the Board would send it to the
4 Director of the Nuclear Reactor Regulation Section, who
5 would make the appropriate findings before allowing low
6 power testing.

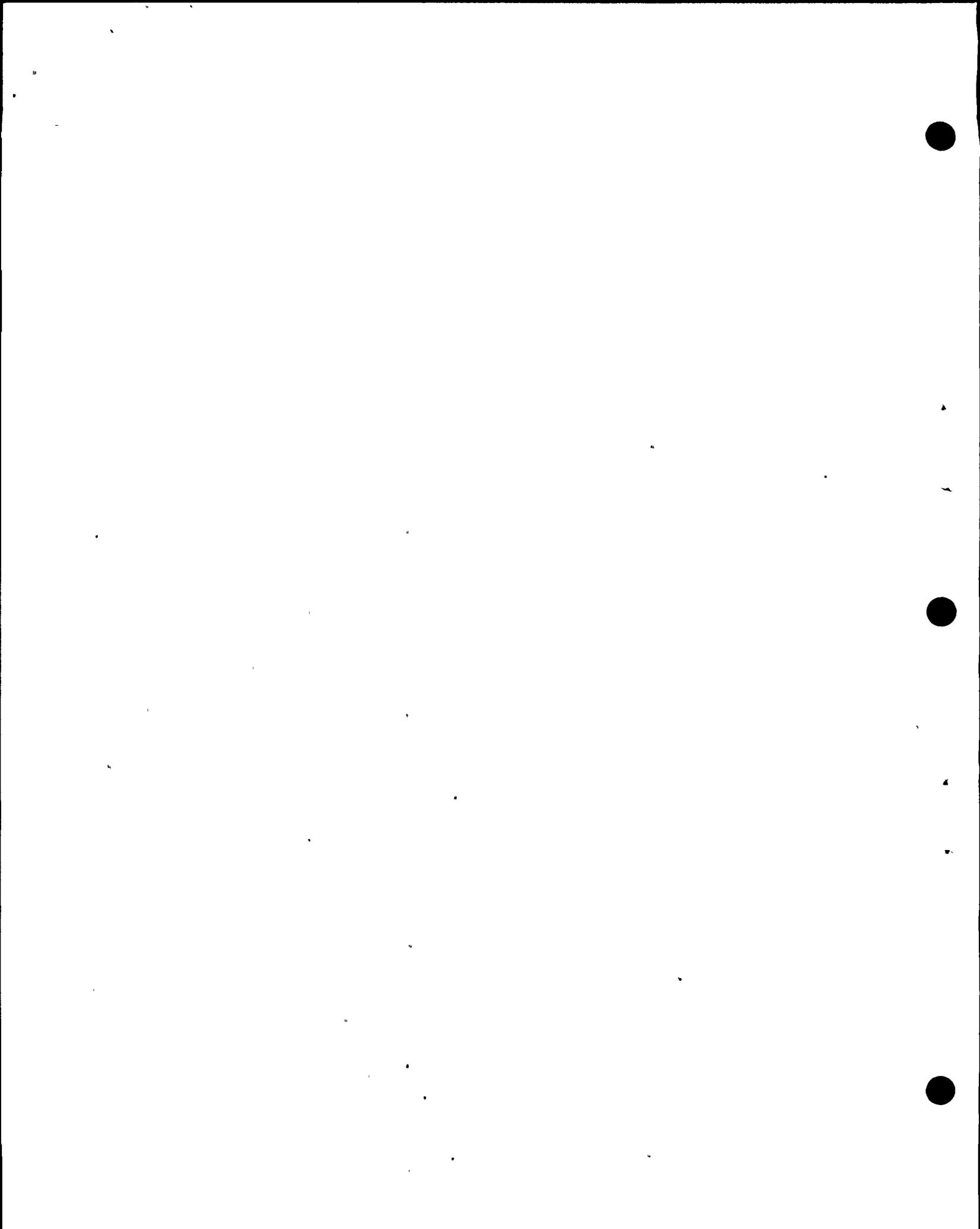
7 However, Intervenor -- as we unfortunately
8 strongly thought they would -- have opposed it. They don't
9 want any low power testing. And so there's no sense of
10 taking up the Board's time by having a hearing on whether
11 or not it should go to the Director and interfere with their
12 decisionmaking process on the operating license procedure.

13 So in essence the motion is withdrawn. It has
14 been filed, it is in the record. But we are not pursuing
15 it now because timewise it's a no win situation, and that's
16 what the Intervenor want and that's what they got.

17 MR. KETCHEN: I don't understand that logic
18 process.

19 But basically if it was a motion that had no
20 chance of going anywhere -- I would like the record to show
21 that the Staff took no position one way or the other on the
22 motion and the motion was withdrawn. And we would reserve
23 our comments to an appropriate time to respond to any motion
24 made by any party under the rules.

25 Thank you.



mpb18 1

2 MRS. BOWERS: Now can we go back to the
3 business at hand?

4 MR. NORTON: Yes.

5 MR. FLEISCHAKER: Are we ready for cross-examination?
6 Is that where we are?

7 MRS. BOWERS: Yes.

8 MR. FLEISCHAKER: I have no questions on cross.

9 However, I would like the record to reflect that
10 that doesn't mean, one, I don't have any query in mind, two,
11 that what they have said isn't interesting, it is interesting,
12 or, three, that I agree with everything they've said.

13 But we have no questions.

14 MR. NORTON: Well, I think that could have been
15 told to us a little bit sooner, but that's all right.

16 MRS. BOWERS: Let me check with the Staff?

17 Mr. Ketchen?

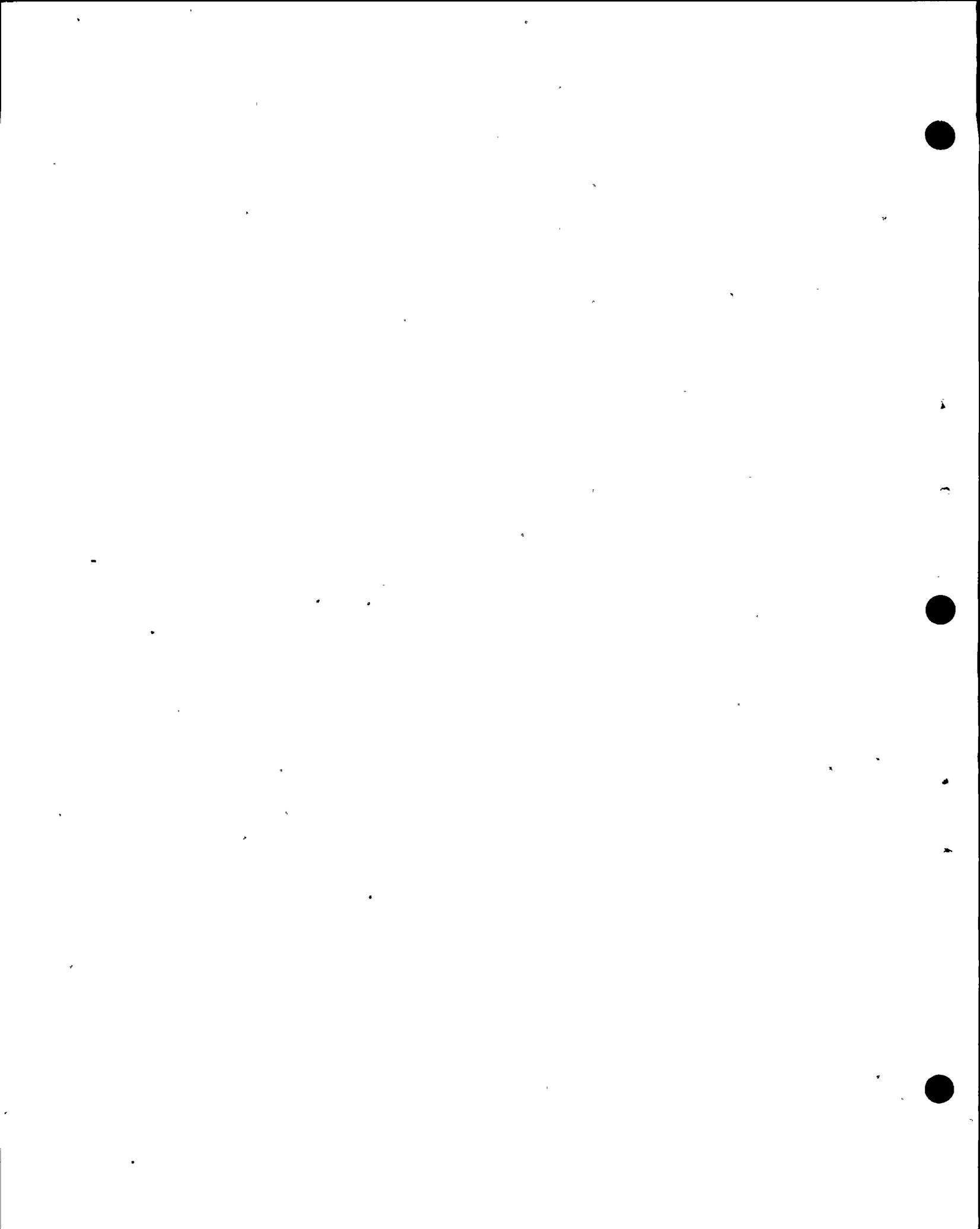
18 MR. KETCHEN: The Staff has no questions.

19 MRS. BOWERS: Well, I guess I should have asked
20 this two days ago when Dr. Hall was here, but let me ask
21 these witnesses.

22 EXAMINATION BY THE BOARD

23 BY MRS. BOWERS:

24 Q Mr. Norton -- and it was pursued again this
25 morning -- wanted to know how the -- quote -- pie shaped
piece of land got where it is. Now the thing that puzzles me,



mpb19 1 why couldn't it have been there all the time? Why was there
2 an assumption made that it had moved from one place to
3 another?

4 MR. NORTON: I can answer, if we can show the
5 viewgraph as to the assumption I made, and I think Dr. Hall
6 testified as to why it moved.

7 MR. FLEISCHAKER: Wait a minute.

8 I object. I think that Dr. Jahns is probably
9 qualified to give the Board a response, and since he's under
10 oath and is an expert, and since Mr. Norton isn't under oath
11 and is not an expert, I think that a response would be better
12 from Dr. Jahns.

13 MR. NORTON: Well, excuse me.

14 I think the question can also be referred -- the
15 answer to that question could be referred to by Dr. Hall, who
16 did answer that question. And I can find it in the transcript.

17 MR. FLEISCHAKER: Okay. Fine.

18 MR. NORTON: That's all I was trying to do.

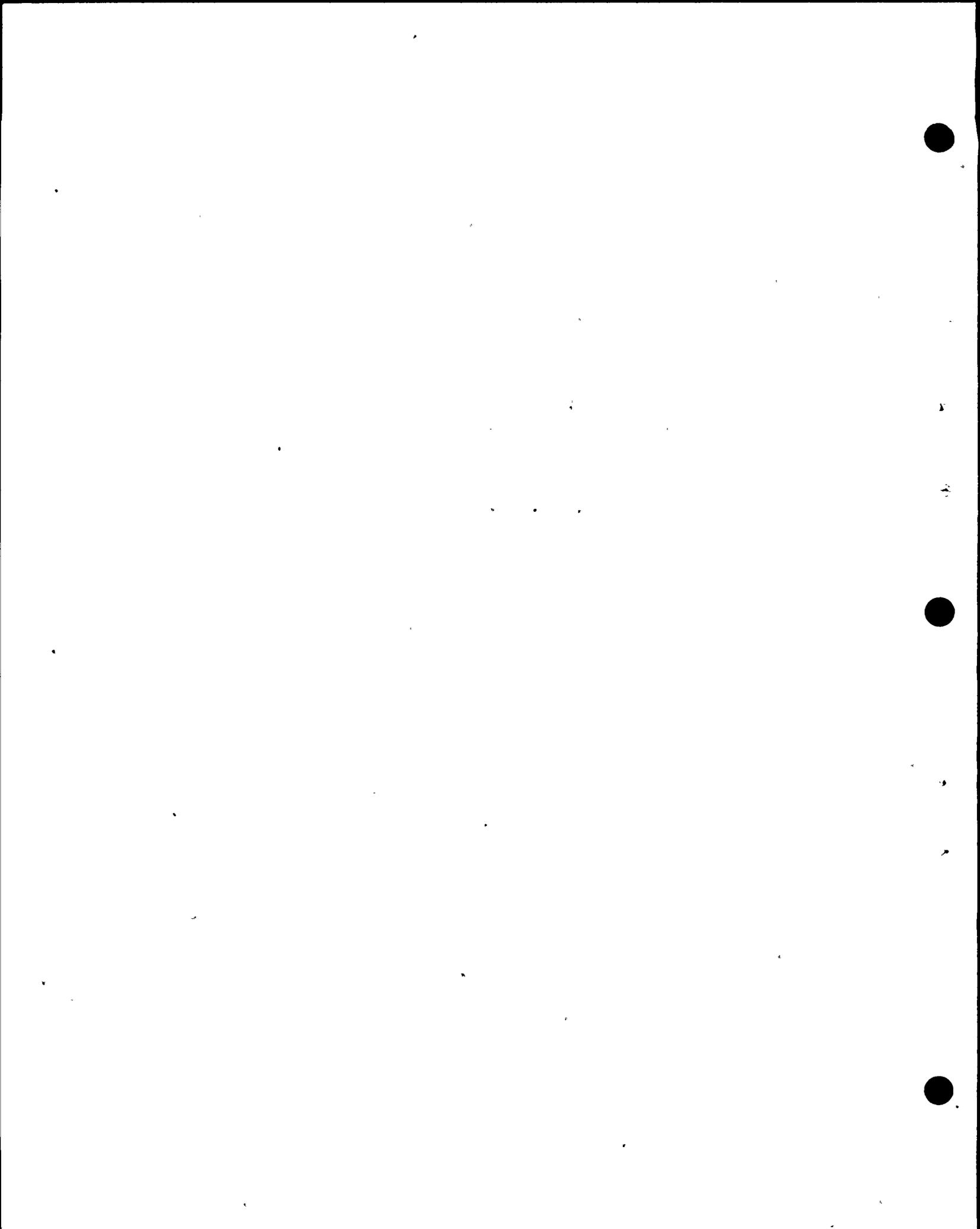
19 BY MRS. BOWERS:

20 Q Well, is it because the X' is there? You know,
21 I'm just puzzled as to why --

22 MR. NORTON: Just a moment and I'll find it in the
23 transcript.

24 (Pause.)

25 (Slide.)



mpb20 f

1 MRS. BOWERS: Actually the X' is below it,
2 isn't it?

3 MR. NORTON: Right.

4 Mrs. Bowers, at page 9661 of the transcript we
5 were talking about the offset, the land on the west side of
6 the Hogri moving in a northwesterly direction, and the
7 alleged offset between Point Sal and San Simeon. And my
8 question was:

9 "Now what I'm having a great deal of
10 difficulty with is if you move the land mass
11 just south of that well -- that's where the SH
12 is..."

13 And I was pointing to it.

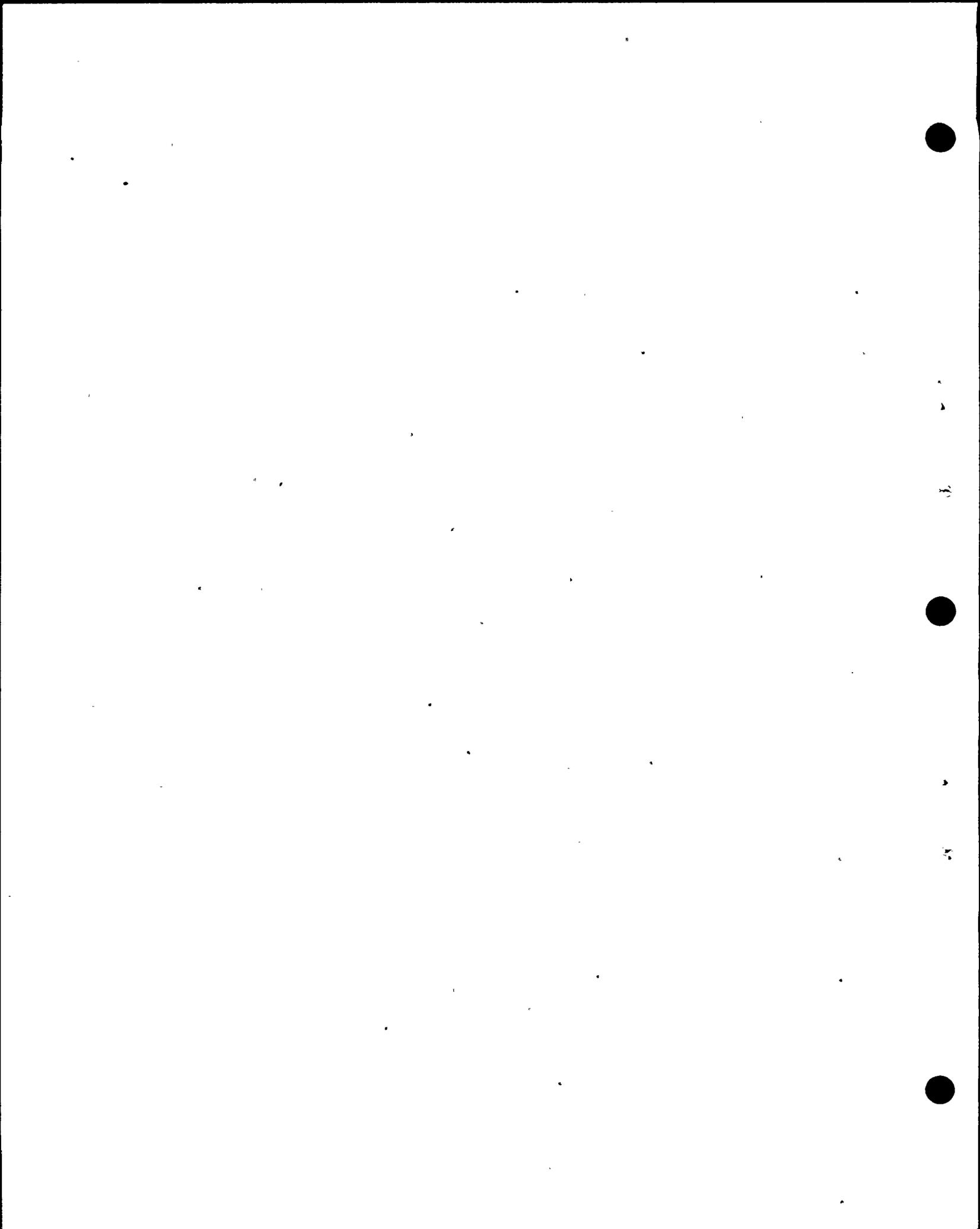
14 "...50 to 80 kilometers northeasterly,
15 what happens..."

16 And I said "northwesterly", excuse me.

17 "...what happens to that land mass
18 that's the piece of pie?"

19 In other words, if the whole land mass moves,
20 the piece of pie has to move too, is what I was saying.

21 "Where does it go and where does it
22 come from? I mean, I just look at that map
23 and I see that land mass moving from the
24 large circle at Point Sal 50 to 80 -- and
25 frankly if you scale down that map it's more



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than 80 kilometers to the northwest -- what happens to that little distance south of Point Sal or south of the Hosgri on the west side of the Hosgri? What happens to it? Where does it come from, because it comes plumb out of your Y on the Lompoc-Solvang? Where does that land come from? How do you explain that?"

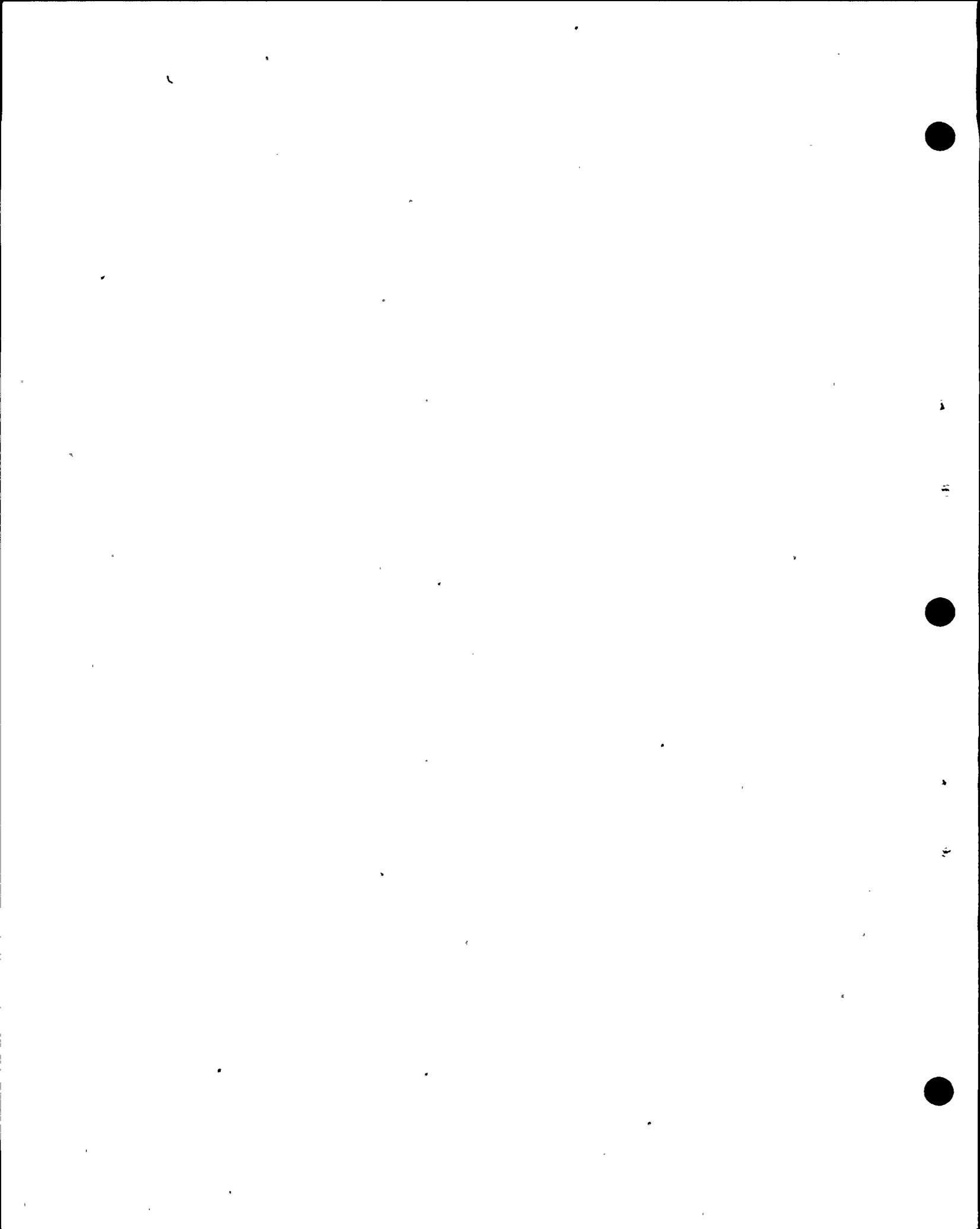
He said:

"Answer: The land in the pie that is on the west side of the Hosgri fault south of the SH -- for the Standard Humboldt well -- it's coming from the area to the southwest of the Hosgri fault."

"Okay. Let me get a microphone and come over with a pointer because I'm having trouble following your answer to my question and I'd like to try it another way."

It went on again:

"The question I'm trying to understand is if I move this land mass from right here, and I'm pointing to the west side of the Hosgri fault at Point Sal 50 to 80, 90 kilometers in a northwesterly direction up here to San Simeon, it seems to me that this



mpb22 1.

2 of the Høsgri and south of Point Sal has to
3 move along with it, okay? And if you've got
4 a fault that goes out here representing the
5 southerly portion of the Y on the Lompoc-
6 Solvang, I don't understand physically what
7 happens to that land. It seems to me you
8 would just suck it all out of there. I don't
9 understand physically where this land that's
10 there now came from.

11 "Now could you show me with a pointer
12 where it came from, the land that exists
13 there now?

14 "Answer: What I'm saying is that this
15 piece moves the 80 kilometers to the north.

16 "Question: Right.

17 "Answer: And what you're asking is
18 where is this piece coming from.

19 "(Indicating.)

20 "Question: Well, yes, I assume it's
21 going along with it.

22 "Answer: That's right.

23 "But remember, now this --

24 "Question: And where does the land
25 that's there now come from?



mpb23 1

"Answer: Right.

2

"Remember, now, that this is a
generalized fault map for west-central
California..."

3

4

5

6

7

And we go on into the discussion that I had
this morning with Dr. Jahns about he pointed first south of
the Lompoc-Solvay and then north, and so on.

8

9

10

11

12

13

That was my question. And that was his answer.
He agreed that when the 80 kilometers moved northwesterly --
when the land moved 80 kilometers in a northwesterly
direction that that pie had to move along with it. And my
question to him was that there is land there today, and
where did it come from.

14

15

And that's what I was trying to pursue with him
and that's what he was trying to answer.

16

17

18

MRS. BOWERS: Well, is the -- are we looking at
charting here of faults where just below X' is sort of the
Santa Barbara area?

19

20

21

MR. NORTON: Below X', as I understand it --
considerably below that is Santa Barbara. But that area
is the Transverse Ranges.

22

23

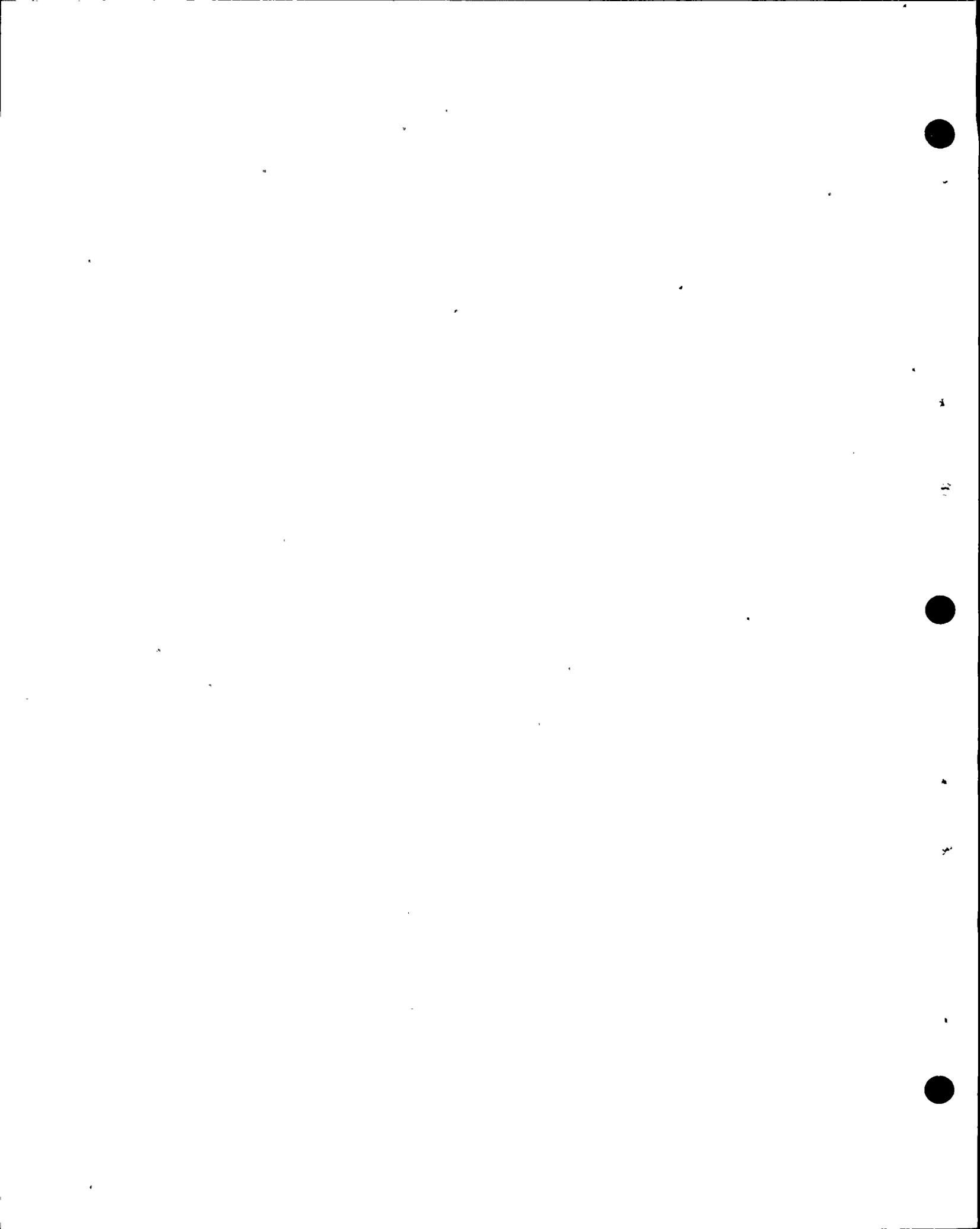
Santa Barbara, if you follow the coast -- in fact
if you look below the YY, you see "SB" and a little circle.

24

MRS. BOWERS: Oh.

25

Well, I'll tell you the thing, I think, that's



mpb24 1 bothering me, it's been called "pie shaped" because it is.
2 It's got a fault shown above it and a fault shown below it.

3 MR. NORTON: Right. And the coastline --

4 MR. KETCHEN: Mrs. Bowers, I think probably the
5 best procedure would be for the witnesses to answer the ques-
6 tions.

7 I don't mean to interrupt, but Mr. Norton's
8 explanations are just not evidence. And Dr. Jahns is very
9 apt. And I would just ask for that procedure.

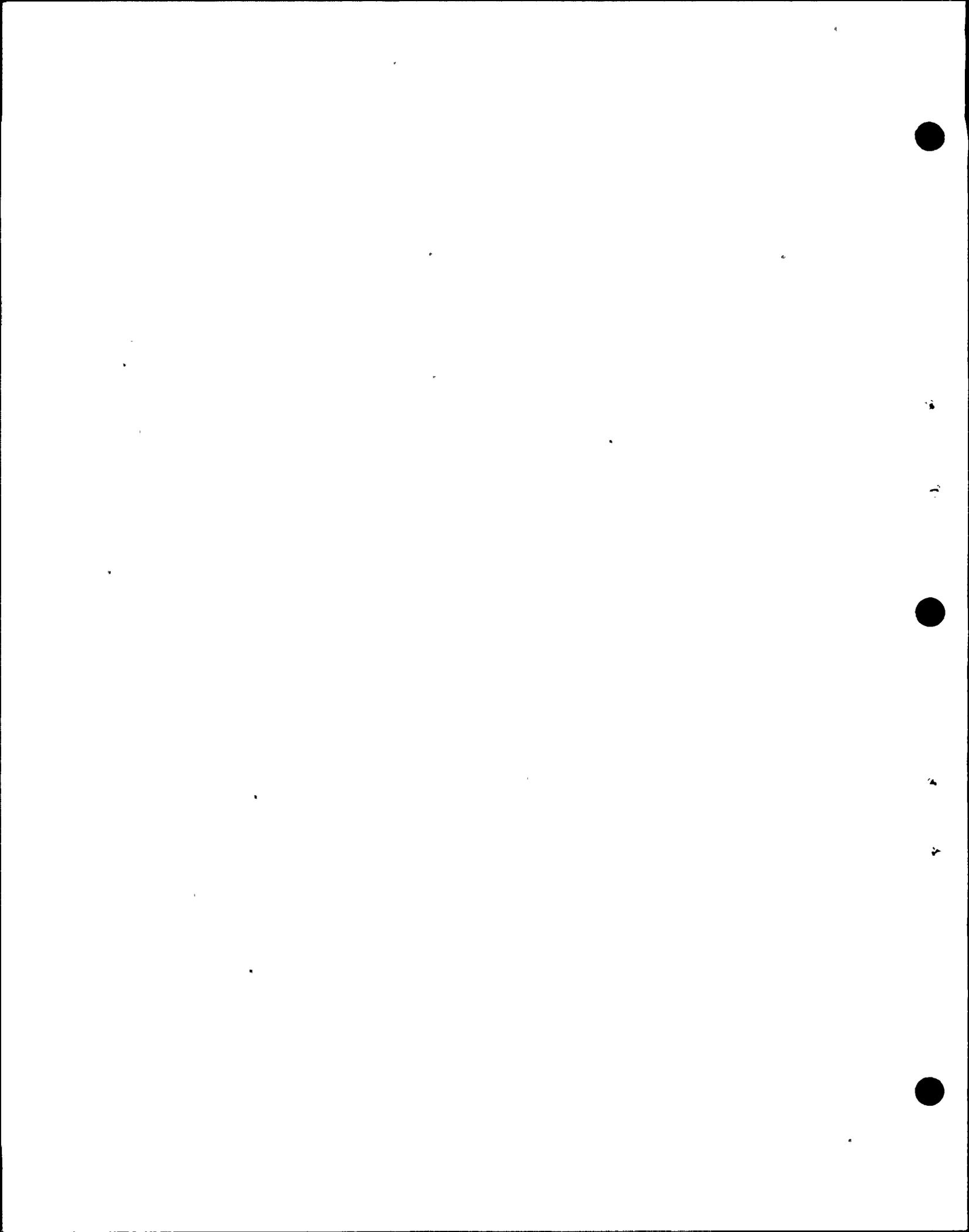
10 MRS. BOWERS: Well, you know, maybe my problem
11 is it's hard to keep track of about 150 million years.

12 (Laughter.)

13 MRS. BOWERS: And is my confusion that at an
14 earlier time whatever was there moved northwest, and then
15 much later --

16 MR. NORTON: No, that was the point of all the
17 questions about when the formation occurred of the pull-
18 apart basin, which occurred 9 to 13 million years ago,
19 according to Dr. Hall, and all of the movement on the Hosgri
20 occurred after the formation of that basin within the last
21 five million years. That was the gist of my questions.

22 This is obviously not evidence. This is, as I
23 can see, a way of understanding what I was asking about.
24 And, frankly, if you want to ask questions of Dr. Jahns,
25 please feel free.



mpo25 1

I think we've been over it a number of times.

2. It's just a question of understanding it.

3 I obviously am not trying to testify. I can
4 only testify as to what I answered, and maybe Dr. Jahns can
5 explain it a lot better than I've been able to. Maybe Dr.
6 Jahns could explain the dilemma again.

7 MR. FLEISCHAKER: I could also point out that
8 having understood what the Board's concern is, that I would
9 think that the parties would address it in the findings of
10 fact in addition to pursuing it at this point with Dr. Jahns.

11 MR. NORTON: Well, I would assume we would
12 address all of the evidence in the findings of fact, Mr.
13 Fleischaker.

14 MRS. BOWERS: Well, let me throw this out:

15 BY MRS. BOWERS:

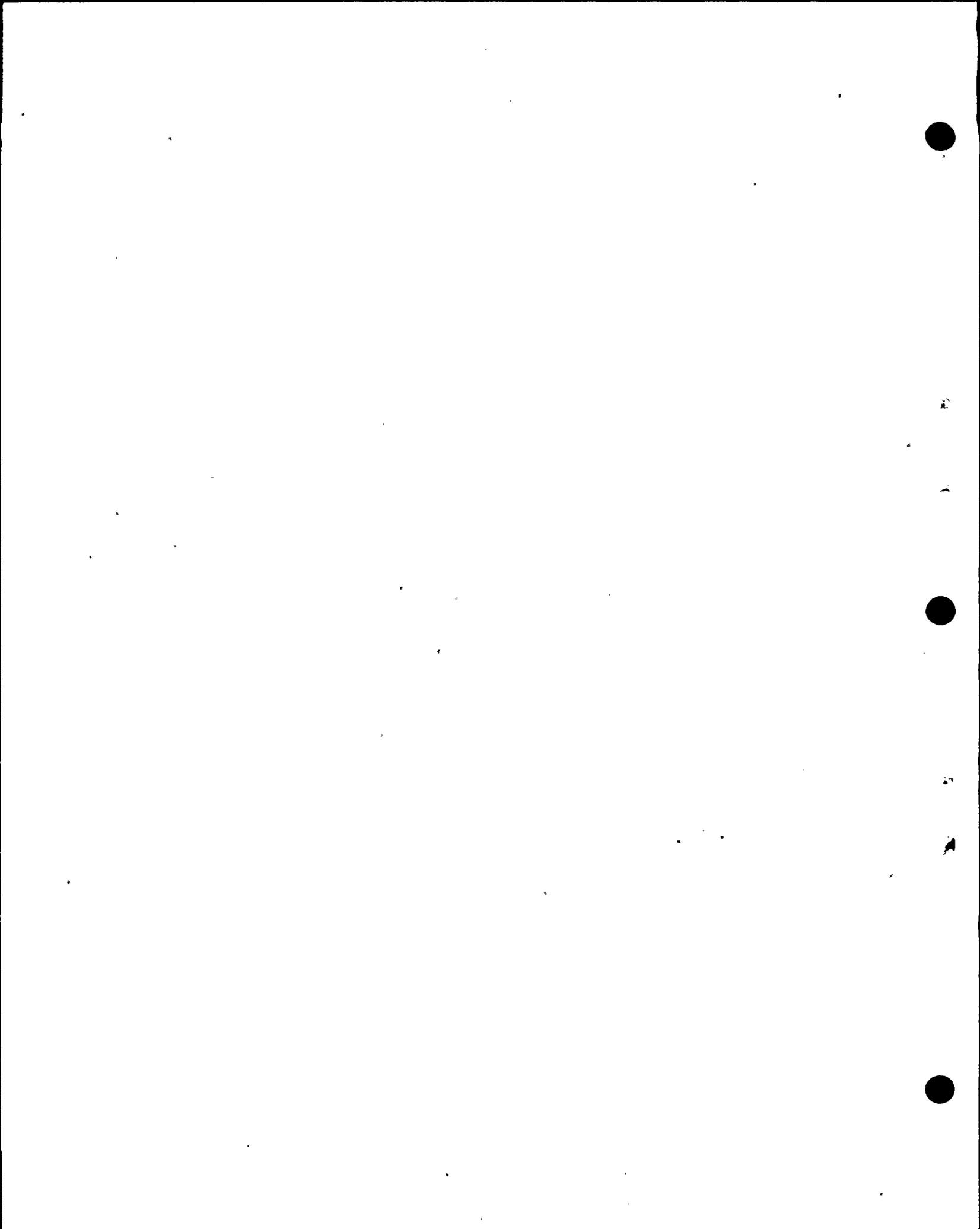
16 Q Now Dr. Hall hatched that little area. There's
17 a drawing of this where he continued to hatch it.

18 Now did the land below it where K' is located,
19 is it supposed to have just stayed put all along?

20 MR. NORTON: That was the testimony of Dr. Hall.

21 MRS. BOWERS: Well, I guess part of my problem
22 is Dr. Hall, of course, has extended the Hosgri down and
23 extended it landward.

24 Now in my mind the only way that pie shaped area
25 could have gone north would be prior to the Hosgri fault



mpb26 1 developing. But this is going back millions of years.

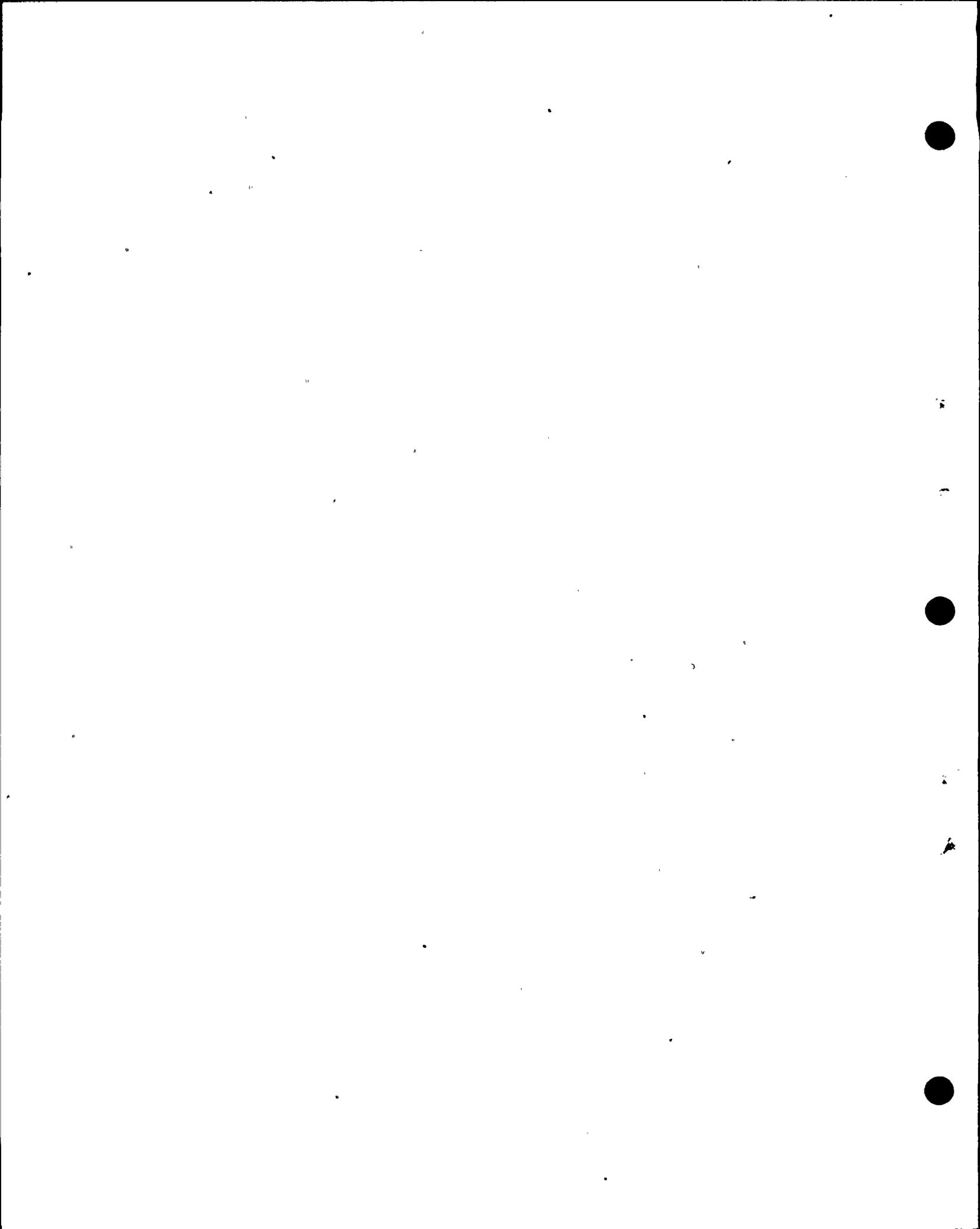
2 MR. NORTON: Dr. Jahns, would you address that
3 question, please?

4 WITNESS JAHNS: I believe you've identified one
5 of the problems in a nutshell. The factor of timing is one
6 in this instance that in effect is a grain of sand in the
7 gears of the system in that the timing of development of the
8 basin, the hatched area is reckoned at, say, 7 to 17 million
9 years ago.

10 That means, as far as this map is concerned,
11 that everything that's hatched, or everything that should be
12 hatched must be somehow involved in the most recent five
13 million years of history for the region during which time
14 this major movement on the Hosgri system has occurred
15 according to the Hall model, and therein lies the problem.

16 Anything that was formed in the way of a refer-
17 ence feature prior to five million years ago, if it lies in
18 ground adjacent to the Hosgri fault must be offset in a
19 consistent manner if the Hall model is followed because the
20 30 kilometers of movement on the Hosgri fault, according to
21 that model, has occurred during the past five million years.

22 So any older feature must be reckoned out
23 geometrically in terms of how far it's been offset and
24 therefore how far one has to move it back to make a geometric
25 restoration as of, say, five million years ago.



IC
WRB/wbl

1 BY MRS. BOWERS:

2 Q Well maybe this is part of my problem. I
3 couldn't see why that little pie-shaped piece was getting
4 so much attention.

5 Now the hatched area, if it went north, you
6 said 17 million years ago, then something came from some-
7 place else to fill that in?

8 A (Witness Jahns) Yes, quite so.

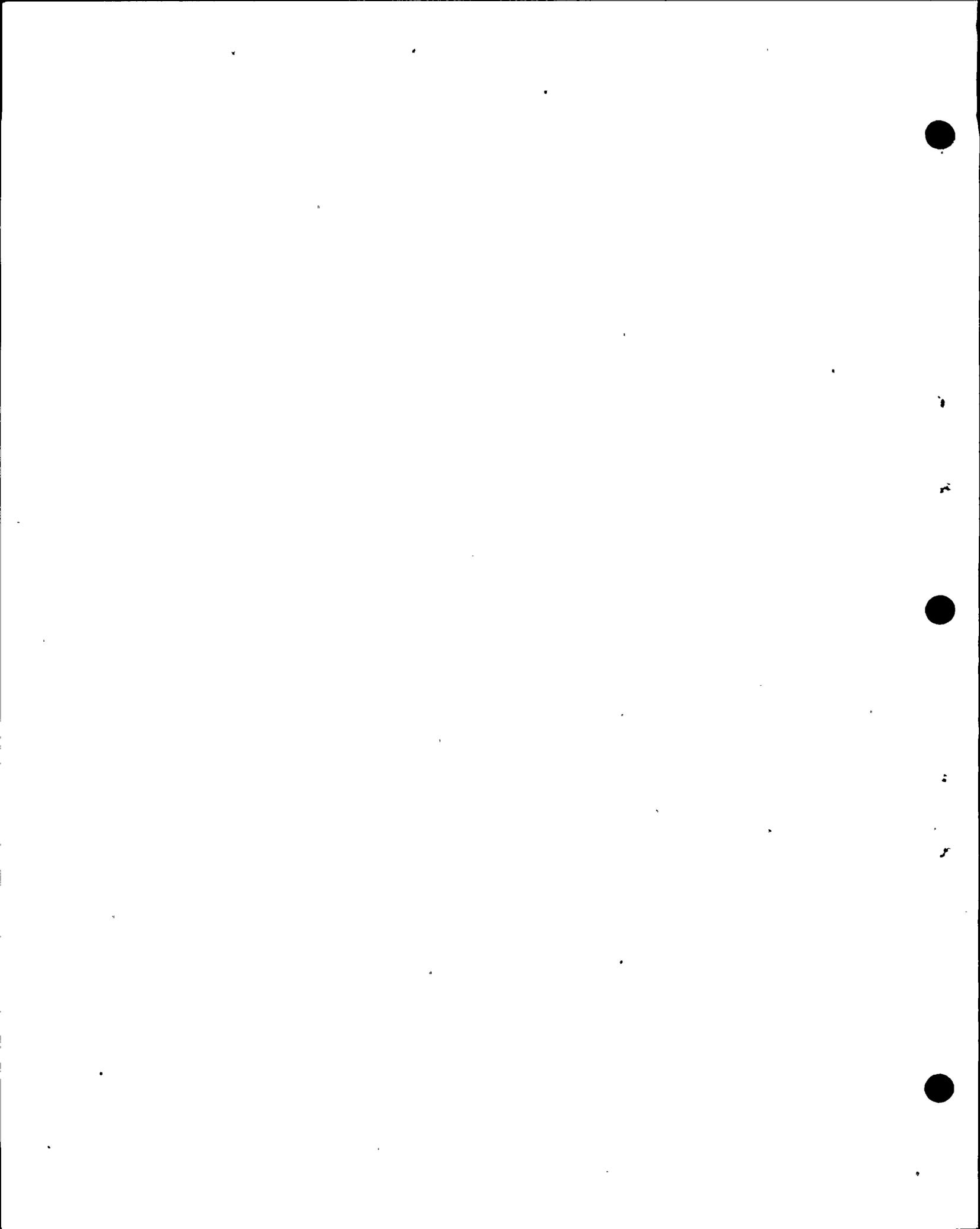
9 Q Does Dr. Hall's theory have it coming from the
10 east? It would have to.

11 A Well this is one reason why, you may recall
12 in his presentation, Dr. Hall added hash marks on the opposite
13 side of the fault and modified his earlier statements about
14 the Hosgri fault constituting one margin of the Santa
15 Maria Basin, or one shoulder, as he put it, and, instead,
16 wound up indicating that really one doesn't know what the
17 maximum westerly extent of the basin might have been.
18 And that was partly--

19 (Slide)

20 Yes, here we are. That was partly in response
21 to the problem of that little wedge.

22 So, in a sense, an ideal topological solution
23 to the problem would be to change the position of the Hosgri
24 fault to something entirely west of places where both it
25 and the fault on the opposite side of that piece of pie are



1 now shown.

2 MR. NORTON: Excuse me. Let me interrupt and
3 say we have put up on the Board, superimposed the same
4 fault map, Applicant's Exhibit 44, where Dr. Hall in the
5 later part of his testimony put in the hash marks extending
6 the basin across the west -- across to the west side of
7 the Hosgri. And it's indicated by hatch marks on the west
8 side of the Hosgri fault and into the pie area.

9 BY MRS. BOWERS:

10 Q And it would be the southedge of the pie that
11 shows the fault was the thing that prevented the land where
12 X' is located from also moving; is that what would have
13 prevented that?

14 A (Witness Jahns) That's according to the follow-
15 ing through of that theory, yes.

16 Q Okay.

17 MR. NORTON: We really have no redirect, seeing
18 as how there wasn't any cross.

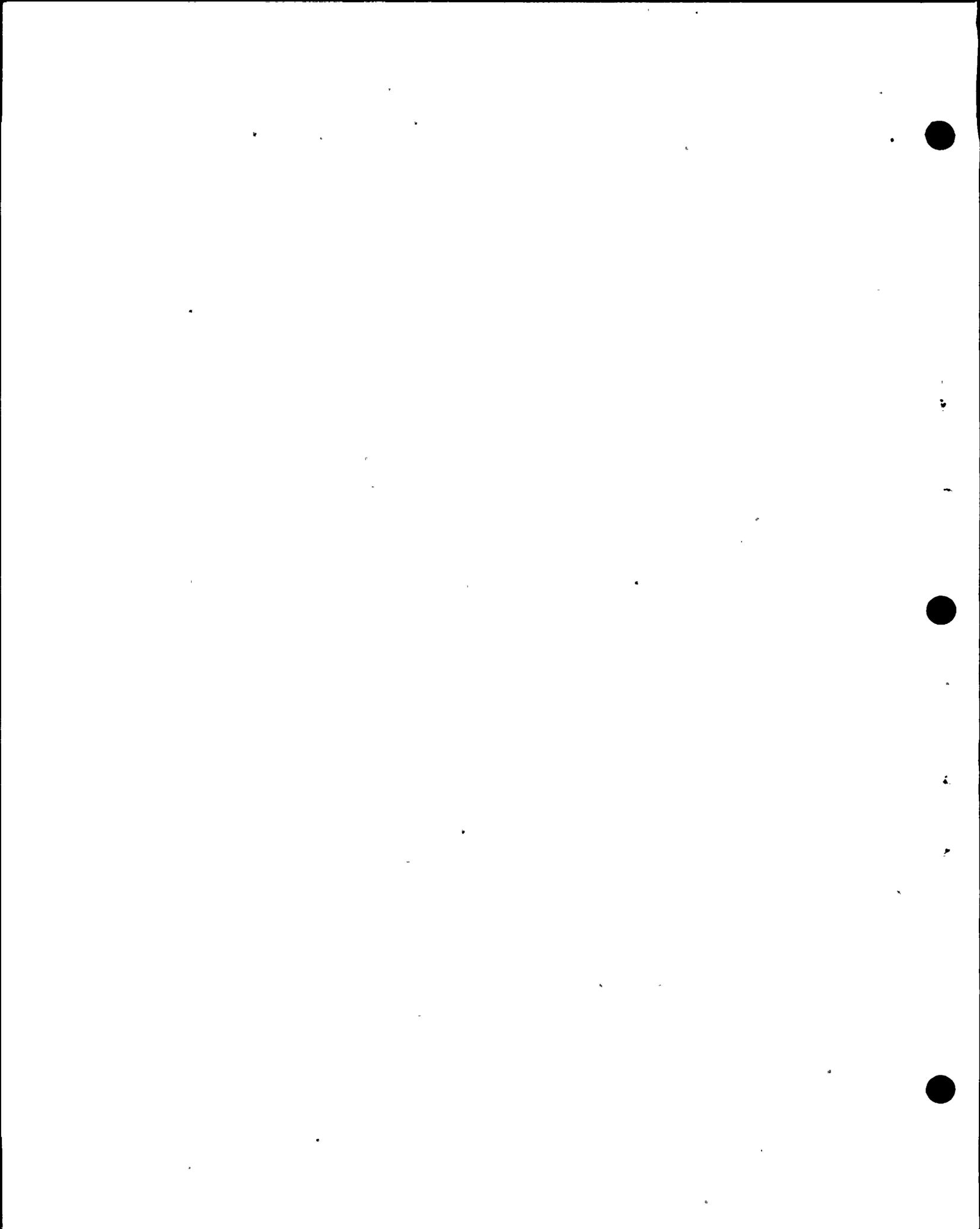
19 MRS. BOWERS: Mr. Fleischaker is not interested
20 in more questions.

21 Mr. Ketchen, how about you?

22 MR. KETCHEN: No, Ma'am.

23 MRS. BOWERS: Well, we have no further questions
24 for these witnesses.

25 MR. NORTON: We would ask, of course, that they



1 be excused at this time.

2 MR. KETCHEN: The Staff has no objection.

3 MR. FLEISCHAKER: No objection.

4 MRS. BOWERS: Well the witnesses can be
5 excused. Thank you.

6 You know, they just go from one side of the
7 room to the other, though.

8 MR. NORTON: No, they're going home.

9 (Panel excused)

10 MR. NORTON: At this time we would like to call
11 our last rebuttal panel, to be comprised of Dr. Blume,
12 Dr. Seed, Dr. Frazier and Dr. Malik.

13 Whereupon,

14 JOHN A. BLUME

15 H. BOLTON SEED

16 GERALD FRAZIER

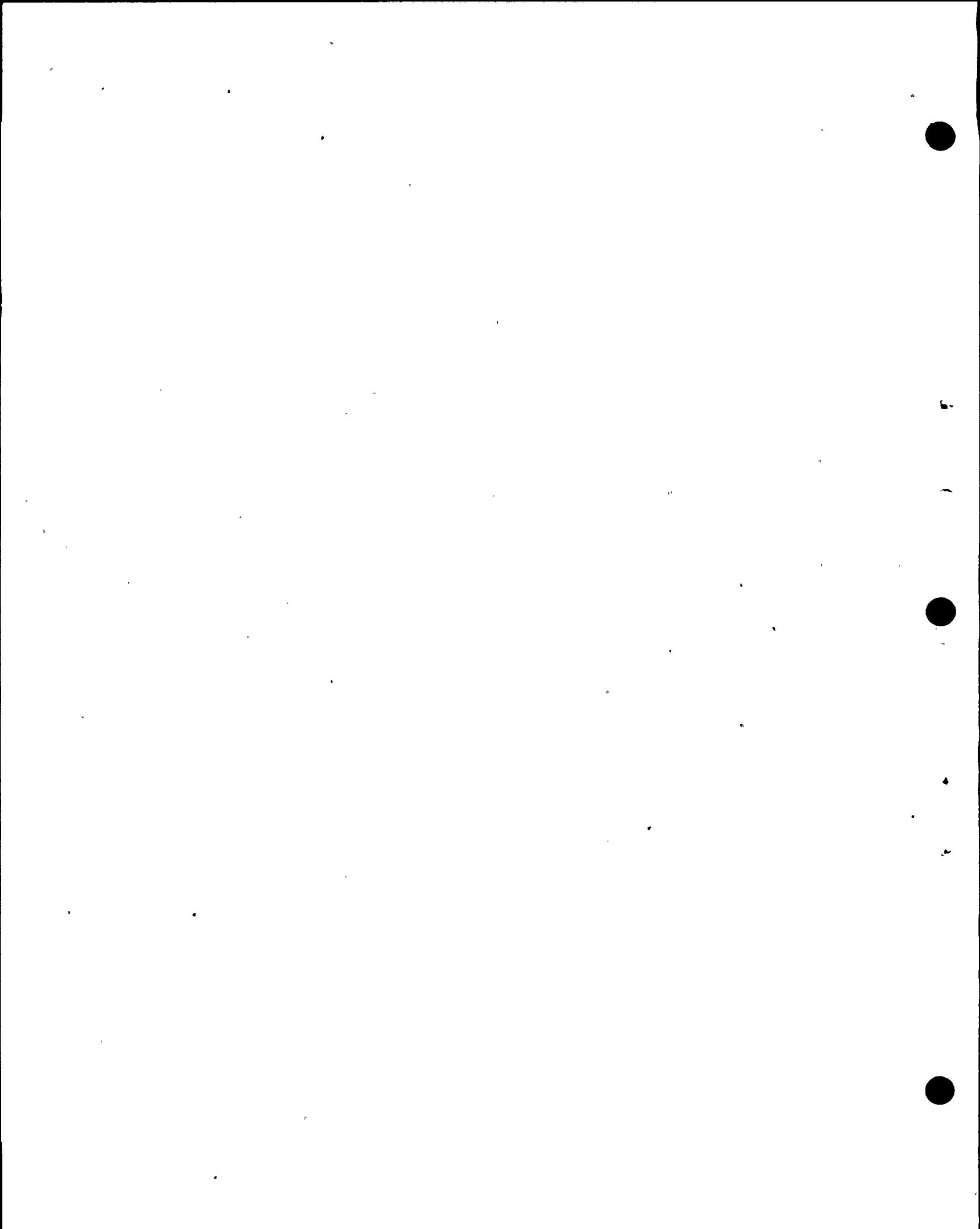
17 and

18 LINCOLN E. MALIK

19 were recalled as rebuttal witnesses for and on behalf of
20 the applicant and, having been previously duly sworn, were
21 examined and testified further as follows:

22 MRS. BOWERS: The record will show, of course,
23 that they've been previously sworn.

24 MR. NORTON: Mrs. Bowers, basically we're going
25 to cover three areas that we might give general heading, and



1 we will use most of the witnesses -- well, that's not true;
2 we'll use most of the witnesses for the first two areas,
3 the third area will be primarily one witness.

4 The first area we're going to discuss is
5 ground motion. Then we are going to -- Mr. Blume is going
6 to give a very short presentation about damping, and then
7 we will cover tau.

8 We'll start out with Dr. Blume discussing ground
9 motion in terms of the Pacoima record and in terms of the
10 effective acceleration, what has been labeled the effective
11 acceleration of .75, but; in fact, the accelerations that
12 could be expected at the site at the foundation, he will
13 discuss those. And then I think he will pass it on to
14 Dr. Malik to do some discussion about the Olive View
15 Hospital and the Bartero paper.

16 DIRECT EXAMINATION

17 BY MR. NORTON:

18 Q Dr. Blume, could you start out with your dis-
19 cussion regarding the Pacoima Dam record and the free field
20 motions, etc., at the site?

21 A (Witness Blume) Yes.

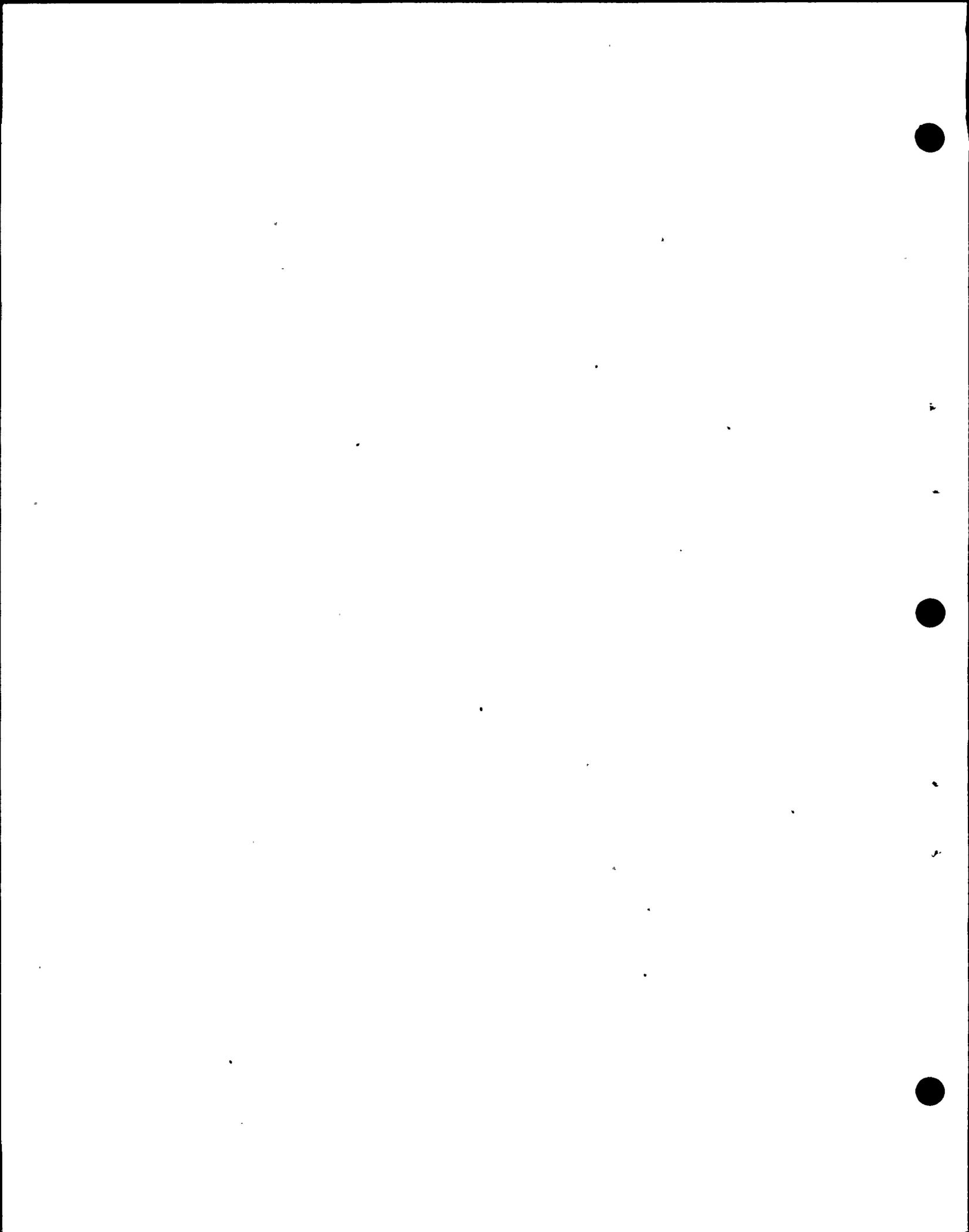
22 There has been a great deal--

23 Q Excuse me, Dr. Blume.

24 One question I should ask of all the panel
25 members prior to any of this:-- This is in rebuttal to

B/wbd

XXXXXXXX



1 Drs. Trifunac and Luco. And I want to make sure that all of
2 you have indeed read, or have been present during, the
3 testimony of-- I know Dr. Frazier was here for the entire
4 testimony of Drs. Luco and Trifunac. But the other three
5 of you gentlemen, would you please state whether you have
6 or have not read the transcript and the papers submitted
7 by Drs. Trifunac and Luco?

8 A (Witness Blume) I have read the depositions and
9 the transcript for the dates, I believe February 8th and 9th.

10 Q Okay.

11 Dr. Blume, the deposition is-- We ran into a
12 little bit of a problem earlier before. The deposition is
13 not in evidence, and you are rebutting what they said in
14 their direct testimony or what they said in their sub-
15 mittals. And you have indeed read all of their submittals?

16 A I have read two days, February 8th and 9th.
17 If that's all of it, I've read it.

18 Q Dr. Blume, there are submittals to the ACRS.
19 You have read them?

20 A Yes. I've read all of those.

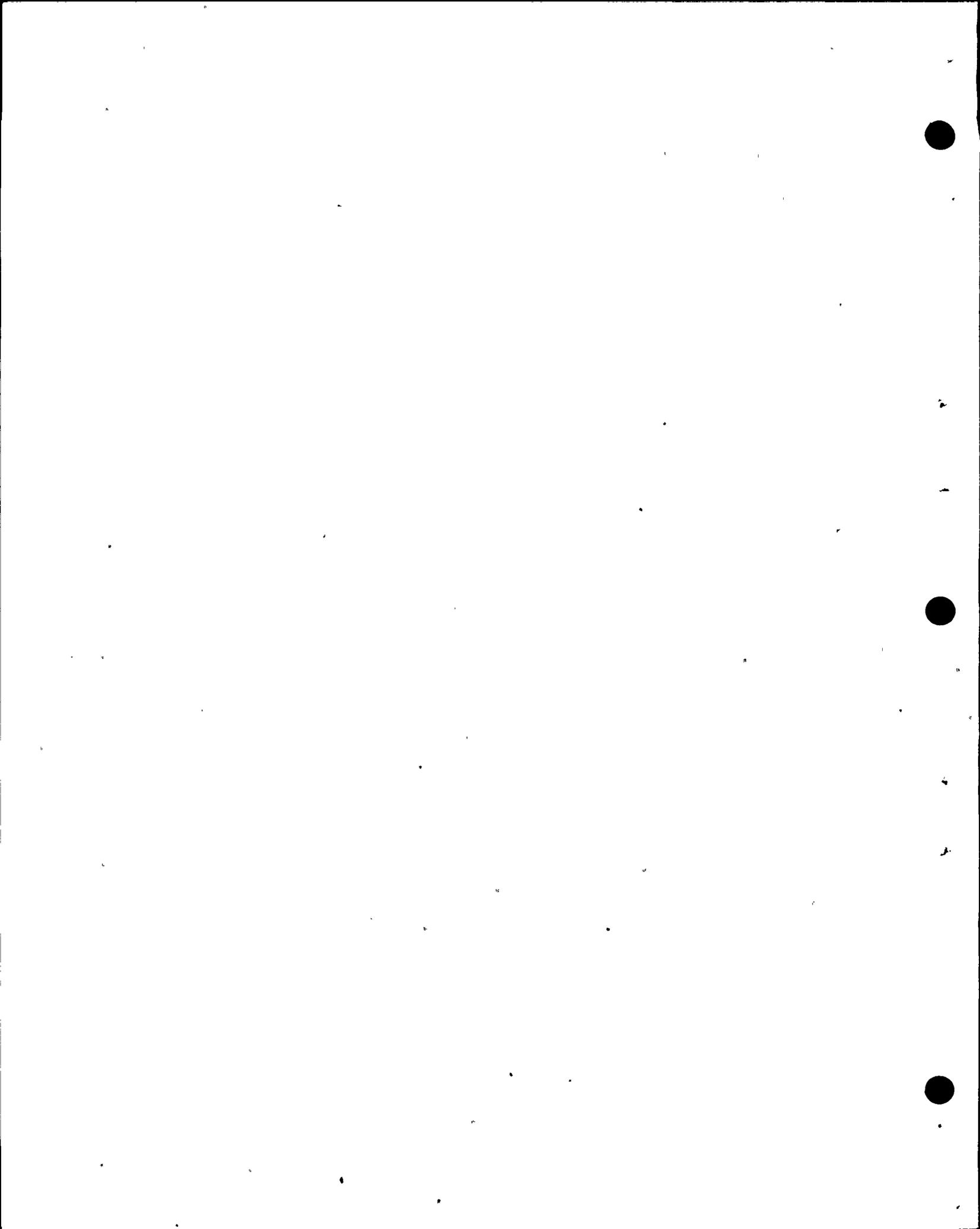
21 Q Dr. Seed?

22 A (Witness Seed) Yes, I've read them.

23 Q And Dr. Malik?

24 A (Witness Malik) Yes, I have.

25 Q All right.

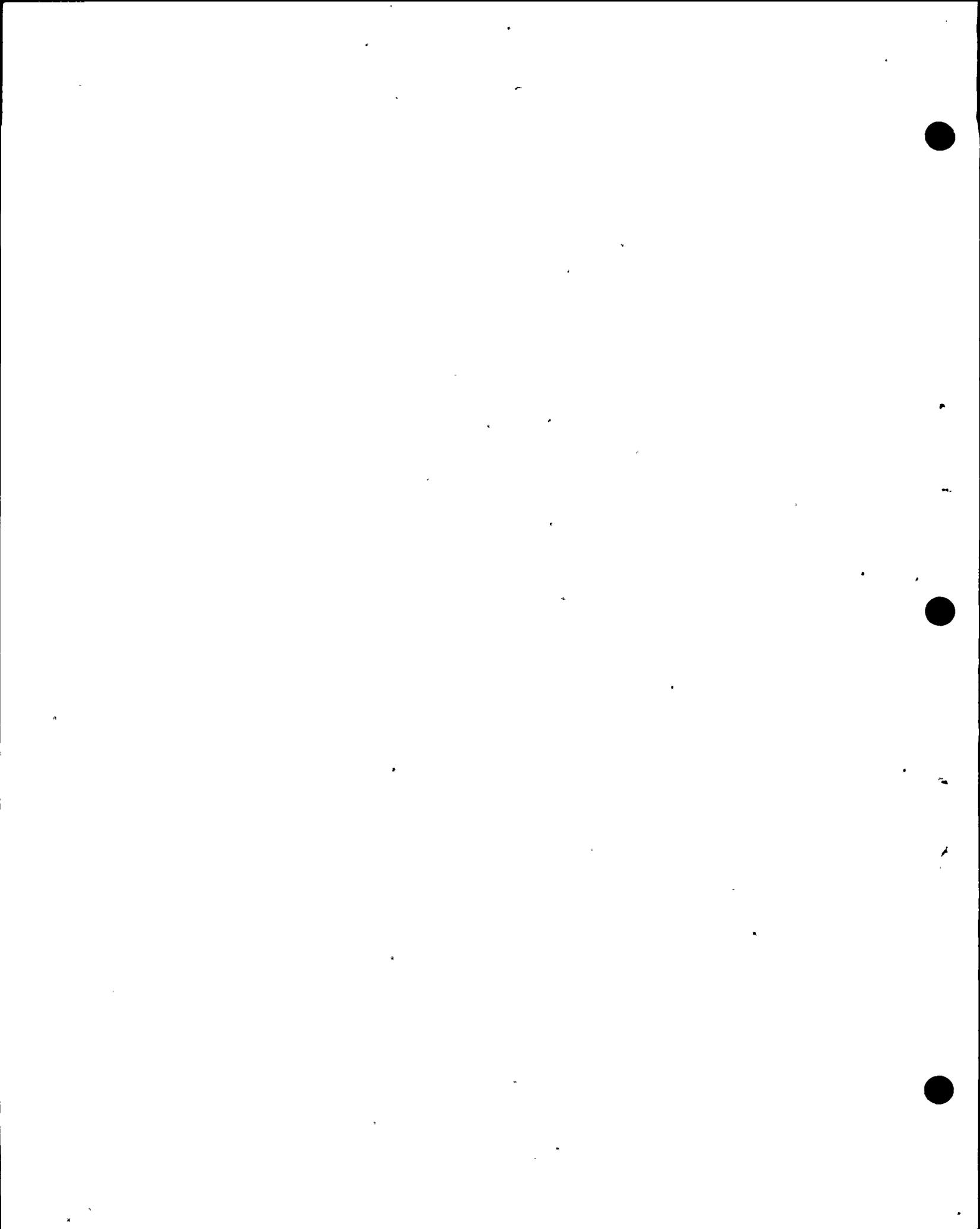


1 Dr. Blume, would you please proceed?

2 A (Witness Blume) There's been a great deal
3 discussion about 1.15g instrumental acceleration as shown
4 in USGS Circular 672 and as used in the Hosgri evaluation.
5 Also there's been discussion of the .75g so-called effective
6 acceleration that was used in determining response spectra.
7 There is, I should say, and I think it has been
8 said many times, a sparcity of data in the region close to
9 an earthquake epicenter or moving fault and at high magni-
10 tudes. Fortunately there have been some recent additions
11 to this data in the form of two foreign earthquakes that
12 are very interesting. But I'm going to concentrate my
13 discussion right now on the Pacoima Dam record which has
14 been discussed through all the ACRS hearings and in this
15 hearing, I believe.

16 Now it so happens that the record was taken
17 on a rocky ridge immediately adjacent to the abutment of
18 a concrete dam with water stored behind the dam. The rocky
19 ridge was elevated above the dam level, it was cracked
20 during the earthquake, there was some damage to the rock
21 itself, and even that alone would make one be slightly
22 suspect that the motion recorded on the instrument was not
23 recording a fling, or motion of broken rock mass, as much as
24 it was the basic earthquake energy.

25 Because of these questions many investigators



1. have studied the Pacoima Dam record, the topography around
2. the region, and they have approached this problem of, Is
3. this a real record of true ground motion, or is it not an
4. amplified motion of a rocky ridge somewhat akin to, perhaps,
5. measuring the motion at the top of a small building of
6. two or three storeys.

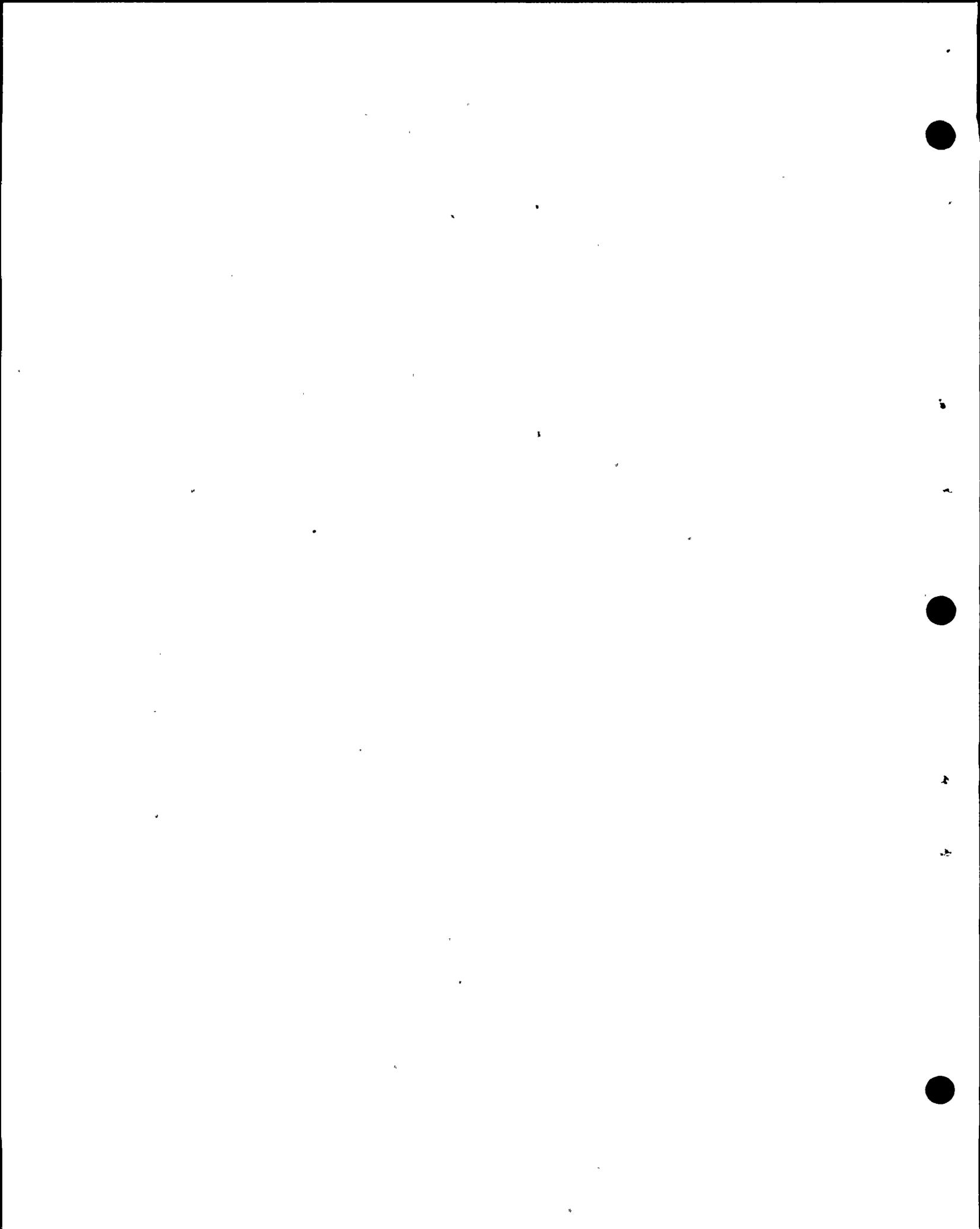
7. As we all know, a building would move more
8. at its roof level than it would at the base.

9. These studies have been reported in DLL-12,
10. which is in the record: I think it was Amendment 50, if
11. I am not incorrect. And I'm going to today not review all
12. of it but merely briefly summarize some of the findings
13. that had to do with studies by different individuals done
14. independently, and all trying to seek the truth as what did
15. that instrument measure at the top of that rocky ridge.

16. The basis of comparison is the ratio of the
17. motion on the ridge to that of the rock, the bedrock that
18. might be the general bedrock area down in the valley below
19. the ridge and below the dam.

20. Now a man named Boore wrote two reports, and in
21. his second report, in 1973, he superceded or cancelled his
22. first report. So I'll only refer to his second report.

23. He came up with the fact that the ratio in
24. his opinion was 50 percent; in other words, the rocky ridge
25. was 50 percent greater than the motion at the bedrock and



1 the floor below the scam.

2 Bouchon in 1973 made a completely independent
3 study using topography and finite elements and other pro-
4 cedures, and he came up with a ratio of 30 to 50 percent.

5 Mickey and several other authors in 1974, using
6 still another method, came up with 40 to 65 percent.

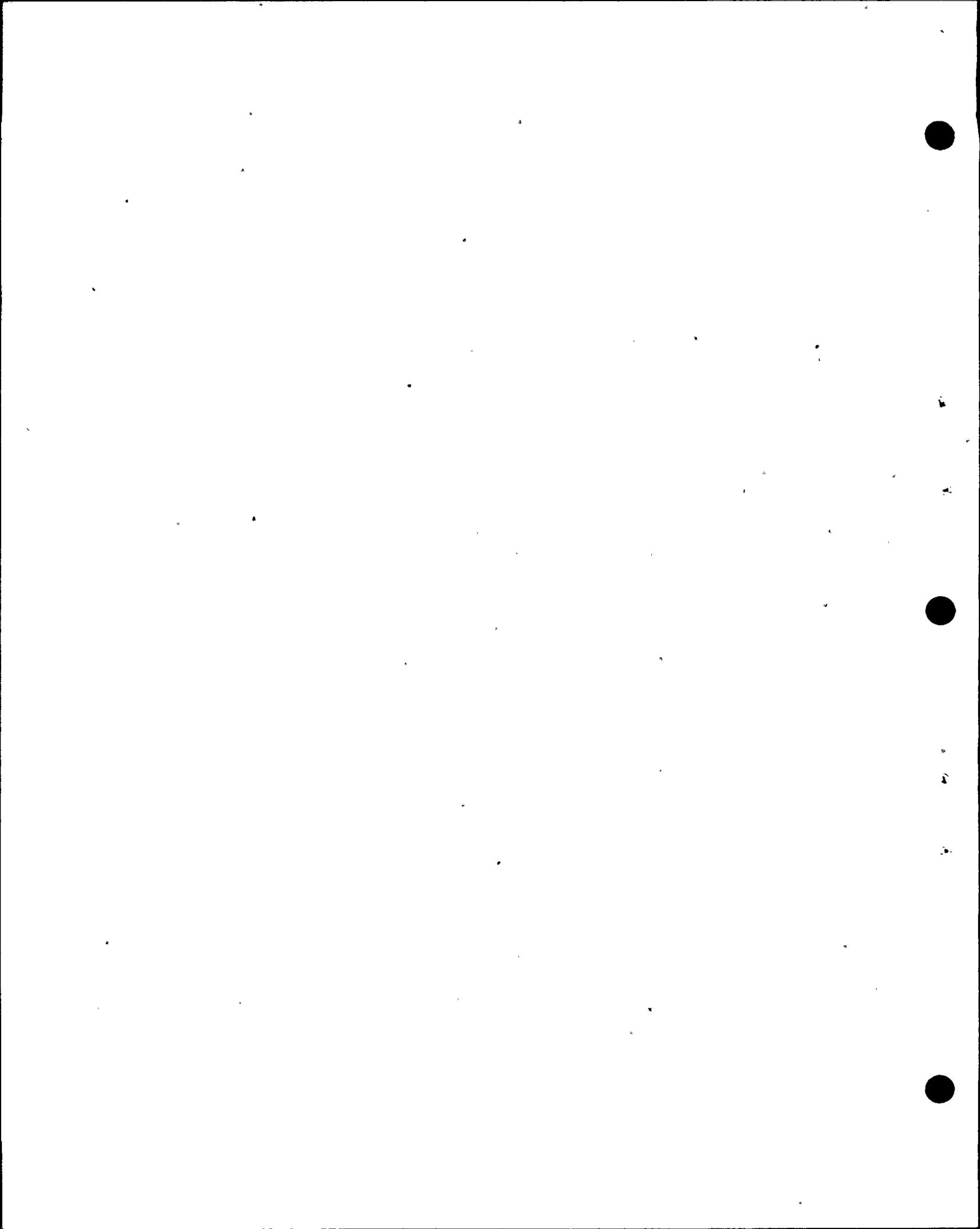
7 Reimer in 1973 came up with, believe it or not,
8 310 percent. In other words, he felt the amplification
9 was over three times what it was at the floor of the valley.

10 Blume, speaking personally and of my firm,
11 made a special study. And I might describe that briefly:

12 We measured aftershocks following the main
13 earthquake with instruments located both at the rocky
14 ridge point and down in the valley on the bedrock. And by
15 getting the records of many aftershocks, some with magni-
16 tudes up to 4 and over: I think we got possibly up to
17 4.4: and going through mathematical procedures we obtained
18 transfer functions which we like to call little black boxes,
19 which gave us a ratio of 50 percent.

20 So now if we averaged all of these findings
21 that I have mentioned we would come up with an average of
22 100 percent. In other words, the rocky ridge moved 100
23 percent more than it should have if it had been true bed-
24 rock.

25 If for any reason you wanted to throw out Reimer

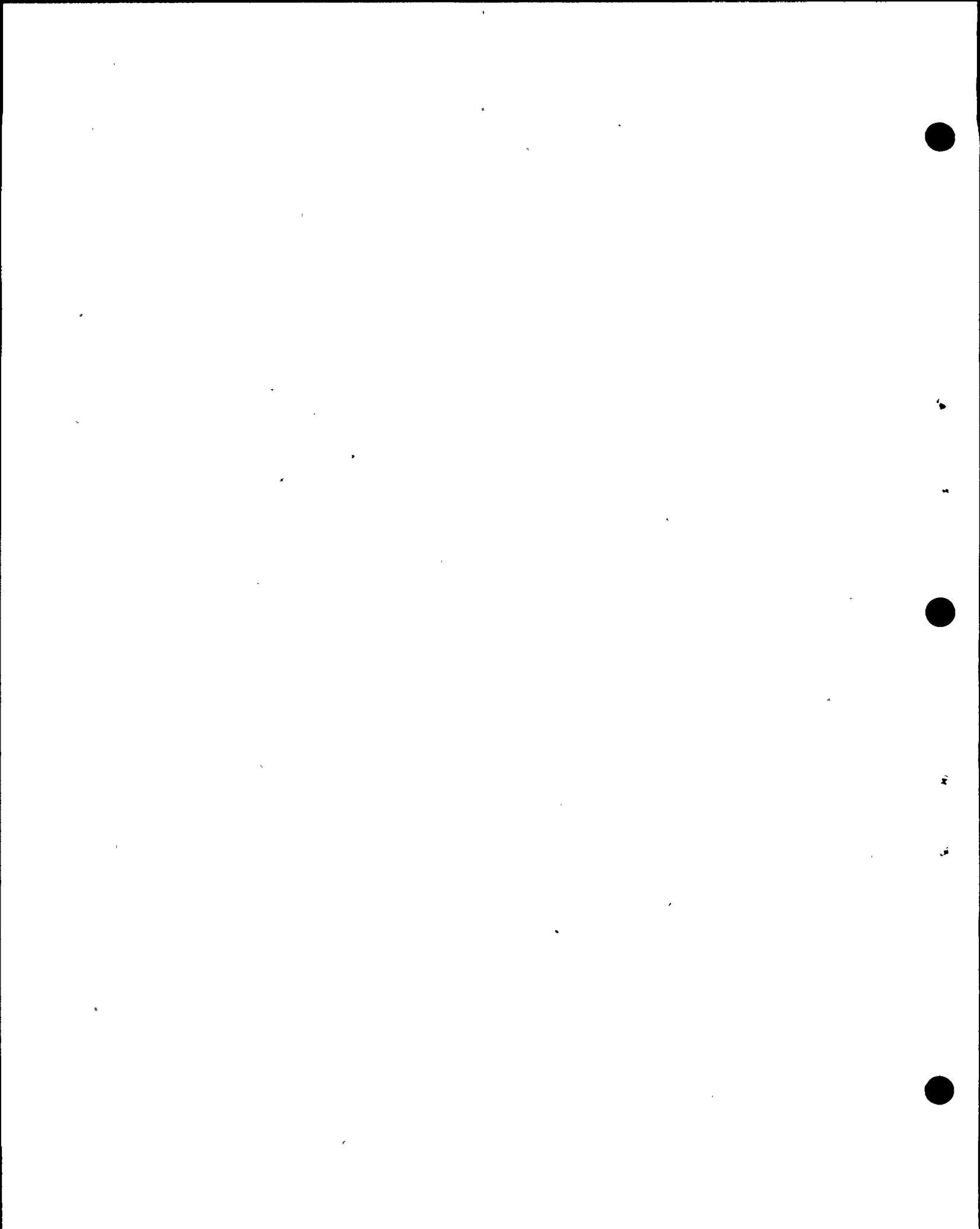


1 as being 310 percent, as being far above the others, you
2 would still average 48 or, shall we say in round numbers,
3 50 percent.

4 So taking these two averages of averages I
5 would find that if we included Reimer's work, the true
6 ground motion was .63g instead of 1.25g as stipulated -- not
7 as stipulated, but as given in various testimonies by
8 various people, I think mainly Trifunac and Luco.

9 If, on the other hand, we threw out Reimer
10 entirely -- and I have no real basis for doing that, but
11 if we did, hypothetically, the motion would still only be
12 .83g as representing true motion.

13 Now as a further proof of the fallacy of the
14 basic record, I can refer to a study by Hanks and Johnson
15 which is shown as Figure 12(e) in the same report I referred
16 to, Report DLL-12. And in their figure in which they plot
17 amplitude as a log of the peak acceleration versus magnitude,
18 one point sticks out as a very anomalous point. And that
19 point is Pacoima Dam, because they did not put any correction
20 factor on the motion as recorded. All the other points they
21 have recorded, including magnitudes much greater than
22 Pacoima Dam, fall below their 2 kilobar line as shown in
23 figure 12(e). I won't take the time to show all these
24 other slides because they have been shown and are in the
25 record.



1 Now since all this has happened there have been
2 two major earthquakes which give further confirmation
3 to the fact that magnitudes -- I mean, that accelerations
4 over 1g are quite rare, if ever they do happen indeed;
5 except with magnification. The Russian Gazli Earthquake,
6 which is roughly two to two and a half kilometers from the
7 moving fault according to the latest issue of USGS on this
8 subject, measured .81g in one direction and .63g in the
9 other direction. And that magnitude was 7.8 or 7.7, they
10 haven't quite decided yet.

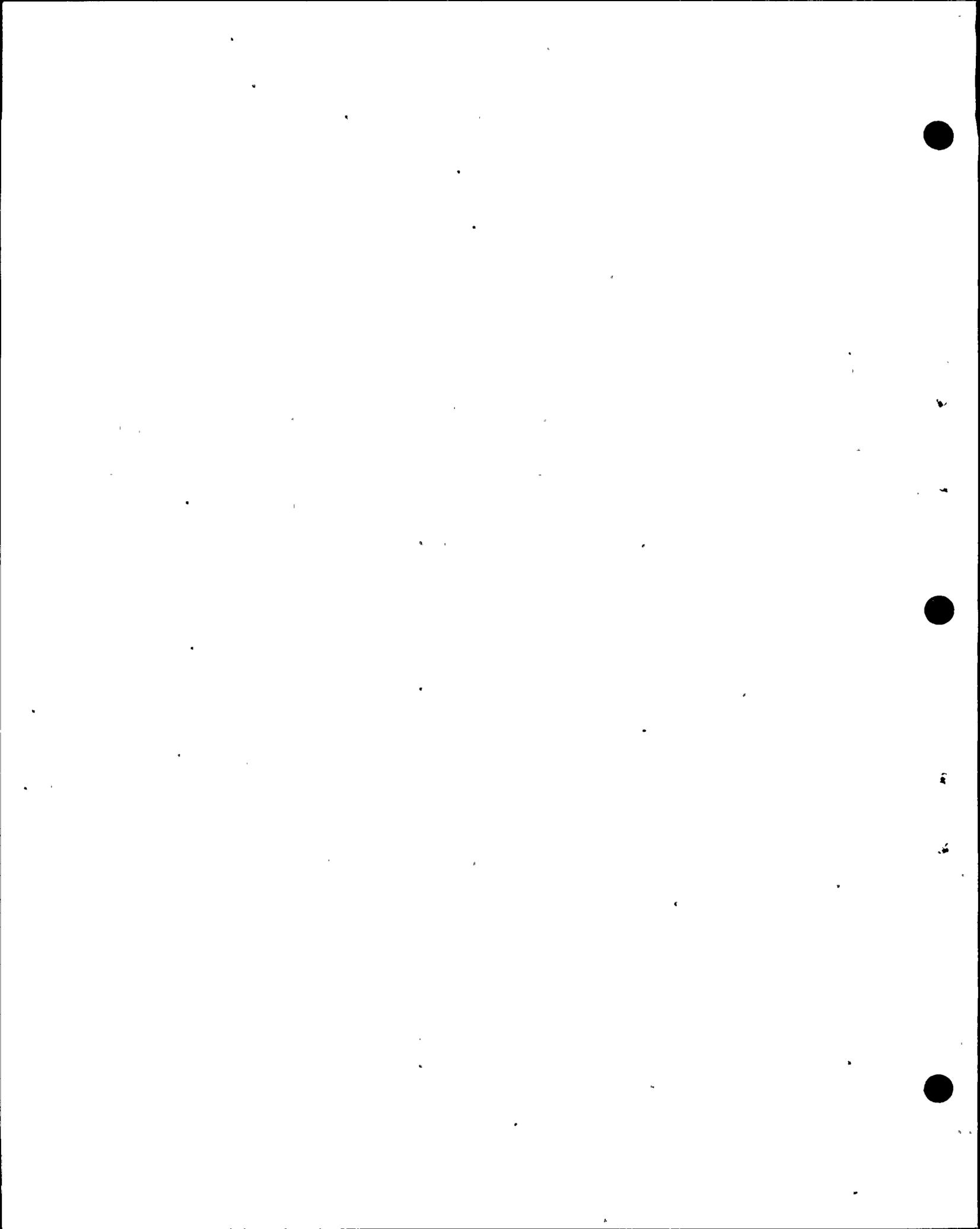
11 The Tabaz earthquake in Iran quite recently
12 apparently only five kilometers from the end of the moving
13 fault, some say less than five, and it was a 7.7 or 7.8
14 magnitude, again measured .8g.

15 So I think all of these things put together
16 would make me come to the general conclusion that the
17 Pacoima record of 1.25 is anomalous, it is not a true
18 record of motion, and has been greatly overused so far in
19 the literature and in some of the testimony in this case.

20 Q Dr. Blume, in the Gazli, you mentioned the two
21 directions as being .8 and .6, or something like that I
22 believe; is that correct?

23 A Gazli I have as .81 and .63. Those are the
24 two horizontal directions.

25 Q And the vertical in that was --?



1 A A The vertical was over 1g.

2 Q All right. And it was 1.3, I believe, was it
3 not?

4 A I'm not sure. Something like that.

5 Q All right.

6 Dr. Malik, you were here also during the testi-
7 mony of Dr. Luco who discussed the Bertero paper regarding
8 what the Olive View Hospital saw as a ground motion in the
9 San Fernando earthquake. Unfortunately I don't have
10 Dr. Luco's paper in front of me, his submittal. But the
11 statement, subject to someone screaming at me that I'm
12 misstating it, was that the amount of displacement, the
13 thirty inches of displacement at Olive View indicated to
14 him that the motion at Olive View, the ground motion at
15 Olive View, was equal to, or nearly equal to that recorded
16 at the Pacoima Dam record.

17 Do you recall that testimony, and so on?

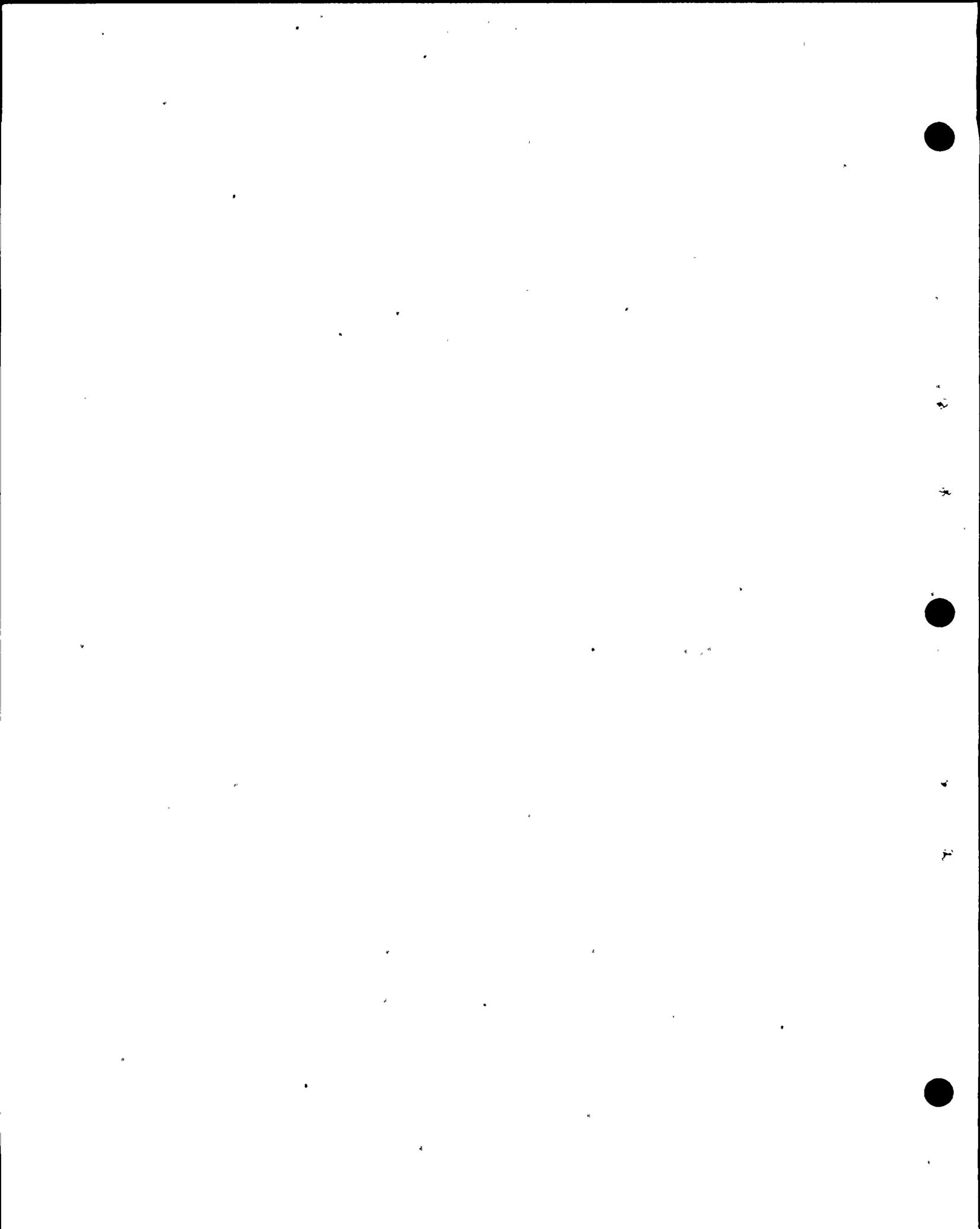
18 A (Witness Malik) Yes, I do.

19 Q All right.

20 Well, Dr. Malik, do you know anything about the
21 Olive View Bertero study?

22 A Yes. I'm very familiar with it. In fact, I
23 participated in some of the work that went into the Olive
24 View analysis.

25 Q Were you at-- Were you working with Dr. Bertero



1 at that time?

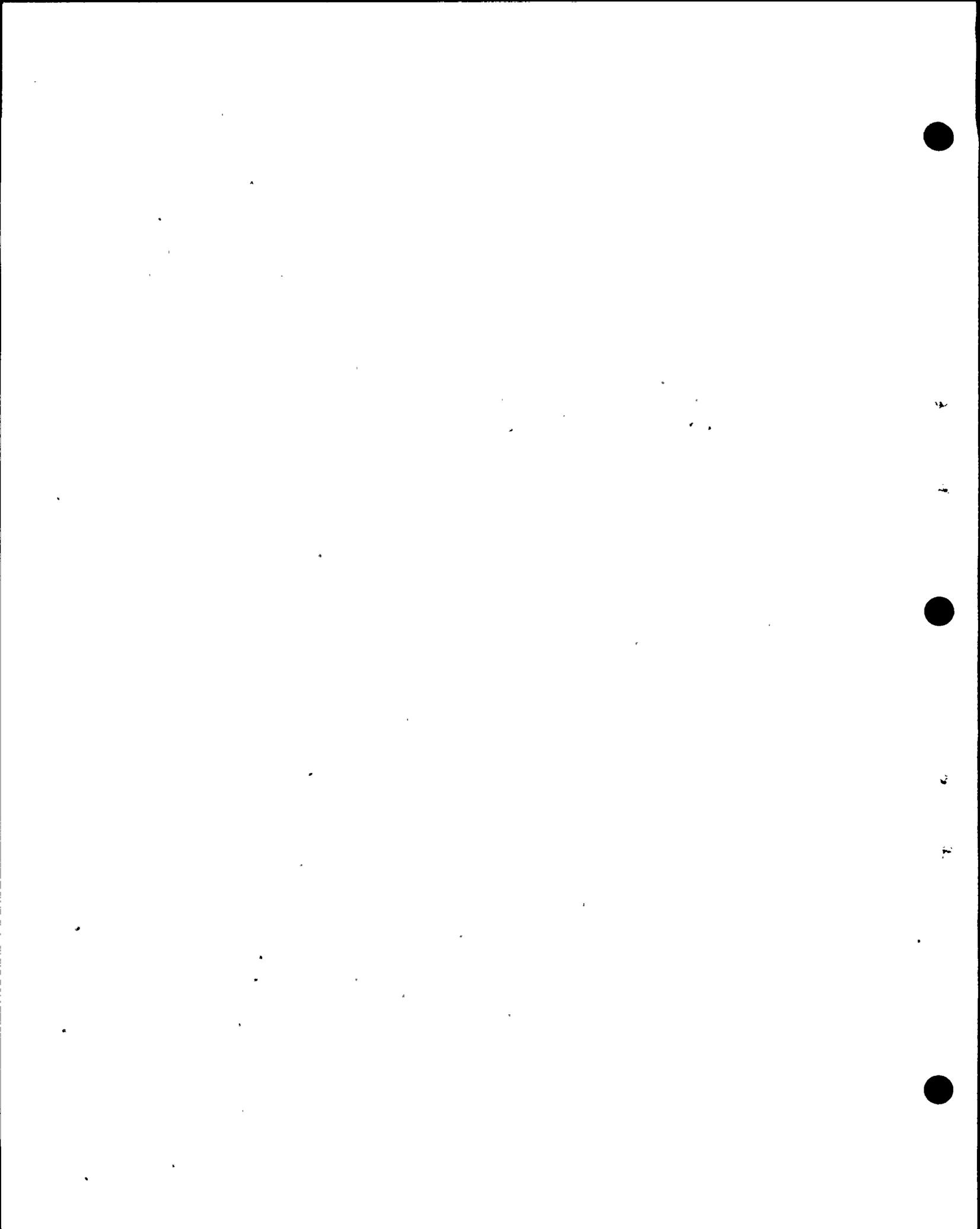
EB/wb12 2 A. Yes. Immediately after the San Fernando earth-
3 quake Professor Bertero took me as a research assistant.
4 I was one of the people who assisted in, first of all,
5 surveying the damage that did happen at the Olive View
6 Hospital through many, many trips to the site.

7 After that I was the one that developed -- took
8 the structural model, developed the structural system, got
9 out the structural system from the construction drawings.
10 After that I was the one who did the first three-dimensional
11 linear analysis for the dynamic characteristics of the
12 structure on the main building.

13 I'm the one that has done all the work for
14 the parking canopy on the Olive View Medical Center and
15 the warehouse, which is going to be published as soon
16 as Professor Bertero finds the time to write it. I hope
17 soon.

18 And I have also aided in the non-linear
19 analysis that Dr. Mahin conducted, and had many, many
20 consultations with both Professor Bertero and Dr. Mahin
21 during the course of that work since I was on the team.

22 Q I take it, then, with your intimate knowledge
23 of the study-- And, incidentally, there is a rather large
24 report that is the basis upon which the paper is written;
25 is that correct?



1 A There is more than one report. There is one
2 report on the main building that has been published.
3 There is Dr. Mahin's thesis which talks about the Olive View
4 Hospital in part. There is another long report about the
5 stair towers which was written by Professor Bertero and
6 Robert Collins. And then there is this paper that seems to
7 be the only one that Dr. Luco said he has read about the
8 Olive View building. And there are others that, like I
9 said, are in progress.

10 Q All right.

11 And you in fact are mentioned in the acknow-
12 ledgments of the Mahin report as being one of the contri-
13 butors, are you not?

14 A Yes, I am.

15 Q Only it's under the name of L. Edgar, is it not?

16 A Yes, it is.

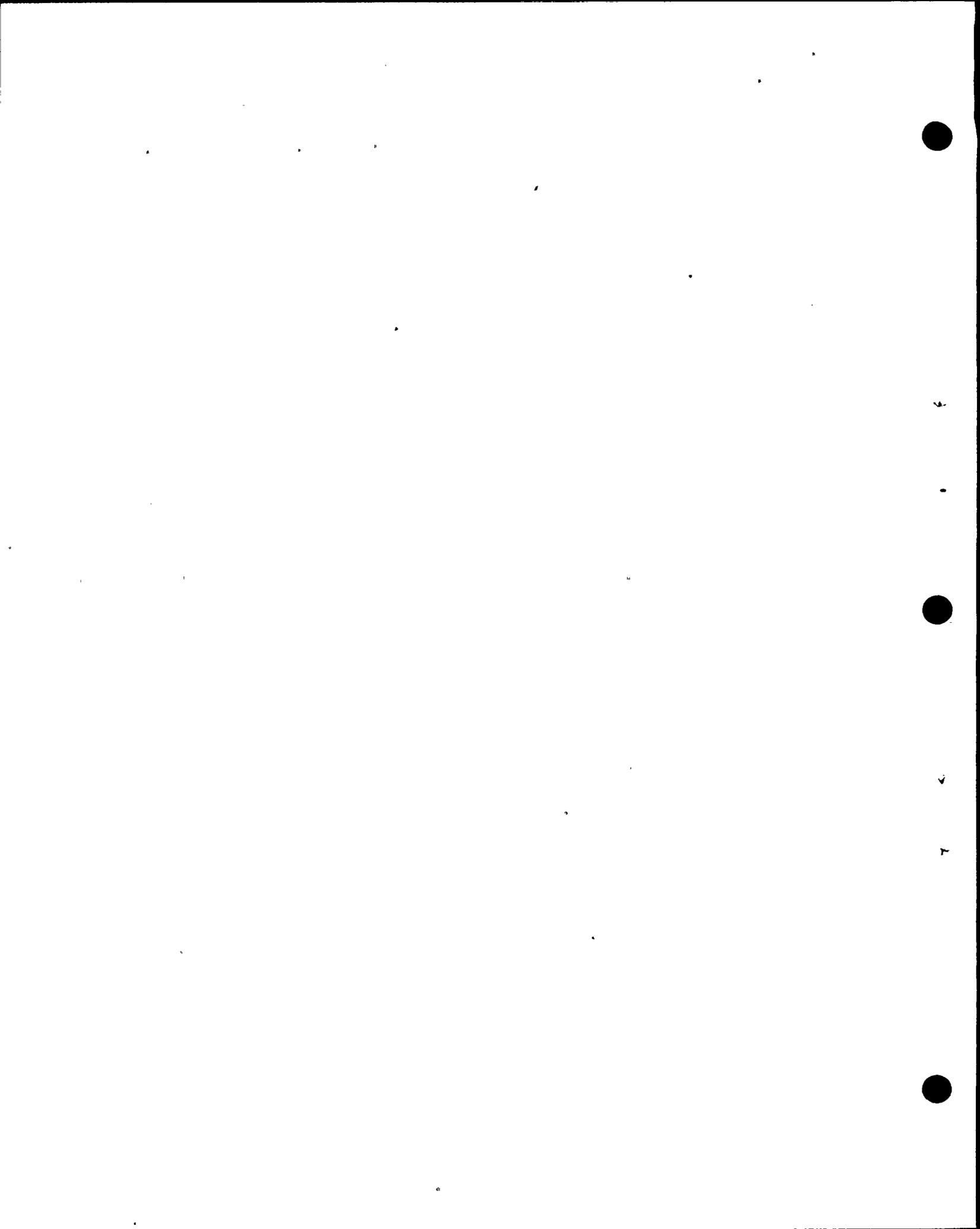
17 Q Instead of Dr. Lincoln Malik? And the reason
18 for that is--?

19 A I went to court since then and changed my name
20 to Lincoln Edgar Malik instead of Lincoln Edgar.

21 Q And Malik I understand, as you told me over
22 coffee or something of stronger substance, was the original
23 family name?

24 A Yes, it was.

25 Q So even though one can't find Lincoln Malik in



1 the acknowledgments, they can find Lincoln Edgar, who is
2 one and the same?

3 A Yes. My Ph.D., in fact, my thesis is also
4 published under Lincoln Edgar.

5 Q All right.

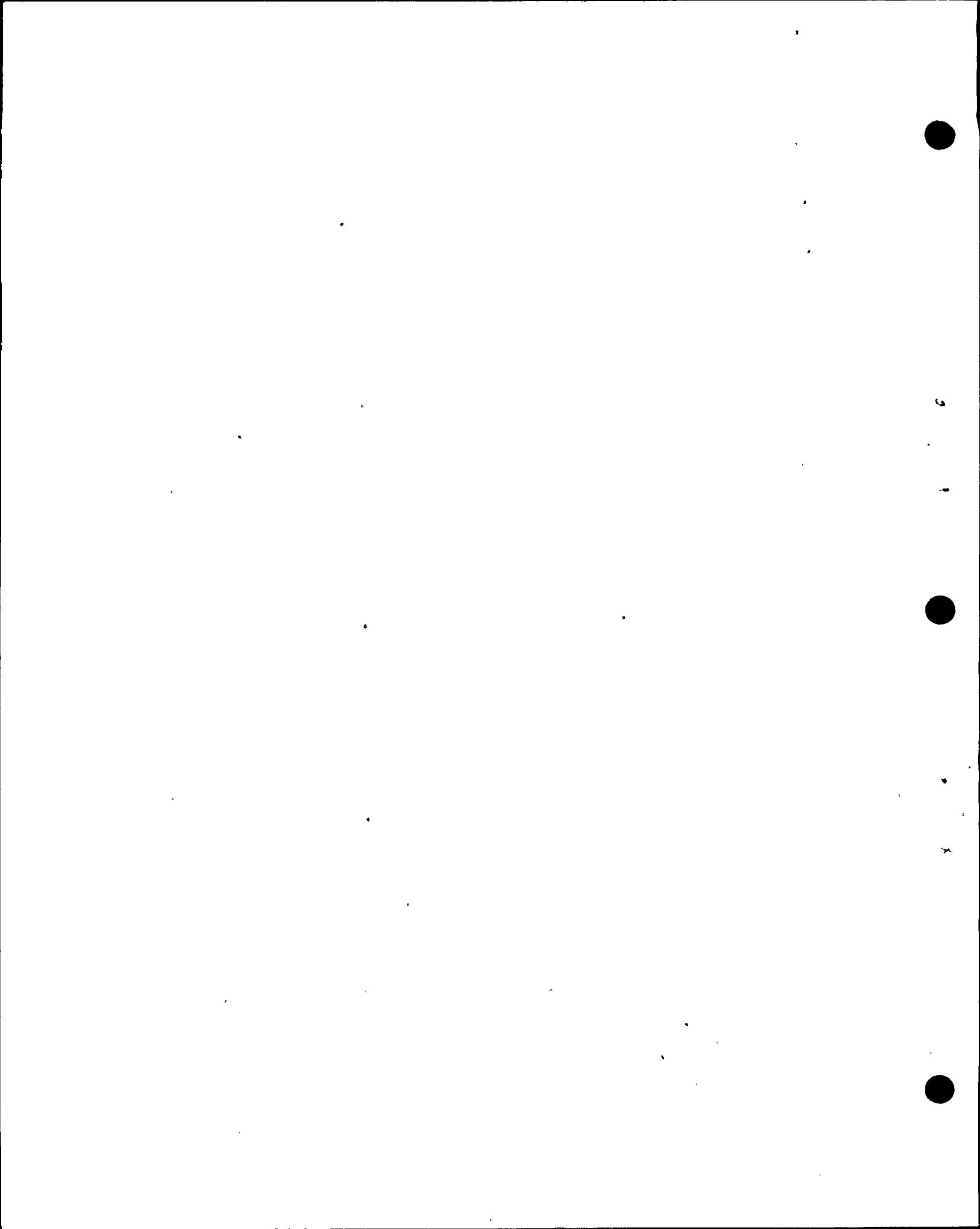
6 Well, with this intimate knowledge you have of
7 the Olive View situation, I take it then you agree with
8 Dr. Luco's conclusions?

9 A No, I don't agree at all. In fact I think, if
10 anything, the Olive View building is a very good case for
11 arguing against the 1.25g as being the motion that was
12 seen at the Olive View site, in fact I think even at the
13 bedrock at the place where it was measured.

14 Q And would you explain the basis of that opinion?

15 A Yes. When we did the Olive View work we
16 had two problems. One of them was that it was, to my
17 knowledge, the first time that a structure of that size
18 was being analyzed so extensively to try to match damage
19 to the analytical result. That was one problem we had.

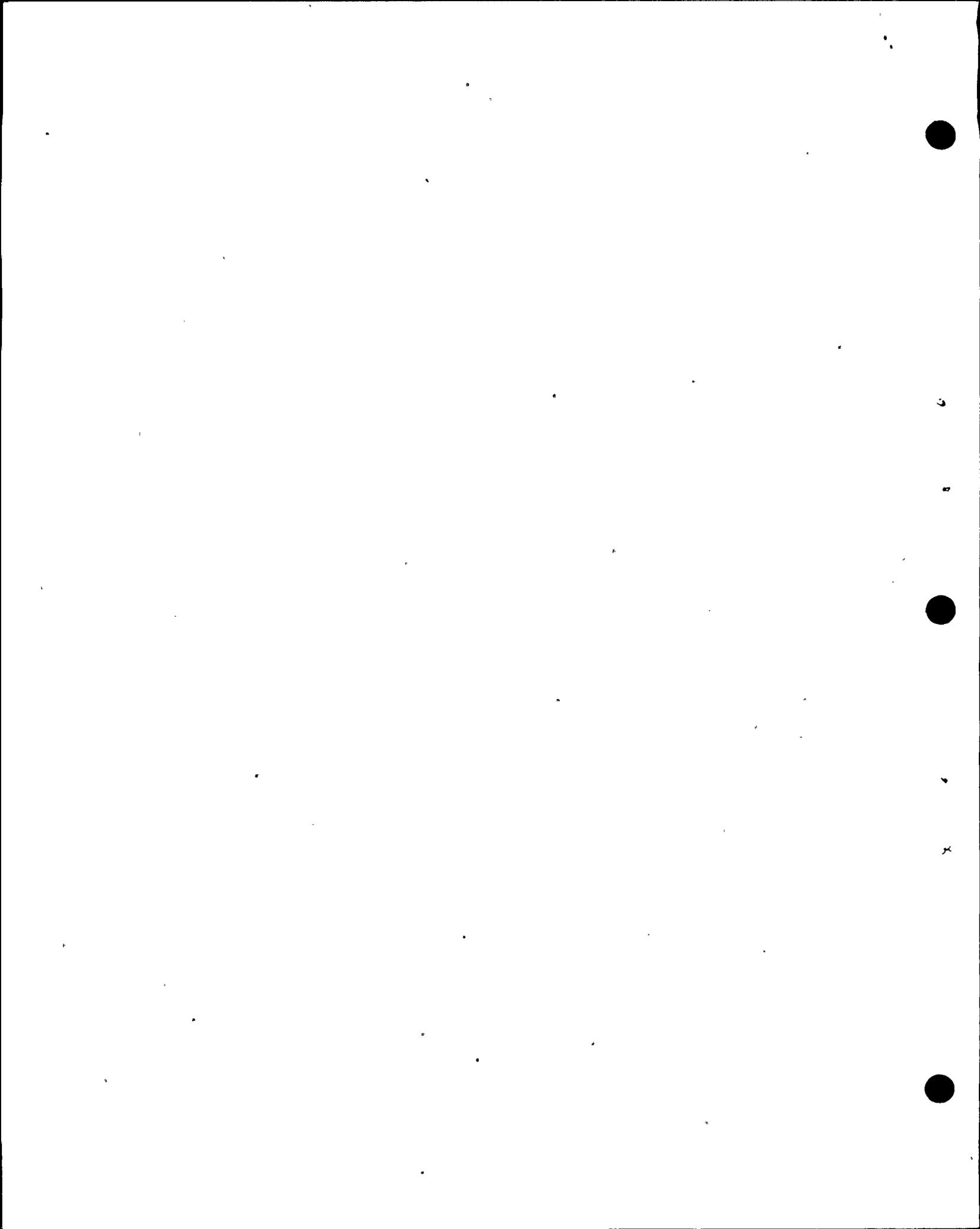
20 The other problem we had was, what was the
21 ground motion at the Olive View site? And we did a lot of
22 work. We tried, for instance, in the canopy, the parking
23 canopy, we tried, if I remember, something like twelve
24 different records, including the record at Pacoima Dam
25 itself. And we found out that in fact the Pacoima Dam did



1 not predict -- the results did not show the damage that
2 happened to the parking canopy, for instance. Because
3 what you have, there is a very high frequency pulse at 1.25g
4 and it just doesn't do the type of damage that we saw on
5 the canopy, for instance.

6 On the other hand, one of the records that
7 Dr. Blume mentioned, the one that was done by Reimer and
8 Clough at the University of California at Berkeley which
9 tried to model the rock outcrop and the dam and the sur-
10 rounding rock area, and said, well if we got this record
11 up here on top of the rock, what would the ground motion
12 be at bedrock that would cause it? And they developed a
13 record from that, which, in the Olive View report has been
14 referred to as the derived Pacoima Dam motion. And that
15 motion has a peak ground acceleration of .399g. The .399
16 occurs much earlier in the record than the 1.25g that was
17 recorded on top of that outcrop.

18 But the interesting part of the Reimer record,
19 if I can call it that, or the derived Pacoima Dam record,
20 is that the .399 pulse is a very long duration pulse, it's
21 a high velocity pulse. And that's what seemed to be
22 the one that gave the kind of damage that we observed in
23 the field. And that's why the researchers on the Olive
24 View building tended to take that record as being the
25 one most likely to be at bedrock.

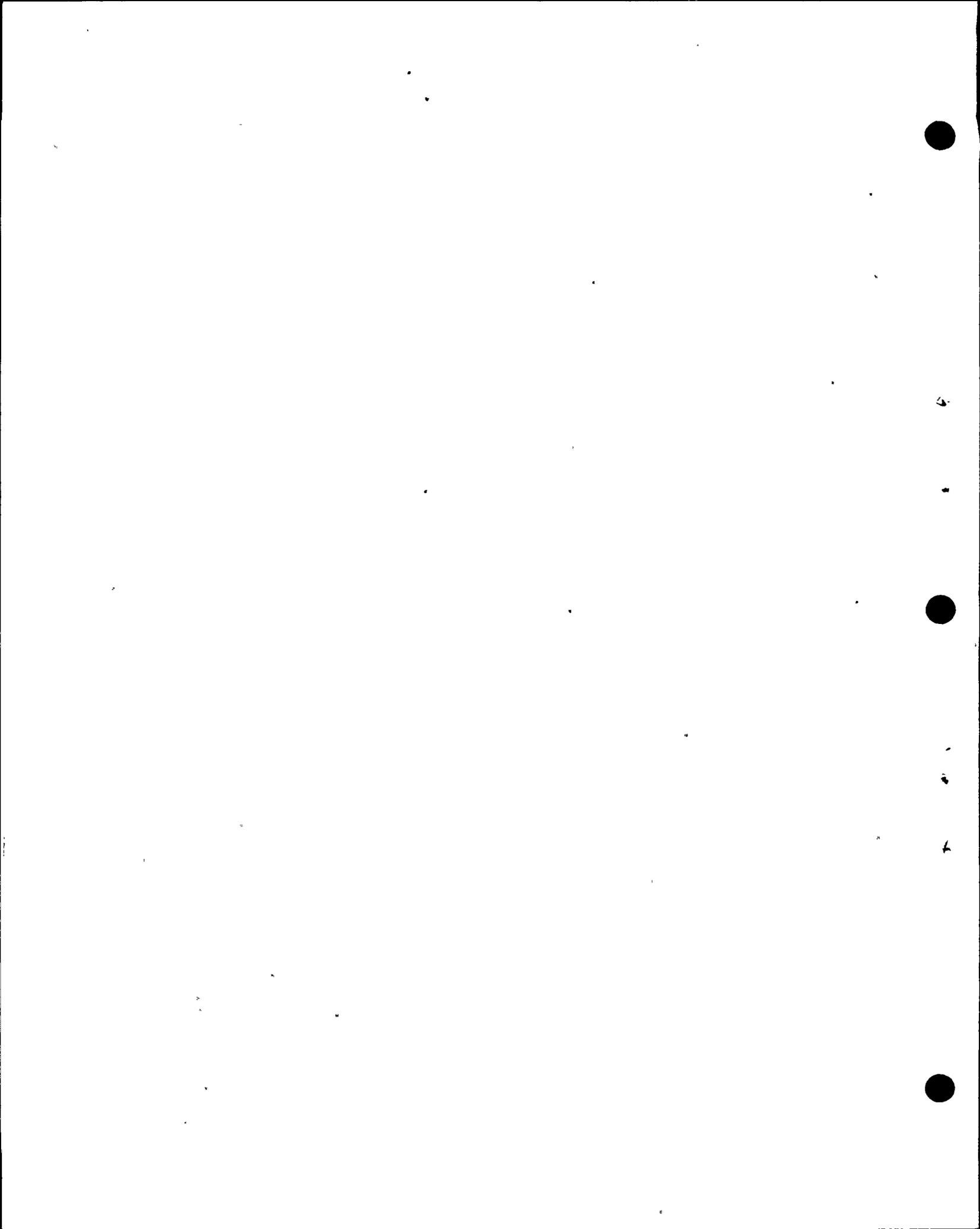


1 And what's happening here is that Dr. Luco I
2 think is misreading the paper that he quoted. The paper
3 does not say that the researchers think that 1.25g was
4 experienced at the Olive View site; in fact, I've had
5 discussions with them since then, as late as a week ago
6 Tuesday, and they still think that is completely --Dr.Mahin
7 thinks that that's not true, he doesn't believe that.

8 The thing is that the type of building we're
9 talking about at Olive View hospital is what's called the
10 moment resistant frame, at least in the first two storeys,
11 the ground level and the first floor, which is similar to
12 office buildings, high-rise buildings, which is very dif-
13 ferent from the Olive View -- from the Diablo Canyon nuclear
14 power plant which is a completely different structural
15 system.

16 Nevertheless, in moment resistant frames there
17 comes a time when you get quite a ways into the inelastic
18 range, that you develop what's called a mechanism; essenti-
19 ally you develop hinges at the top and bottom of columns,
20 and when that happens, and if the acceleration pulse is
21 just continuing, then the building can be pushed fairly
22 easily, if I can use that kind of terminology.

23 So what happened in that building is that these
24 pulses, which were not that high -- they didn't have such
25 high accelerations, nevertheless, as you are rising in the

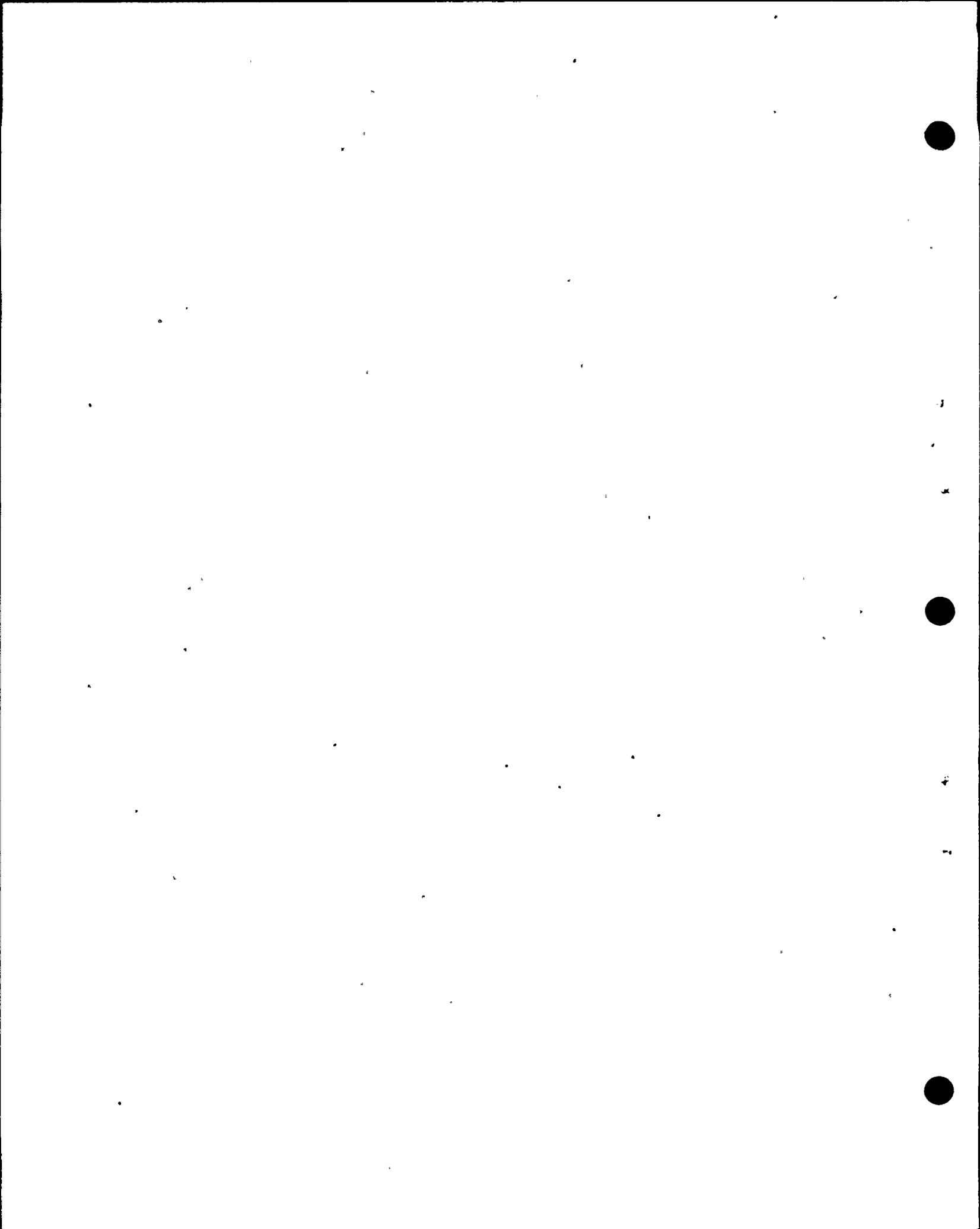


1 pulse you develop the mechanism, and because the pulse
2 lasted for a long time it just kept pushing the building
3 further and further and we had these large drifts.

4 If anything, the analysis -- the argument that
5 they've been trying to make, Professor Bertero and others,
6 is that they are arguing against this preoccupation with
7 peak ground acceleration as being the only thing that
8 people should be looking at. And they have been using the
9 Olive View study to say that it's not the peak ground
10 acceleration necessarily that is doing all the damage, but,
11 rather, in such building, high rise buildings, moment
12 resistant frames, with long periods, it's not so much the
13 peak ground acceleration that controls the response as much
14 as the content of the ground motion, especially the long
15 duration pulses that might have much lower acceleration
16 but do much more damage to such buildings.

17 Dr. Luco seems to have concluded on his own
18 from this paper that you'd need 1.25g to produce the
19 thirteen inches of drift that developed. In fact, if he
20 looked at the structure more carefully, and at the evidence,
21 he would find that in fact what would really do it is not
22 so much increasing the g level but increasing the duration
23 of that pulse by just a little bit.

24 In fact, Dr. Mahin has done some work he's
25 writing up that he's going to publish that shows where he



1 took a single degree of freedom structure, a model,
2 similar in its fundamental frequency to that of the Olive
3 View medical center, and he analyzed it for both the
4 Reimer record with .4g and the Pacoima Dam record with a
5 1.25 g. But it's a high frequency pulse, as I said. And
6 the displacements --- the inelastic deformations on
7 both were approximately the same. And in that paper he's
8 trying to make the argument that it's not just jacking up
9 the ground acceleration that's going to define the damage
10 but, rather, that the duration. And he found out that
11 even a 5 percent of the increase on the duration of that
12 pulse in the Reimer record would do much more damage and
13 would increase the displacements much more than jacking
14 up the peak ground acceleration from .4 to 1.25, but
15 using the Pacoima Dam record.

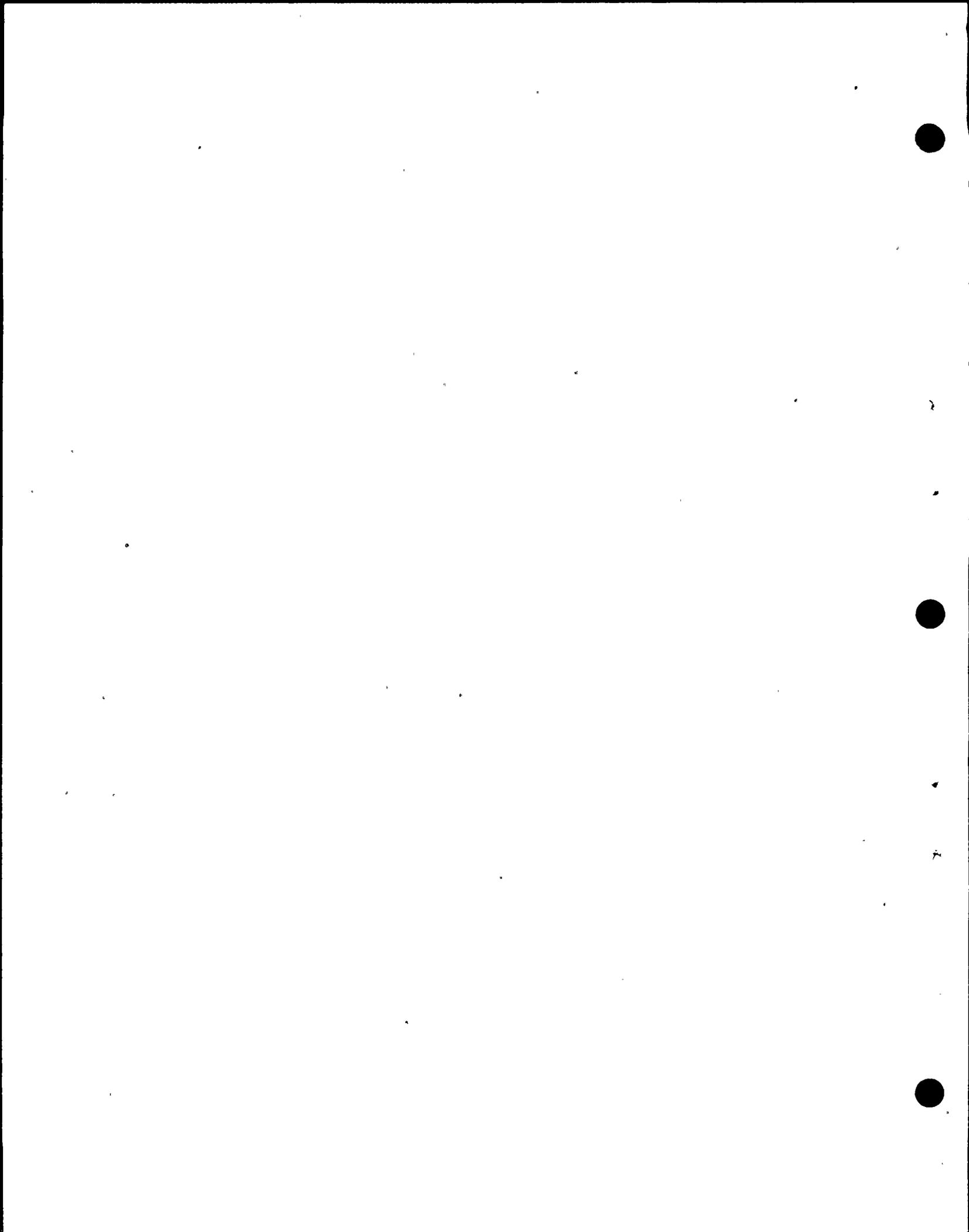
16 So I think that Dr. Luco's conclusions are
17 just a misreading of the work that was done on the Olive
18 View.

19 Q Okay. Thank you, Dr. Malik.

20 Dr. Blume, you turned on your microphone, and
21 I'm afraid I'm not going to be able to stop you.

22 A (Witness Blume) This is very short. I just
23 have two quick comments on Olive View while we're on the
24 subject.

25 No. 1, Lincoln mentioned the velocity and the

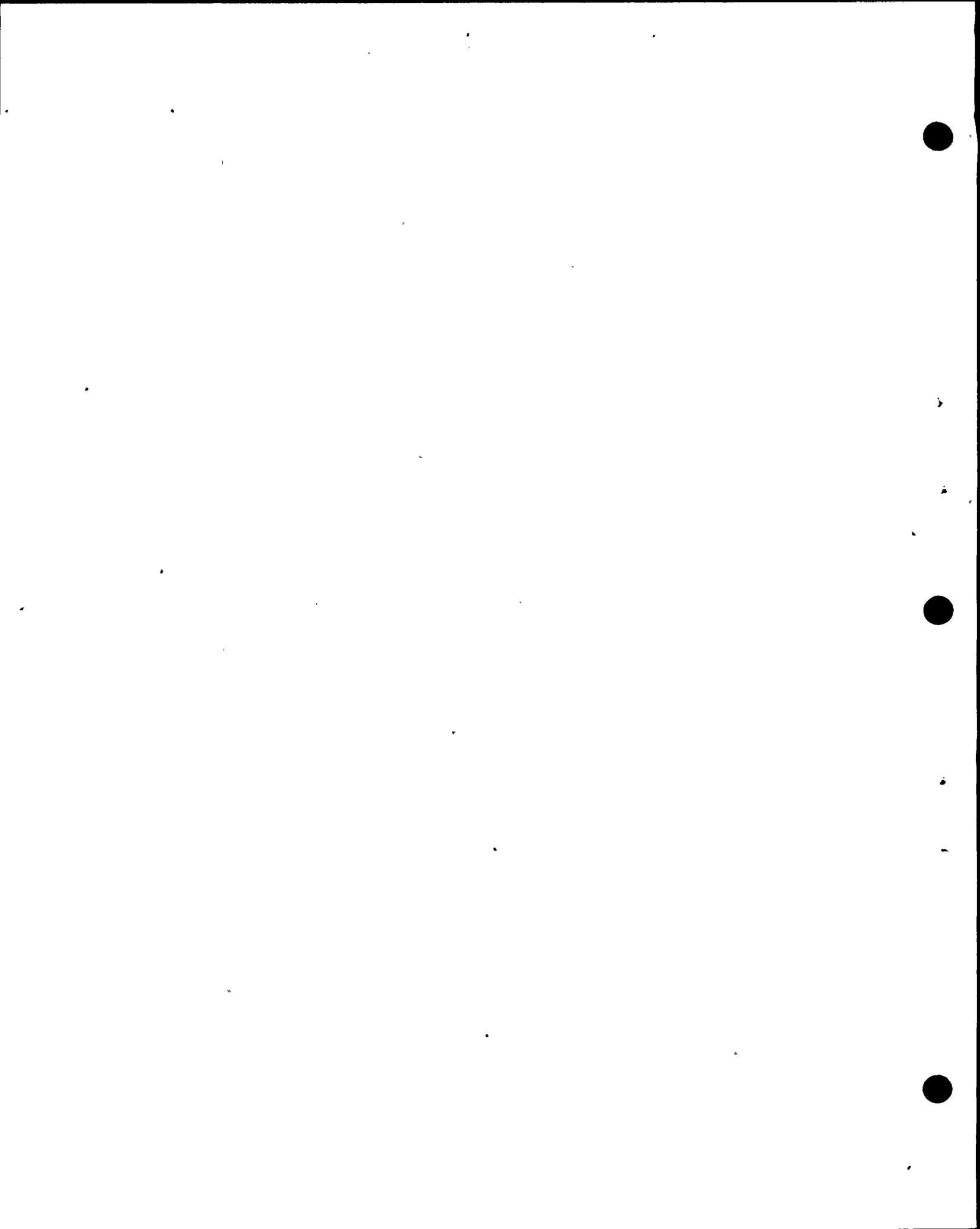


1 width of pulses. I want to remind everyone that the Diablo
2 Canyon plant is not subject to velocity sensitivity because
3 it is so stiff, it has such high frequency structures, that
4 that plant is acceleration-sensitive rather than velocity-
5 sensitive.

6 The second point is that in the Luco and
7 Trifunac testimony -- perhaps just Luco's: I'm not sure --
8 reference is made to the fact that he stated that Olive
9 View Hospital was designed to modern building codes. Well
10 it was, about 1964 or '65, designed to a code then ten
11 years old, in that it did not provide for ductility in
12 the concrete. So none of us in the profession looked upon
13 the Olive View Hospital as representing modern concrete
14 construction, nor do we even think it was extremely well
15 designed under the code then existing.

16 Q Well, Dr. Blume, when you just spoke,
17 Mr. Fleischaker seems to think it's very funny. He
18 evidently thought what you said about Diablo, about the
19 fact that Diablo was not velocity-sensitive but accelera-
20 tion-sensitive was very humorous and disputed all that
21 Dr. Malik just said. So perhaps we can clean that up for
22 him.

23 In fact, the point of what Dr. Malik just said
24 was, was it not, Dr. Blume, that the Bertero paper did not
25 show that the Pacoima record -- or that the ground motion at



1 the Olive View Hospital was 1.25 but something much lower?
2 Isn't that the fact of the Bertero paper?

3 A That's correct.

4 Q Thank you.

5 MR. NORTON: Incidentally, Mrs. Bowers, I have
6 found it increasingly difficult to hold my tongue all day.
7 For some reason Mr. Fleischaker seems to think everything
8 the witnesses are saying today is hilarious. And I remember
9 his criticism of Mr. Geer for laughing at himself the
10 other day, and I frankly would appreciate it if
11 Mr. Fleischaker would quit laughing during the response of
12 the witnesses. I find it irritating even if the witnesses
13 don't.

14 MRS. BOWERS: Mr. Fleischaker, are you going to
15 quit laughing?

16 (Laughter)

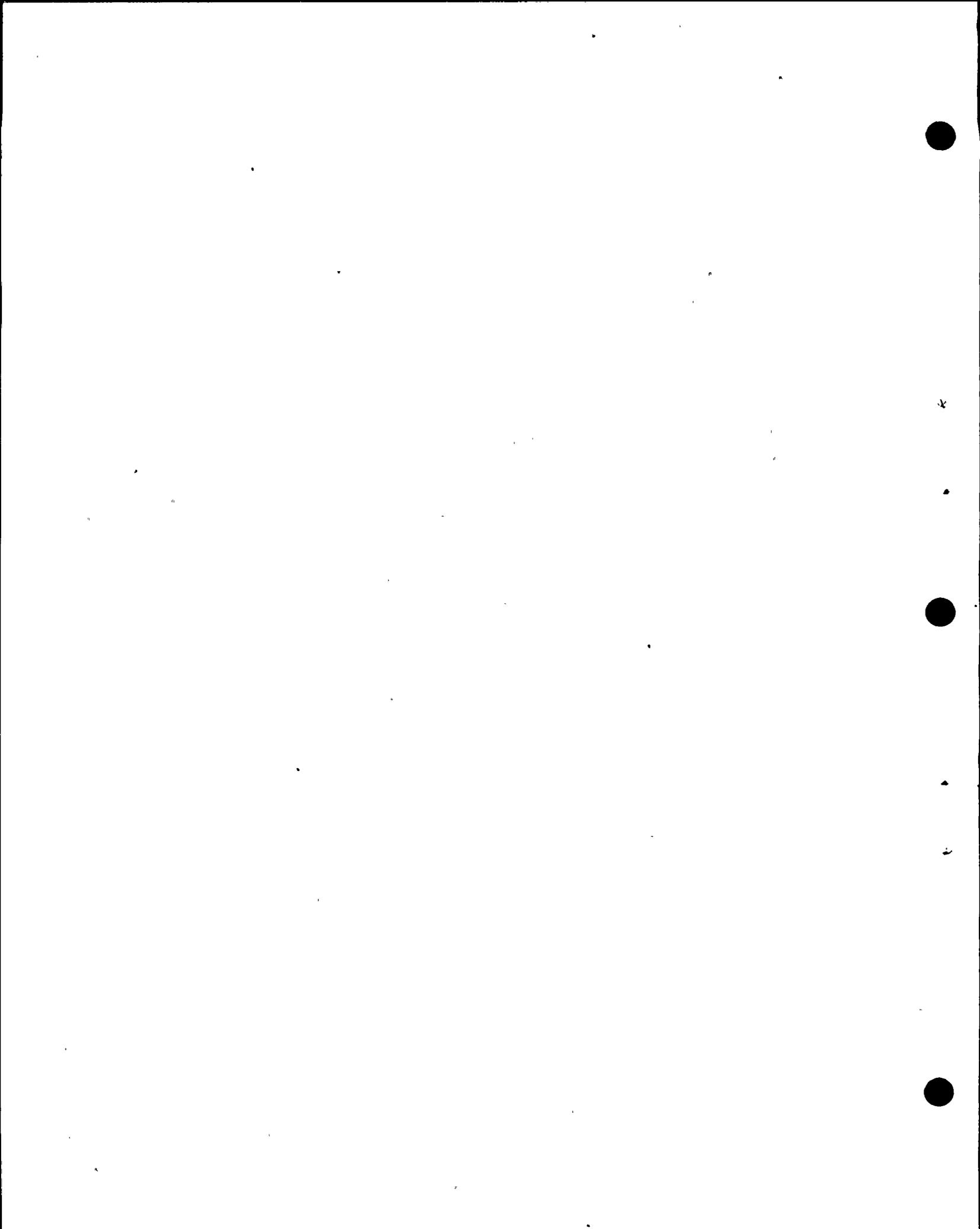
17 MR. FLEISCHAKER: I'm smiling. I think
18 Mr. Norton misinterpreted my smile.

19 I'll try to contain my mirth.

20 BY MR. NORTON:

21 Q Dr. Seed, I understand that you have done some
22 recent work with the Hanks and Johnson data regarding
23 extrapolations, if you will, of magnitude, distances and
24 accelerations from faults; is that correct?

25 A (Witness Seed) That's correct.



1 Q All right.

2 Would you briefly describe what you have done
3 in that regard? And I understand we have some Vu-graphs.
4 And perhaps before you do that we can have Mr. Williamson
5 set up the Vu-graph and we can pass out to the Board and
6 the parties advance copies. And I will identify them now
7 before we get started.

8 MR. NORTON: The slides that are to be shown
9 now by Dr. Seed, or the Vu-graphs will be Applicant's
10 Exhibits 61, 62, 63 and 64.

11 And, by the way, I just remembered that we
12 forgot to move into evidence the exhibits we had marked
13 this morning, which were Exhibits 46 through 60. And these
14 were the Vu-graphs and slides shown by Dr. Jahns and
15 Mr. Hamilton and Mr. Willingham. And we would at this time
16 move them into evidence. Even those people have been
17 excused, the foundation for those exhibits was laid.

18 MRS. BOWERS: Mr. Fleischaker?

19 MR. FLEISCHAKER: I have no objection.

20 MRS. BOWERS: Mr. Ketchen?

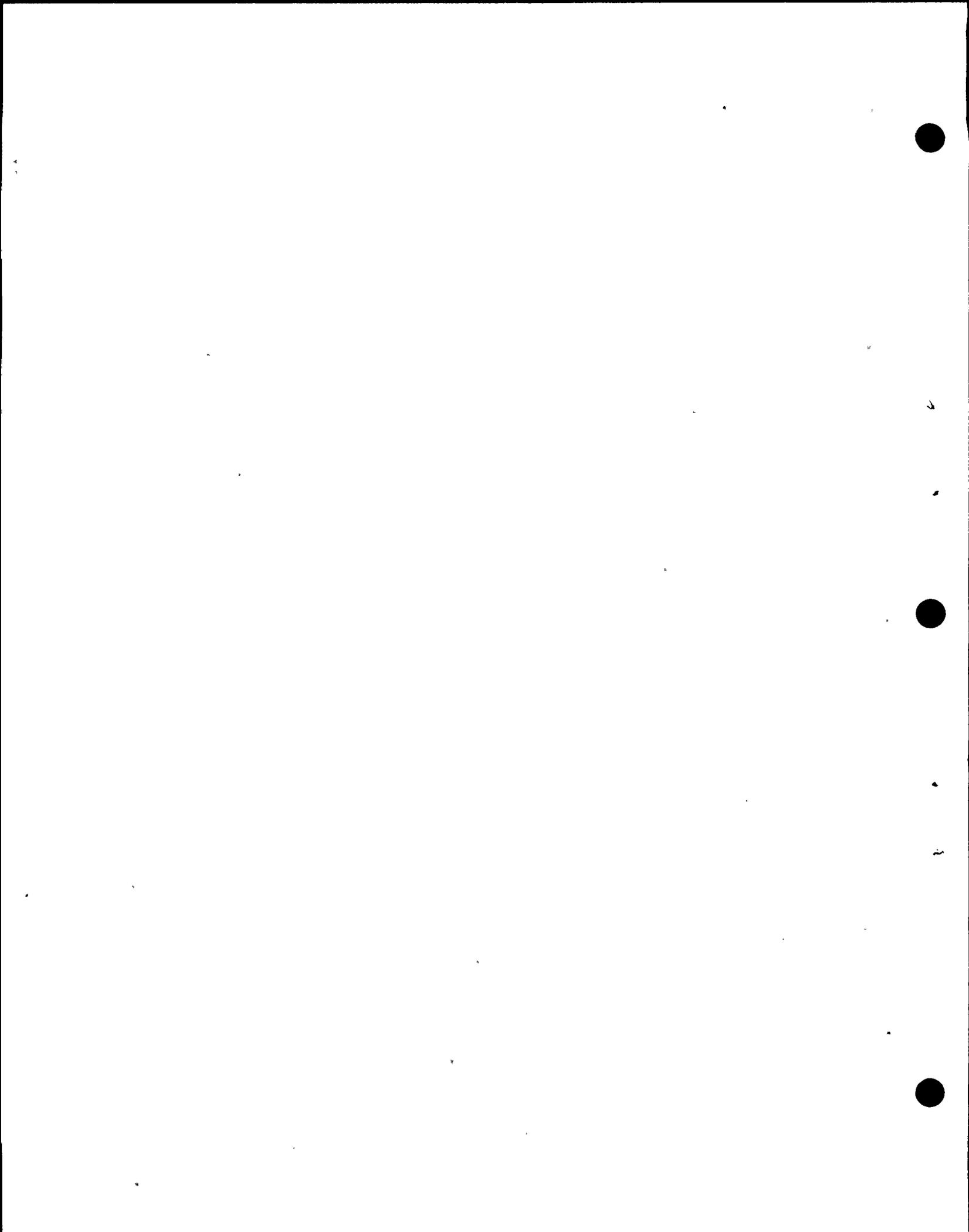
21 MR. KETCHEN: No objection.

22 MRS. BOWERS: Well, PG&E Exhibits 46 through
23 60 are accepted into evidence.

24 (Whereupon the documents referred to,
25 Applicant's Exhibits 46 through 60 for
identification, were received.)

RB/wb21

XXXXXXXX



1C2
WRB/mpbl

1 MR. NORTON: These are 61, 62, 63 and 64, four
2 of them that will be shown in that order.

3 WITNESS SEED: Excuse me.

4 64 doesn't come as yet.

5 MR. NORTON: I'm sorry, 64 -- we're just going
6 to use three now. 64 has to do with tau, I believe.

7 Is that correct?

8 WITNESS SEED: Yes.

9 (Whereupon, the documents
10 referred to were marked
11 as Applicant's Exhibits
12 61, 62, and 63 for
13 identification.)

14 MR. NORTON: I'm sorry.

15 MR. FLEISCHAKER: Can we take a ten minute break
16 now?

17 MRS. BOWERS: That's a good idea.

18 (Recess.)

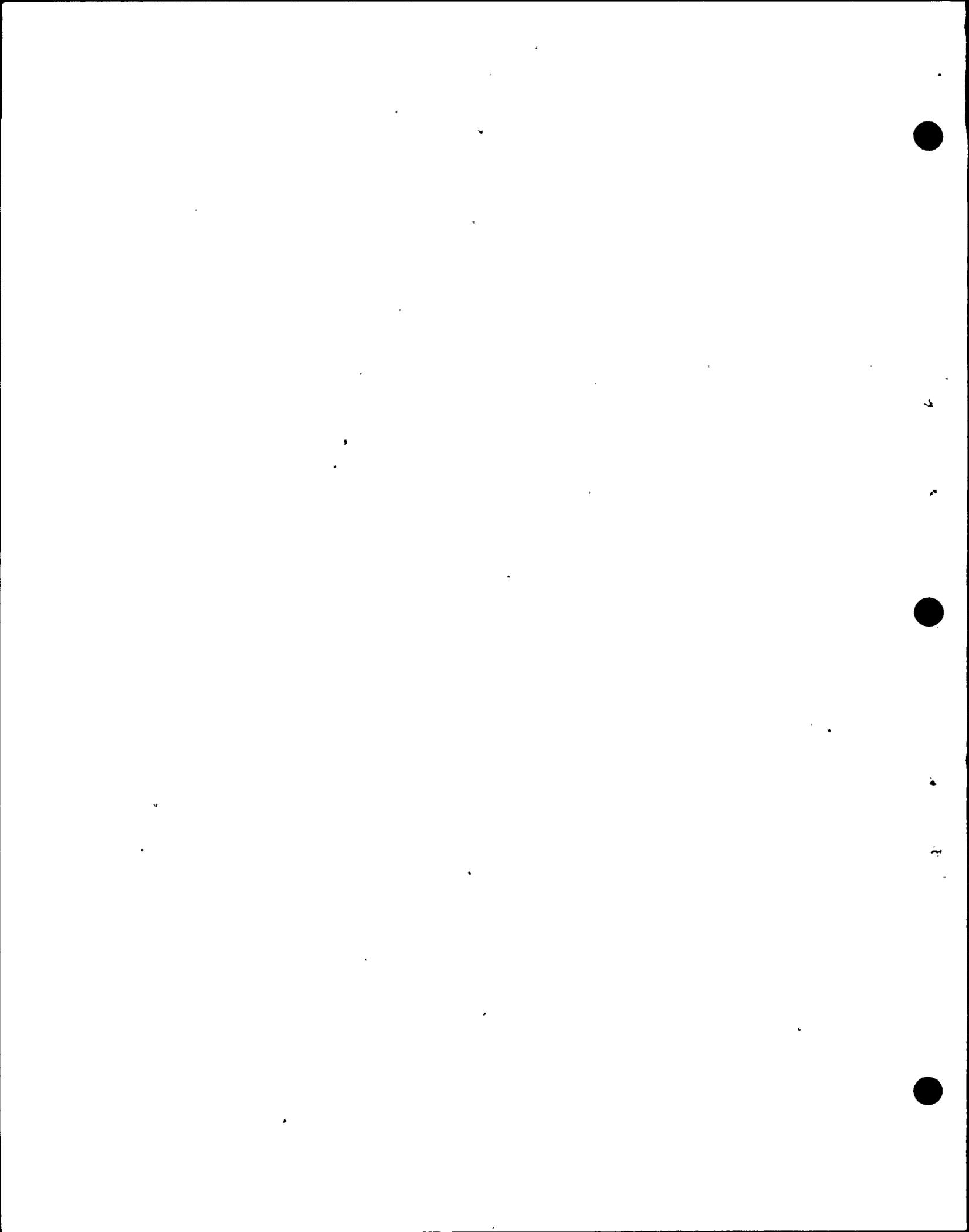
19 MRS. BOWERS: Are we ready to begin?

20 MR. NORTON: Yes.

21 BY MR. NORTON:

22 Q Dr. Seed, I believe where we were was we took a
23 little break to set up the viewgraph and pass our Exhibits
24 61, 62, and 63.

25 MR. NORTON: Let me ask if all the parties have



WPB/mpb2 1

those now, 61, 62, and 63?

2

MR. KETCHEN: Yes.

3

MR. FLEISCHAKER: Yes.

4

MR. NORTON: All right.

5

BY MR. NORTON:

6

Q Dr. Seed, perhaps I can ask a couple of questions before you get started.

7

8

It was the testimony primarily of Dr. Luco that Dr. Trifunac's regression curves predicted the Pacoima acceleration and predicted similar high values for the Hosgri of 1.15g in close. And it is that testimony, I take it, that you are about to discuss in light of the data you have, is that correct?

13

14

A (Witness Seed) Yes, it is.

15

Q All right.

16

Would you please proceed?

17

A Before I do proceed, I would like to address and hopefully put into perspective ultimately one or two matters raised in Dr. Luco's testimony on which I have a different point of view than he appears to have.

18

19

20

21

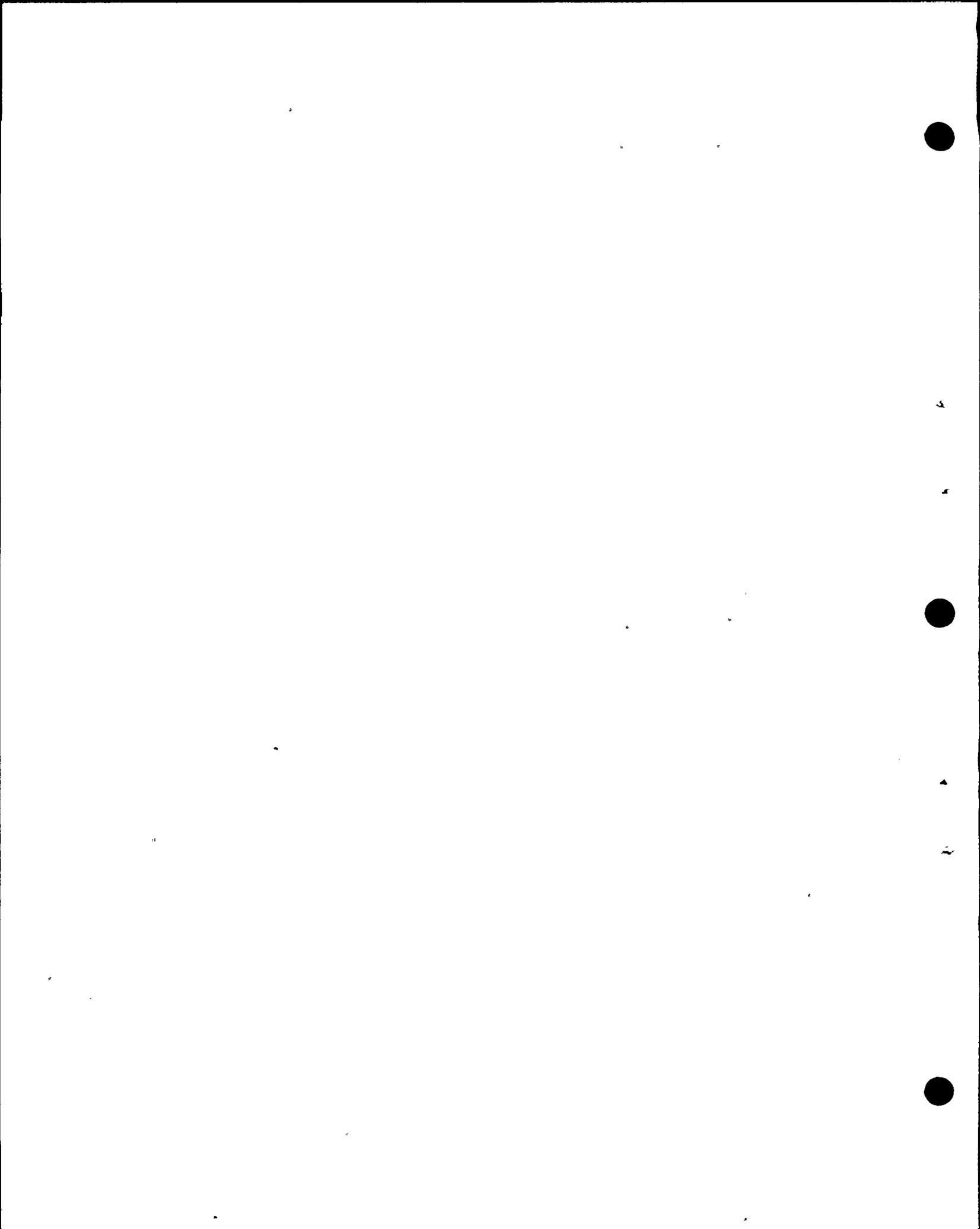
Dr. Luco states on page 8867 of the testimony that there are two issues that he finds troublesome, one, the use of an effective peak acceleration by the Applicant, and, two, the use of the tau effect in evaluating the base motions for the various structures.

22

23

24

25



WRB/mpb31

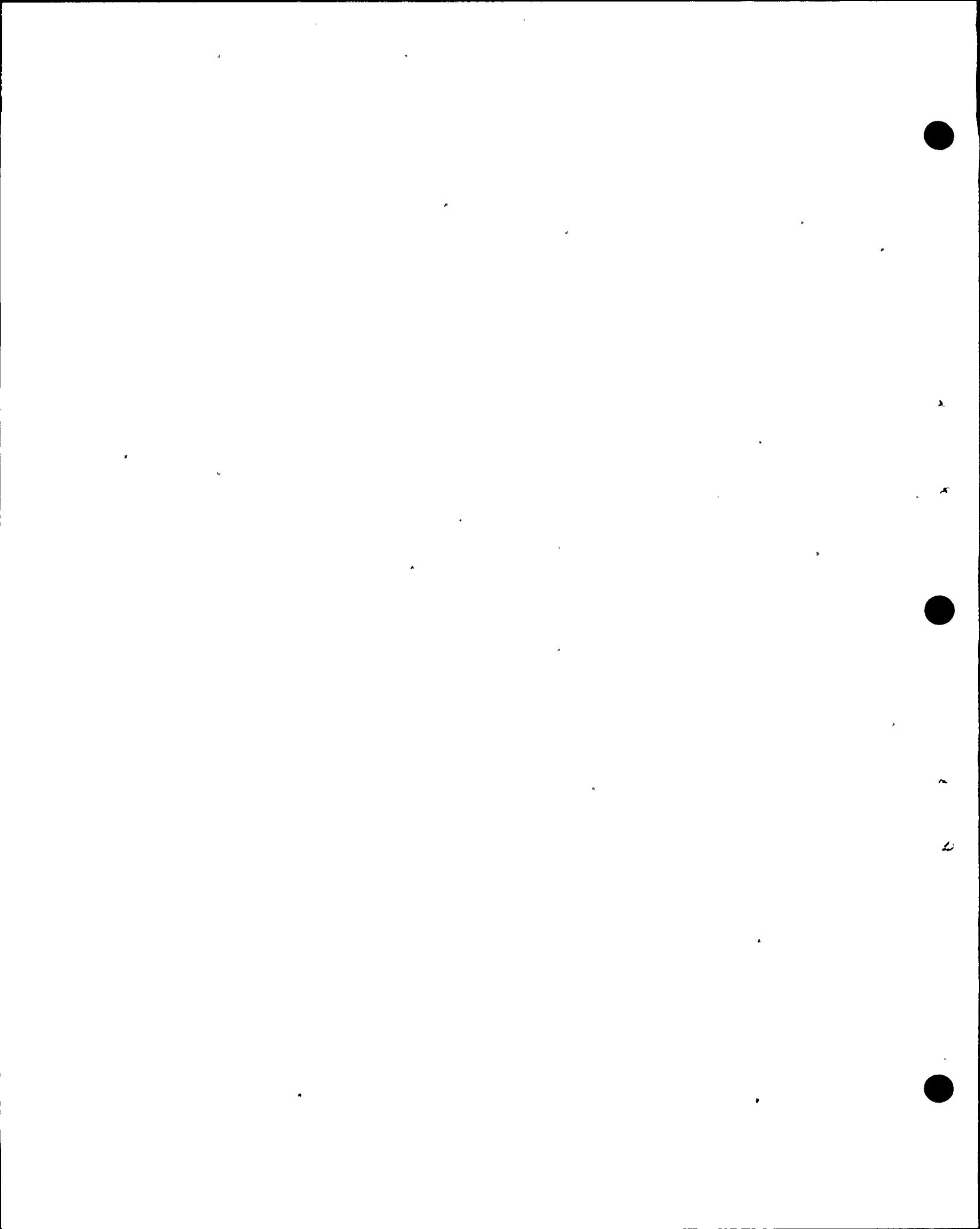
1 First I would like to say that I agree with
2 what I believe to be Dr. Newmark's testimony that while
3 the concept of an effective peak acceleration is a valid
4 concept for use in structural design, it has not been used
5 and established in the design criteria in this case.

6 It is NRC practice, as I understand it, and I've
7 seen a lot of plants and worked on a lot of plants which I
8 passed through the review by NRC, to select a conservative
9 earthquake from which to set ground motion design criteria.
10 to select for this earthquake a mean value of peak accelera-
11 tion that it could produce at the site, and then to use this
12 acceleration as the anchor point for a very conservative
13 response spectrum shape.

14 For a magnitude 7.5 earthquake on the Hosgri
15 fault, the mean peak acceleration developed at the site
16 would not be expected to exceed 0.75g. Accordingly, there
17 is no need to introduce the concept of an effective peak
18 acceleration since this is the value already being used.

19 There are several ways by means of which the
20 selection of 0.75g can be shown to be appropriate and con-
21 servative. I believe the best evidence comes from the data
22 presentation of Hanks and Johnson, supplemented by the accel-
23 erations recorded in other recent earthquakes and discussed
24 in various pieces of testimony presented in these hearings.

25 Accordingly, the first figure that I would like



WRB/mpb41

1 to show is a plot of Hanks and Johnson data on which I have
2 added 12 data points.

3 (Slide.)

4 These represent 12 additional data points which
5 come from six more recent earthquakes which were not avail-
6 able to Hanks and Johnson at the time they presented their
7 initial plot on this fault.

8 Q And would you tell us when that initial plot was?

9 A I think the initial plot was made -- I have the
10 paper here, and it is dated 1976.

11 Since then we have data from six more earth-
12 quakes which could be added to that plot.

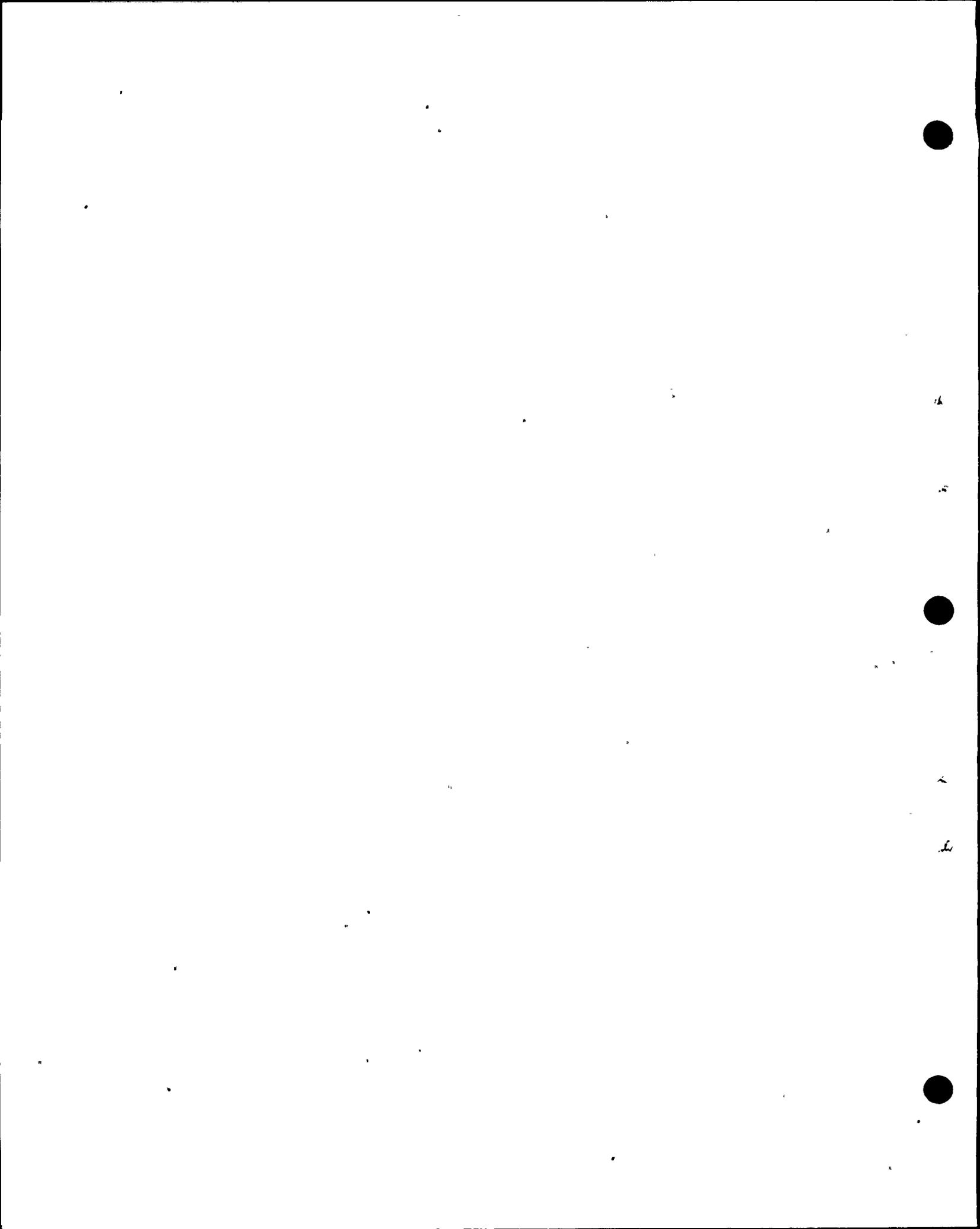
13 (Slide.)

14 That data is shown on the second of the viewgraphs
15 which is now displayed on the board below the actual plot
16 shown at the top.

17 Now the changes that I've made from the Hanks and
18 Johnson data to obtain the most recent plot are two:

19 I have added the peak horizontal accelerations
20 for two components for each of five earthquakes, the Managua,
21 Gazli, Naghan, Baja, and Tabaz earthquakes. And I have
22 changed two of the points on the original Hanks and Johnson
23 plot.

24 The two data points that I have changed are
25 the ones that they plotted for the Pacoima record. They



WR3/mpb5

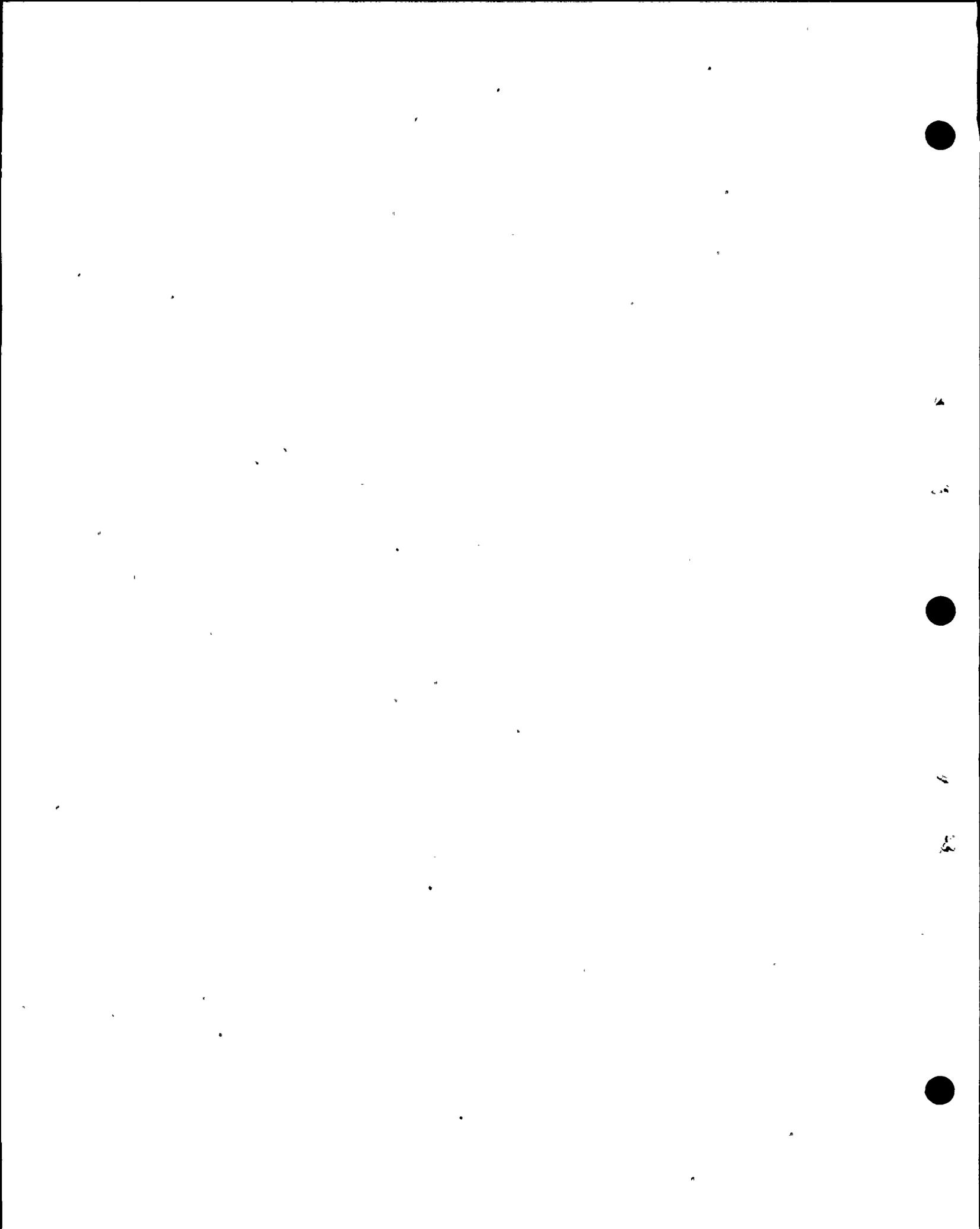
1 plotted the Pacoima record as 1.25g on their plot; and in
2 view of the testimony that you have just heard, and in
3 view of what seems to be the prevailing opinion among
4 seismologists, that the more reasonable value would have
5 been about 0.8g, I have plotted the Pacoima data as 0.8g
6 on this plot. That provides a somewhat larger data base
7 at higher accelerations than was originally available from
8 the Hanks and Johnson data.

9 And that is shown by the upper figure on the
10 screen at the present time.

11 Through the data that is shown there, I have
12 drawn a curved line. That curved line I could have drawn
13 as a mean line through the data points. I didn't do that,
14 I drew a line slightly above the mean just in the interest
15 of being a little more conservative than the mean.

16 What I would like you to notice is that that line
17 becomes essentially horizontal at magnitude 6.25 and above,
18 indicating, as other people have argued in these proceedings,
19 that that peak acceleration becomes magnitude independent
20 at close in distances for magnitudes greater than about 6.25
21 on this plot.

22 Now if we follow that line along to magnitude
23 7.5, the vertical scale is the log of acceleration, and that's
24 unfortunate. But I will interpret that. And the horizontal
25 line labeled two bars on that plot coincides with the line



WRB/mpb6 1. that I have drawn at about 7.5 magnitude earthquake.

2. The acceleration level at that point is 0.7g
3. and that is above a mean value. The mean, if I would take
4. all the data points above magnitude about 5.5, would work
5. out to be about 0.6g.

6. So I conclude that the actual mean value for a
7. magnitude 7.5 earthquake is probably about 0.6g. Then a
8. conservative value of the mean value is 0.7g. And since
9. it is the mean value that we normally use in establishing
10. design criteria for nuclear power plants then it is a value
11. of this order of magnitude that we should be using for the
12. design criteria.

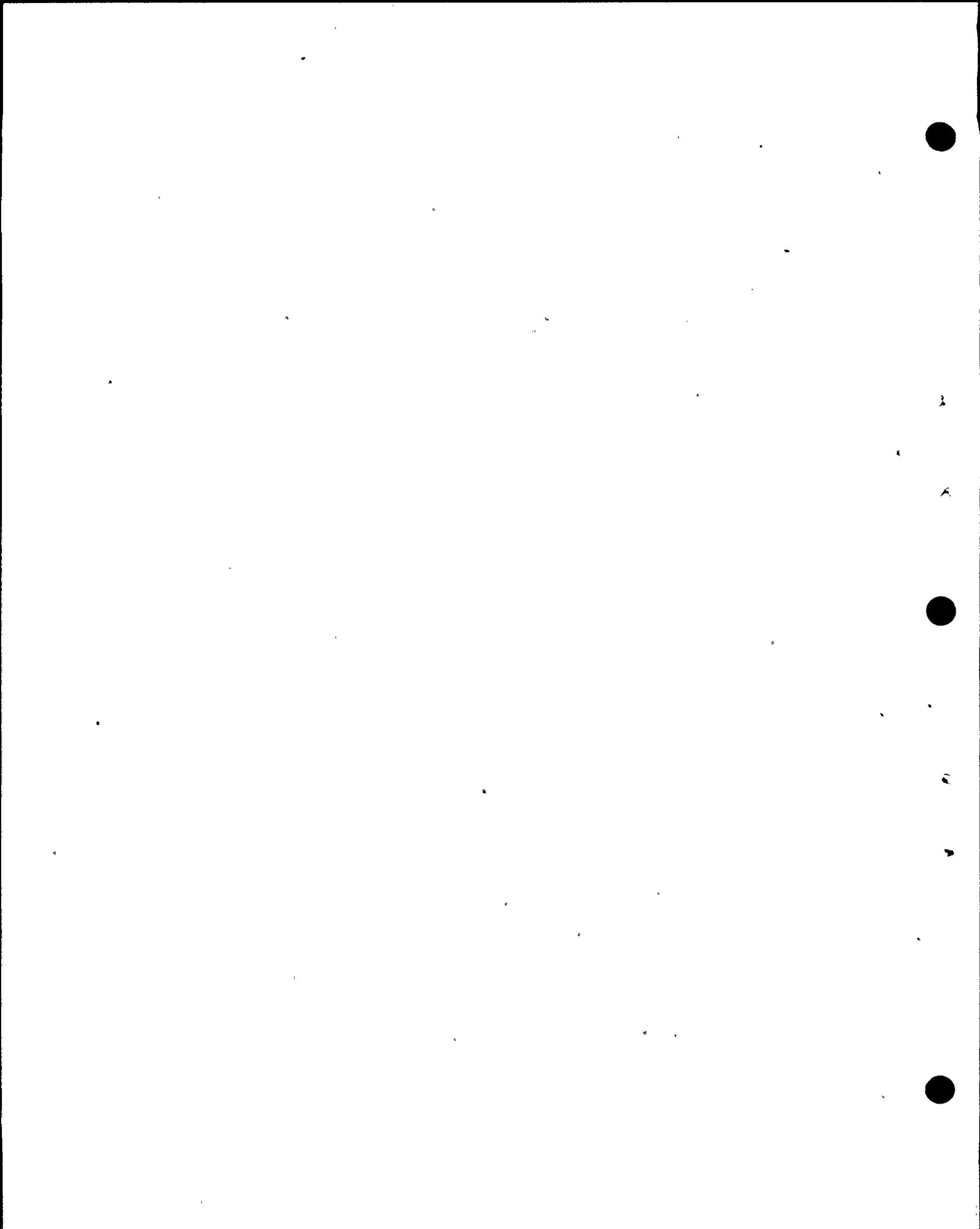
13. I have another figure to show. That is figure
14. 3, or the third of the handouts that you just received.
15. Actually it happens to be labeled figure 4 on this slide, but
16. not in the handouts.

17. Q Let me identify those very carefully for the
18. record.

19. The first one which was the graph was Exhibit 61.
20. The second one, which happens to be labeled Figure 2, is
21. Applicant's Exhibit 62. And now this third one, which has
22. the figure 4 on it even though the figure 4 has no meaning
23. to these proceedings, is in fact Applicant's Exhibit 63.

24. (Slide.)

25. A I might note that all the points that are plotted



WRB/mpb7

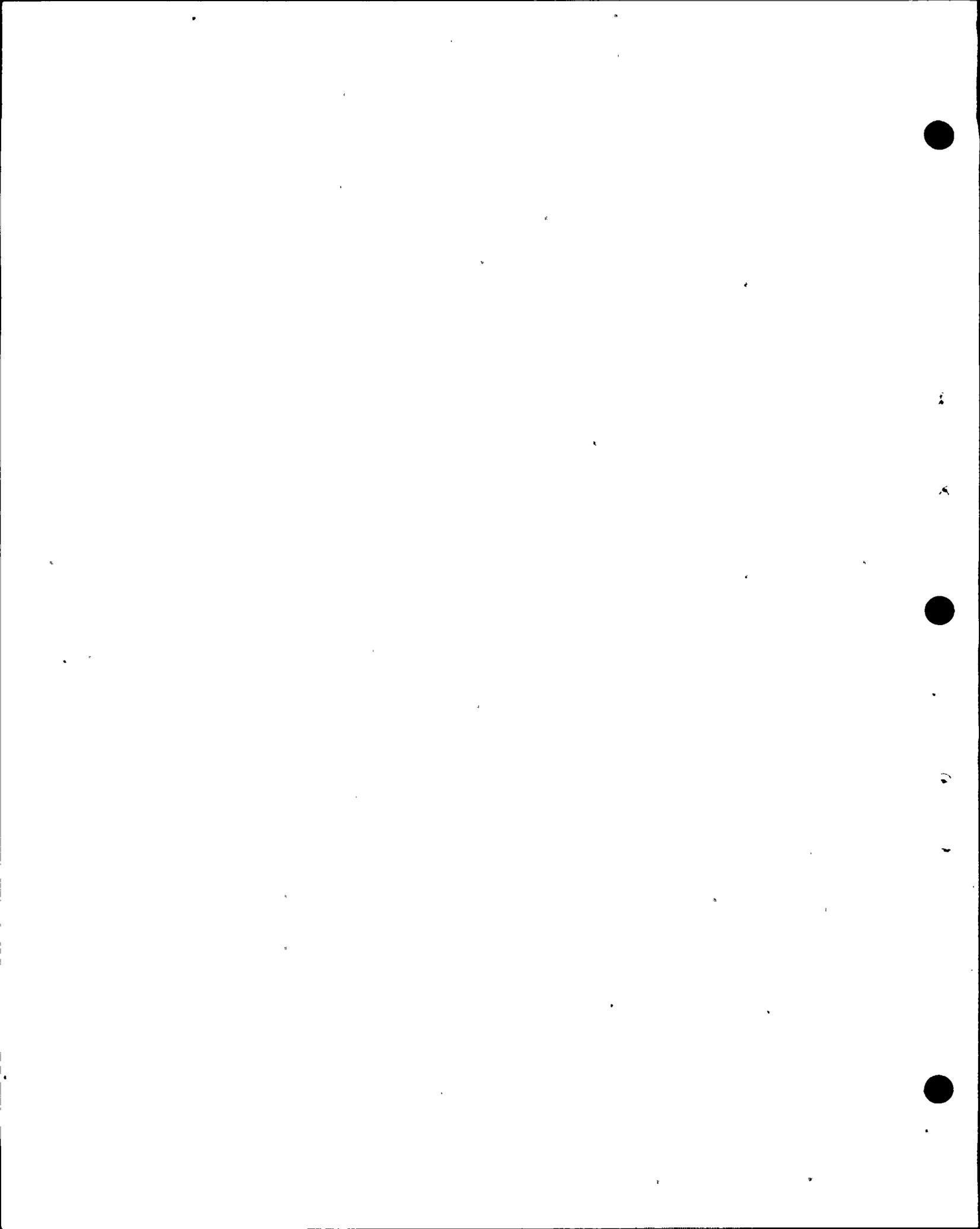
1 on the Hanks and Johnson graph that I showed previously
2 are all for earthquakes at a hypocentral distance less than
3 ten kilometers, and are therefore typical of the kind of
4 records we would be getting from the Hosgri fault at the
5 Diablo Canyon site.

6 Now on this particular plot, I have done what
7 Dr. Luco did in one of his more recent reports to the NRC.
8 He took the three strongest records he could find. What I
9 have done is take the four strongest records I could find.
10 I can do this because we have more records now than we
11 had when Dr. Luco wrote his report.

12 They are for the Naghan earthquake in 1977,
13 the Pacoima earthquake in 1971, the Koyna record in 1967,
14 and the Gazli earthquake in 1976. The magnitudes range
15 from 5.5 to 7.2. And you'll notice that it's appropriate
16 to include the 5.5 magnitude earthquake because in point of
17 fact although the magnitude for that is the lowest of the
18 four records included, that the peak acceleration for that
19 is higher than that for any of the other records that are
20 shown there.

21 So what I've done is pick out the four strongest
22 horizontal component records that are available at the present
23 time and averaged those accelerations, and the average of
24 all those is 0.3.

25 Now if the average of the four strongest is 0.3



WRB/mpb8

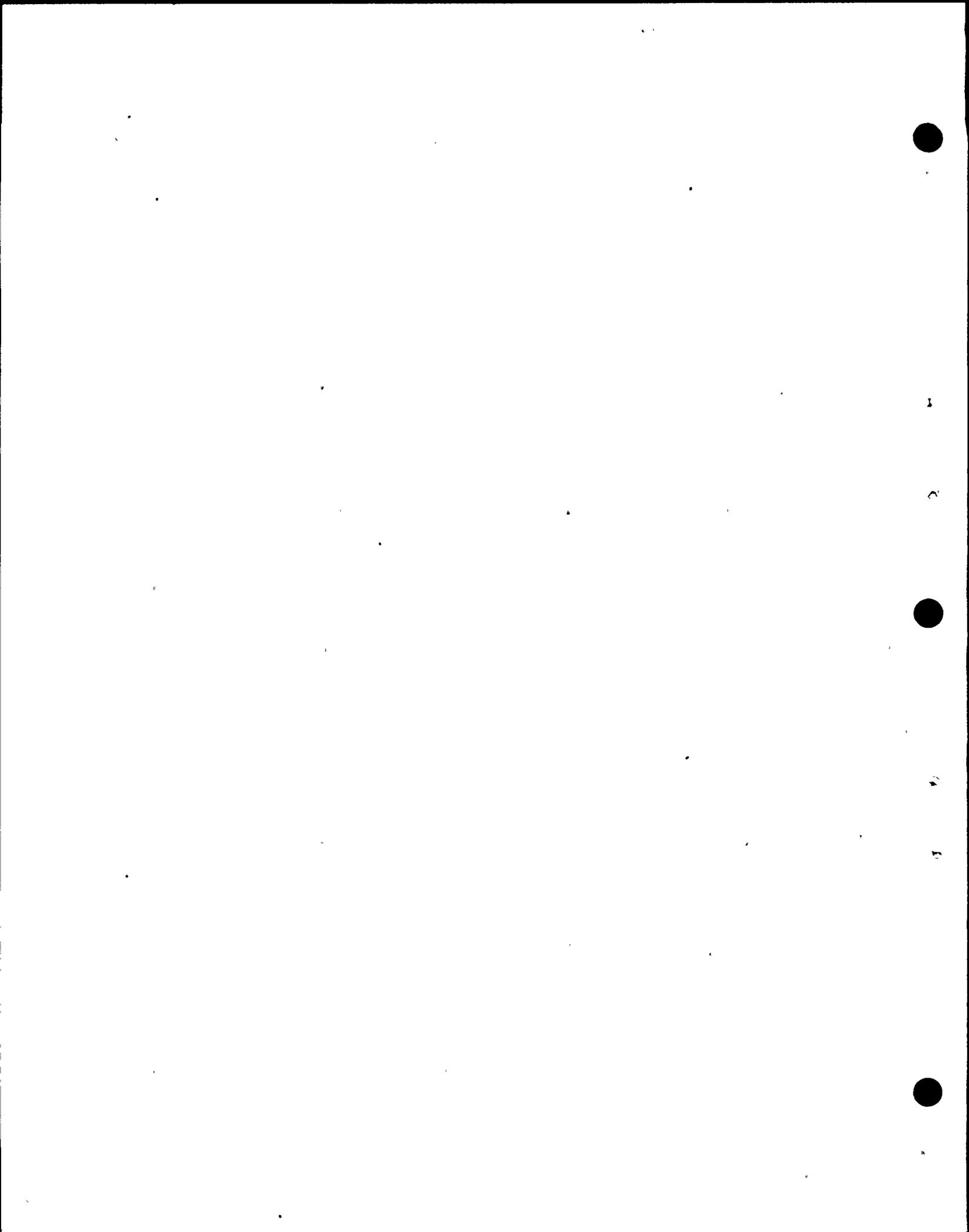
1 then the mean clearly must be less than 0.8. And therefore
2 I cite this as another example and as another simple way of
3 showing that the mean acceleration produced by a Hosgri
4 earthquake would be not greater than 0.75g which is the
5 value being used to anchor the spectrum for the design of
6 the Diablo Canyon Plant.

7 I conclude from these results that there is no
8 need to introduce the concept of an effective peak accelera-
9 tion in this case. The actual mean acceleration associated
10 with the magnitude 7.5 earthquake of the Hosgri fault is
11 less than 0.75g. And this is the value used to anchor the
12 spectrum in accordance with customary NRC procedures.

13 Accordingly, if no effective peak acceleration
14 is involved in the procedure, there is no reason for Dr.
15 Luco to find it troublesome.

16 Q Dr. Saed, I would like to take a moment to dis-
17 cuss -- and I'm really going to be switching from you to
18 Dr. Frazier very quickly here -- in the transition, as I
19 understand it, there are several ways to look at what one
20 could expect as a mean peak acceleration at a close in site,
21 less than ten kilometers, to a fairly large earthquake, let's
22 say magnitude 5.56, -.57, in that range.

23 One, you could look at all the data from large
24 earthquakes as defined, say 5.5 and above, regardless of the
25 distance, where all your data, or -- excuse me, not all your



WRB/mpb9

1 data, but the vast majority of your data would be at
2 distant points, 1-0 kilometers, 80 kilometers on out, more
3 than 40 kilometers. And that in essence is what Dr. Trifunac
4 did in his regression analysis, is that correct?

5 A That's right.

6 Q All right.

7 Another thing to do is to do what Hanks and
8 Johnson and you, since then, or in addition to what they've
9 done, which is simply look only at large earthquakes that
10 are in close. And even though you have a very small data
11 base, you look at just that.

12 Is that correct?

13 A That's correct.

14 I would not totally agree that we have a very
15 small data base now. We have a much larger data base than
16 we had before.

17 Q All right.

18 When Hanks and Johnson did it in 1976 --

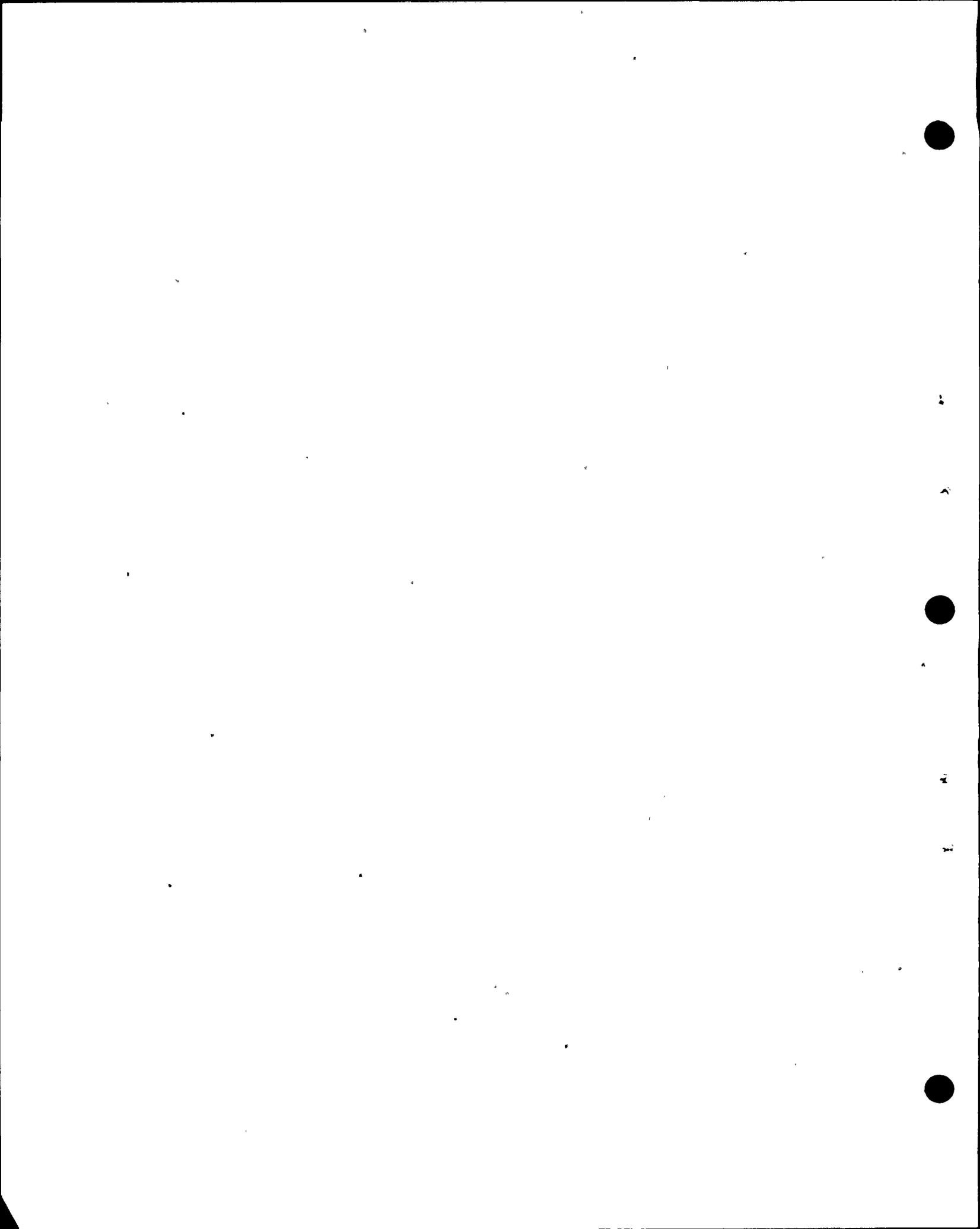
19 A They had a fair data base.

20 Q They had a fair data base.

21 And since then you have added to it, and you've
22 also adjusted the Pacoima record to what you feel it really
23 was, and therefore feel that you have a better handle.

24 A That's right.

25 Q All right.



WRB/mpbl0 1

2 Would you have more confidence in that kind of
3 an actual data base as opposed to the kind of data base that
4 Dr. Trifunac had, which is the large magnitudes far out and
5 then using a regression analysis to give you values in close?

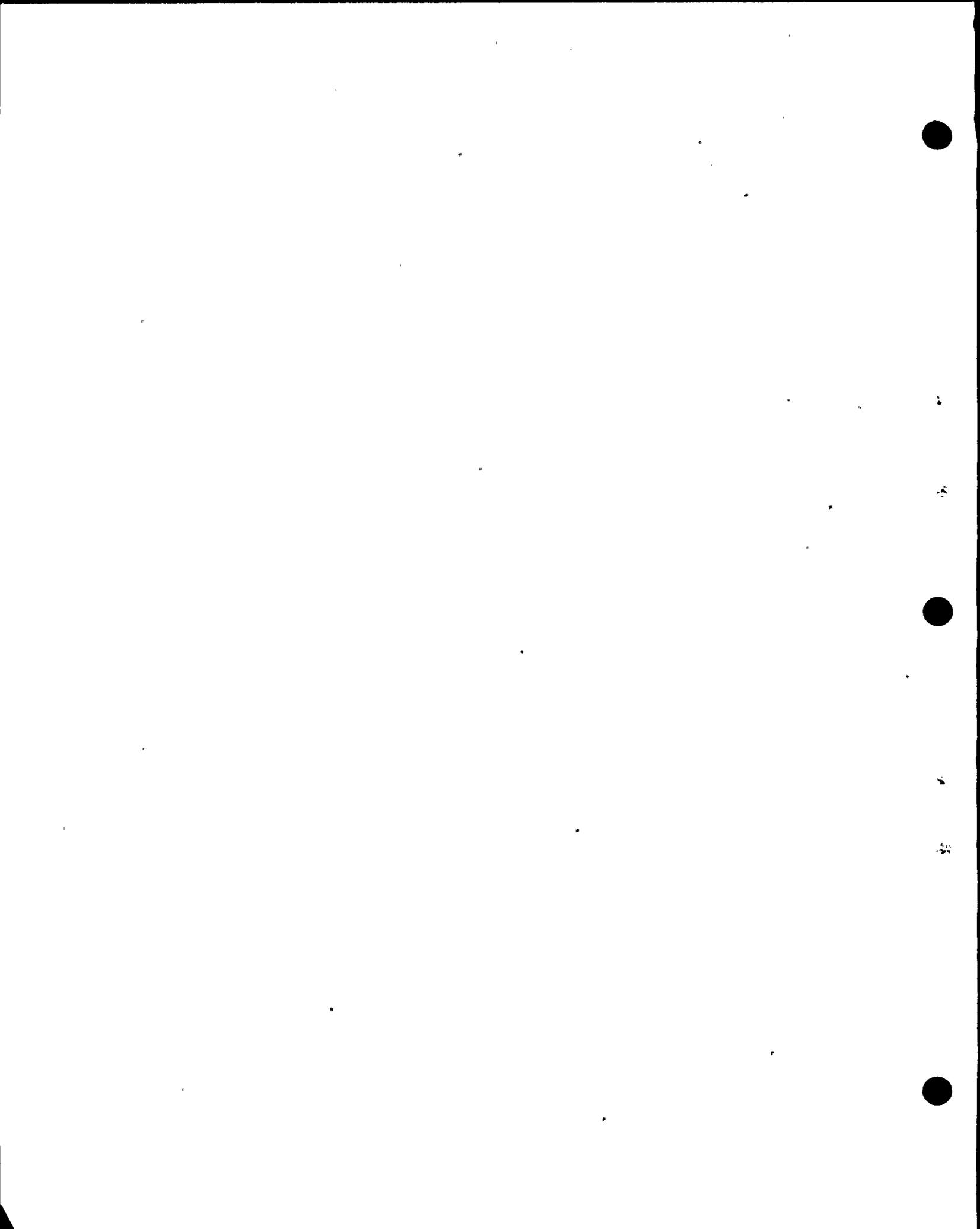
6 A I think the former approach, that is using the
7 Hanks and Johnson approach, is a little more foolproof than
8 the other in that the data source is all from close in earth-
9 quakes.

10 Q All right.

11 A If you used distant events and then tried to
12 extrapolate a curve to near source events, then you usually
13 have to assume some form of the relationship that you are
14 going to pick through those events. And so there are a
15 number of assumptions that are involved in the kind of plotting
16 that Hanks and Johnson did and that I have just shown.
17 They are fewer than those involved in the kind of analysis
18 that Trifunac and others, including myself, I might add, have
19 done.

20 Q All right.

21 Now it seems to me there is a third approach,
22 and that would be to take only records that are in close,
23 regardless of magnitude, and then work out a regression
24 analysis based on that, scaling out the magnitude; instead
25 of going far out and doing a regression analysis in close
you take all the in close records disregarding magnitude in



WRB/npb11

1 terms of a selection basis, and then plotting what you
2 would get as you increase the magnitude.

3 Would that be an approach that could --

4 A That would be an approach, but I don't think
5 that's as nice an approach as the Hanks and Johnson approach
6 because, as you can see from the data -- the slide has been
7 removed. Perhaps it could be put back on, the Hanks and
8 Johnson plot.

9 (Slide.)

10 The peak accelerations seem to be magnitude
11 dependent up to a certain point. And doing your third
12 approach would be assuming that they would be totally
13 magnitude independent.

14 Q All right.

15 A And so I would prefer not to do that if I had a
16 choice, and to use the data that Hanks and Johnson have to
17 find the point at which they cease to be magnitude dependent.

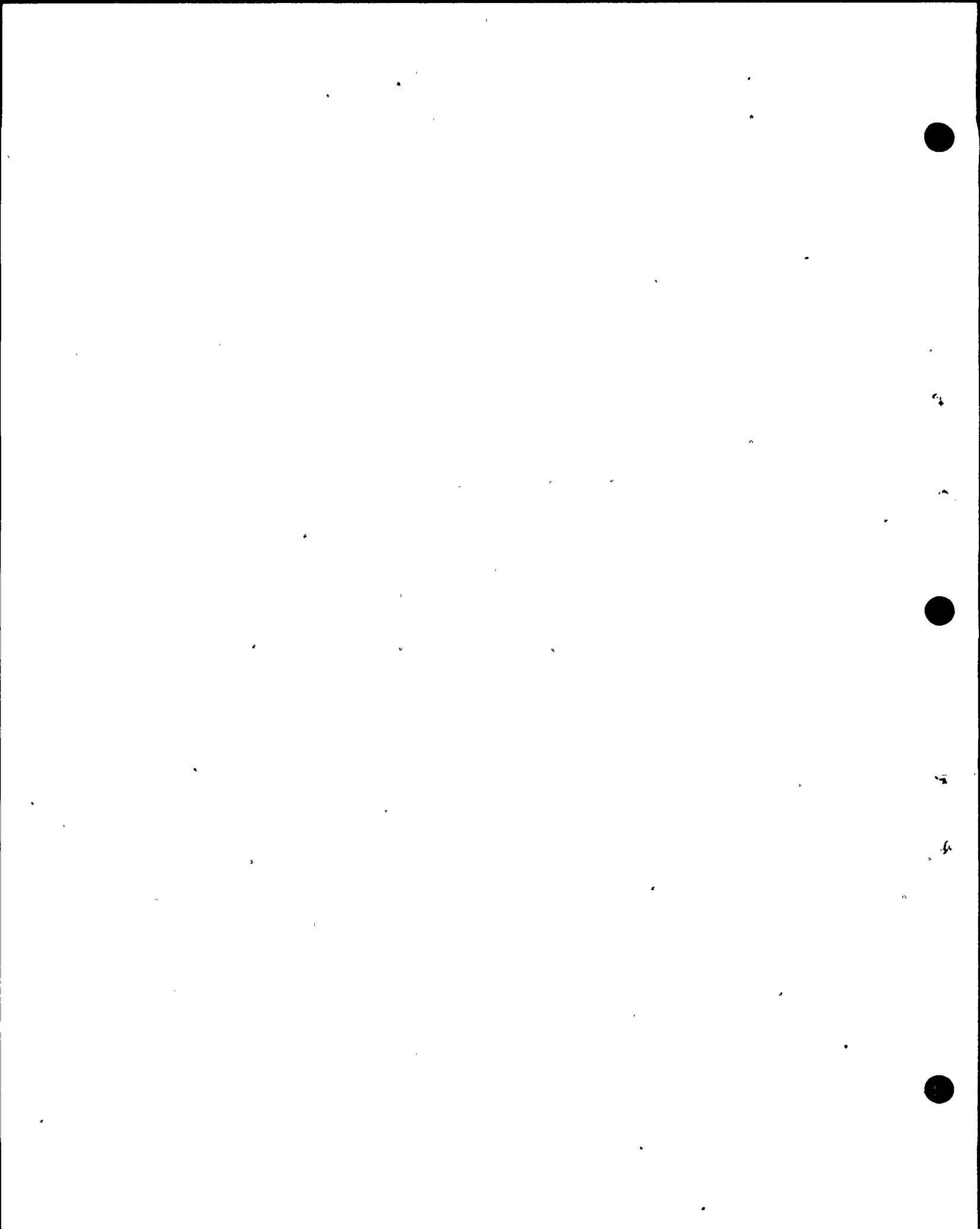
18 Q All right.

19 But with that approach, which assumes magnitude
20 independence, would it have the same kind of assumption,
21 only it's a magnitude assumption, as the Trifunac approach,
22 which assumes it's distance independent?

23 A That would be correct, I believe.

24 Q All right.

25 So there is another way of looking at it?



npb12 1

A Yes.

2 And your third approach which you suggested
3 involves an assumption. And Trifunac and other people's
4 approaches -- I don't want to just mention Dr. Trifunac here
5 because there are at least -- I think I gave a lecture on
6 this last week in San Francisco -- 25 different attenuation
7 laws of which Trifunac's is one. So by no means is he the
8 only person who uses the attenuation type approach.

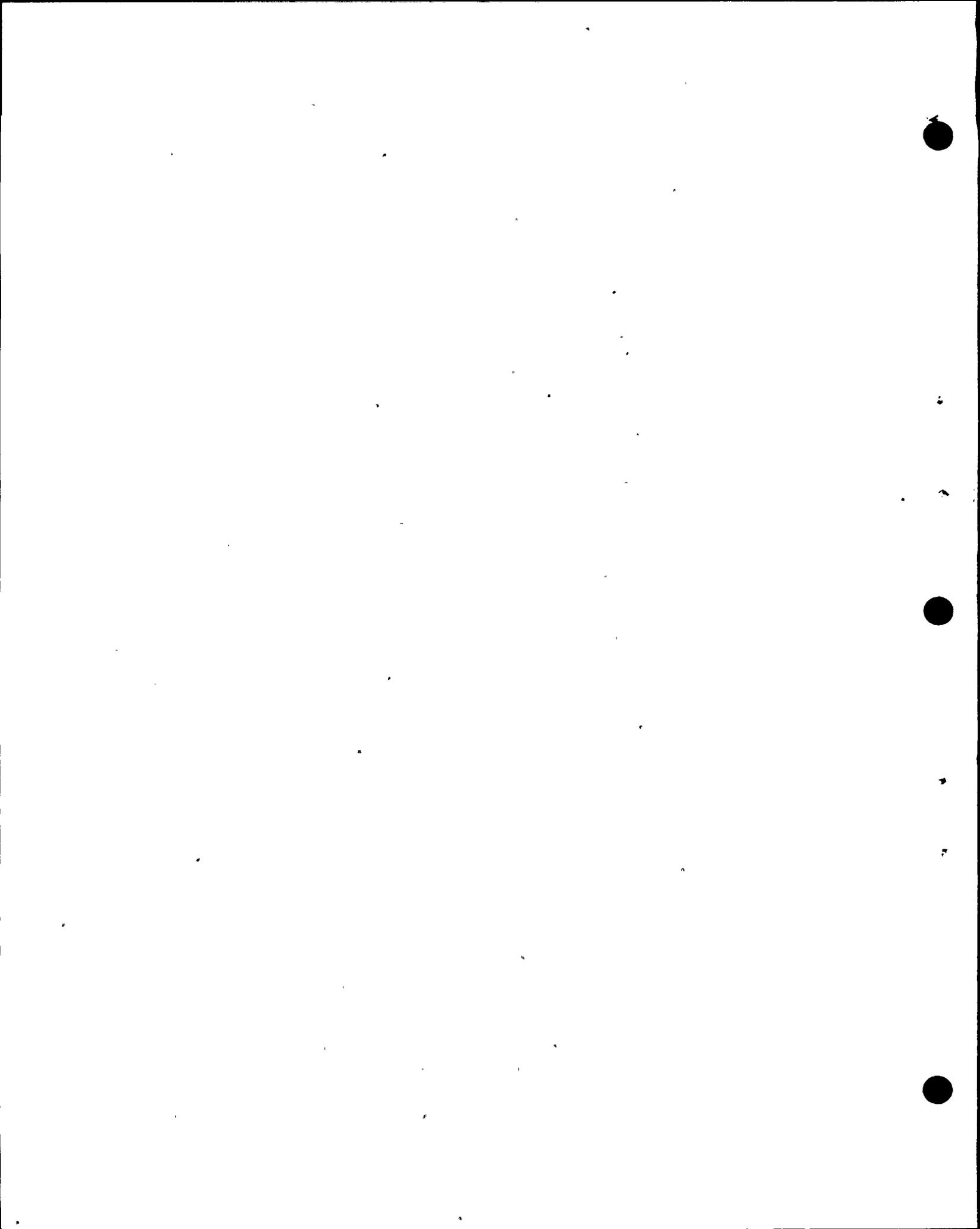
9 But in all of those laws one usually involves
10 an assumption about the shape of the curve that you have to
11 produce back to close in distances to get values of close in
12 distances.

13 The Hanks and Johnson approach doesn't have to
14 make that assumption.

15 Q All right.

16 Would you say in an analysis of the assumption
17 where it's magnitude independent of a large number of data
18 points, close in data points, would be in the same realm of
19 validity as would the Trifunac approach which uses distance
20 independent assumption?

21 A I don't think one can answer that clearly
22 because if one is making assumptions the validity of the
23 results that you obtain depend clearly on the validity of
24 the assumptions that you make. And the reason we have 25
25 different attenuation laws is that 25 different people have



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1 made 25 different assumptions. And they can't all be right.

2 So obviously some people are going to be more
3 right than others, if I may put it that way.

4 Q All right.

5 At this point I would like to turn to Dr. Frazier
6 and ask Dr. Frazier if he has taken a look at the question
7 of magnitude dependence, distance dependence on accelerations
8 in light of the Trifunac regression analysis, Hanks and
9 Johnson analysis, et cetera.

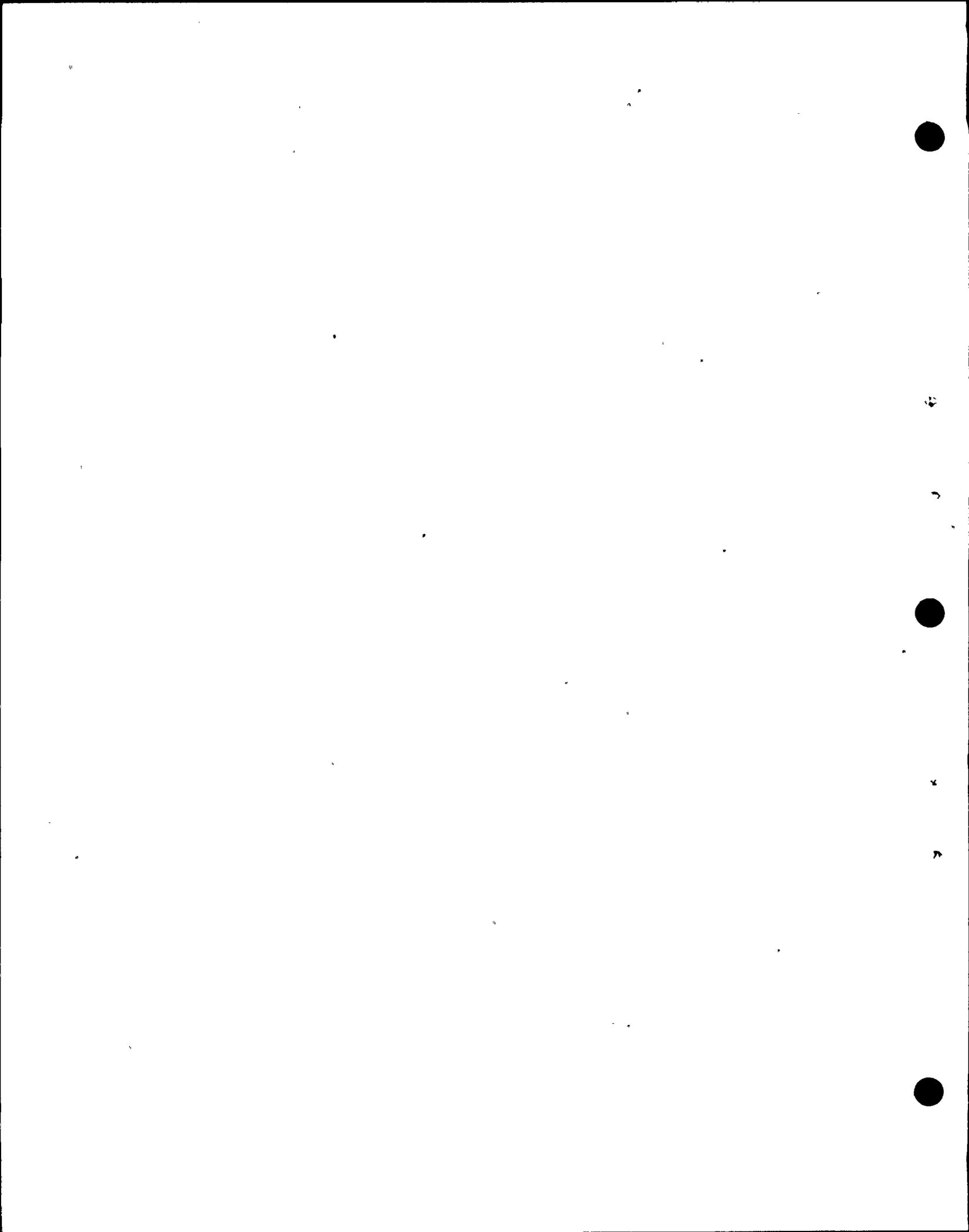
10 A (Witness Frazier) Yes, I have.

11 Q All right.

12 And would you please explain to the Board what
13 work you have been doing in that area?

14 A First I'd like to reiterate that when our panel,
15 the seismology panel was up, each of the members were asked
16 something to the effect is .75g in your opinion a conserva-
17 tive number to use for peak acceleration at the distances
18 of Diablo Canyon, and each of the members answered yes.

19 And let me extend that, in light of the Trifunac
20 and Luco testimony, extend that, that I know from personal
21 involvement with these other panel members, that each of the
22 panel members have considered that question from many points
23 of view, both regressions with distance, regressions with
24 magnitude, looking at data, averaging all the large earthquake
25 data, all of that goes into their answer to that question.
I just want to point that out.



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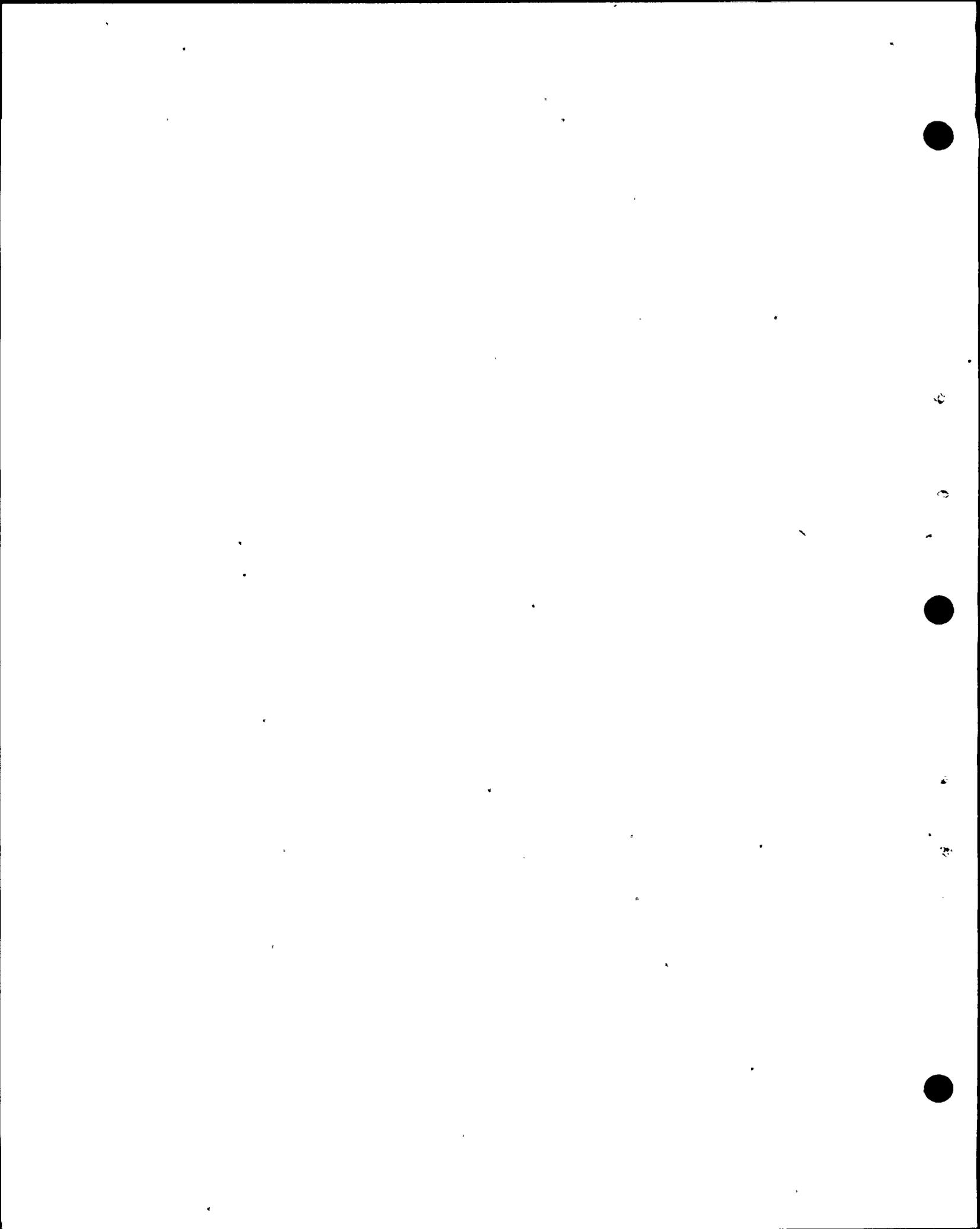
I've been quite concerned for several years, actually, with the procedure of extrapolating inward from distant data, and attempting mathematically to come up with answers to what we should expect for ground motions within a few kilometers of a major earthquake rupture.

The reason that concerns me is that if you take the data that are used in those types of analyses and actually change the data just arbitrarily by a factor of 2, either double it or cut it in half by a factor of 2, all the data within, say, 15 kilometers, it doesn't change the answers.

So what that tells me is the data out beyond 15 kilometers is controlling the answer within 15 kilometers, if I can change all the data points inside by a factor of 2 and it doesn't change the answer to any significant degree. That concerns me.

Q Excuse me, Dr. Frazier, let me, if I can, get you to expand on that a little bit.

If I understand what you're saying, it is that you do your regression -- you take your data points within 15 kilometers say, for example, in the Trifunac regression analysis, and you take all of his data points within 15 kilometers, and let's say they gave you, as an example, .75 g as the acceleration. You double that to 1.5 g. Are you saying that it would not change significantly the shape of his curve or the predictions?



wel 2

1 A That's correct. If he held the function, the
2 regression procedures constant that he has used -- and, again,
3 I want to generalize, this is true not only of Dr. Trifunac's
4 work, but of this kind of procedure -- if he holds everything
5 else constant, the shape of the curve, and so on, and just
6 says, let the data tell me what the answer is, and if you
7 take that data and, say, double it, which would give you
8 data that would run the Pacoima Dam record up to around .2 g,
9 and so forth, it would change the answer for extrapolating
10 inward toward the fault. It would change the answer by less
11 than .1 g.

12 MRS. BOWERS: Mr. Norton, I may have missed this,
13 but it seems to me when this panel started out, that you
14 checked with Dr. Bluma, Dr. Seed, and Dr. Malek about whether
15 or not they had read the transcript and are familiar with
16 the filings, but I don't believe you checked with Dr.
17 Frazier in that regard.

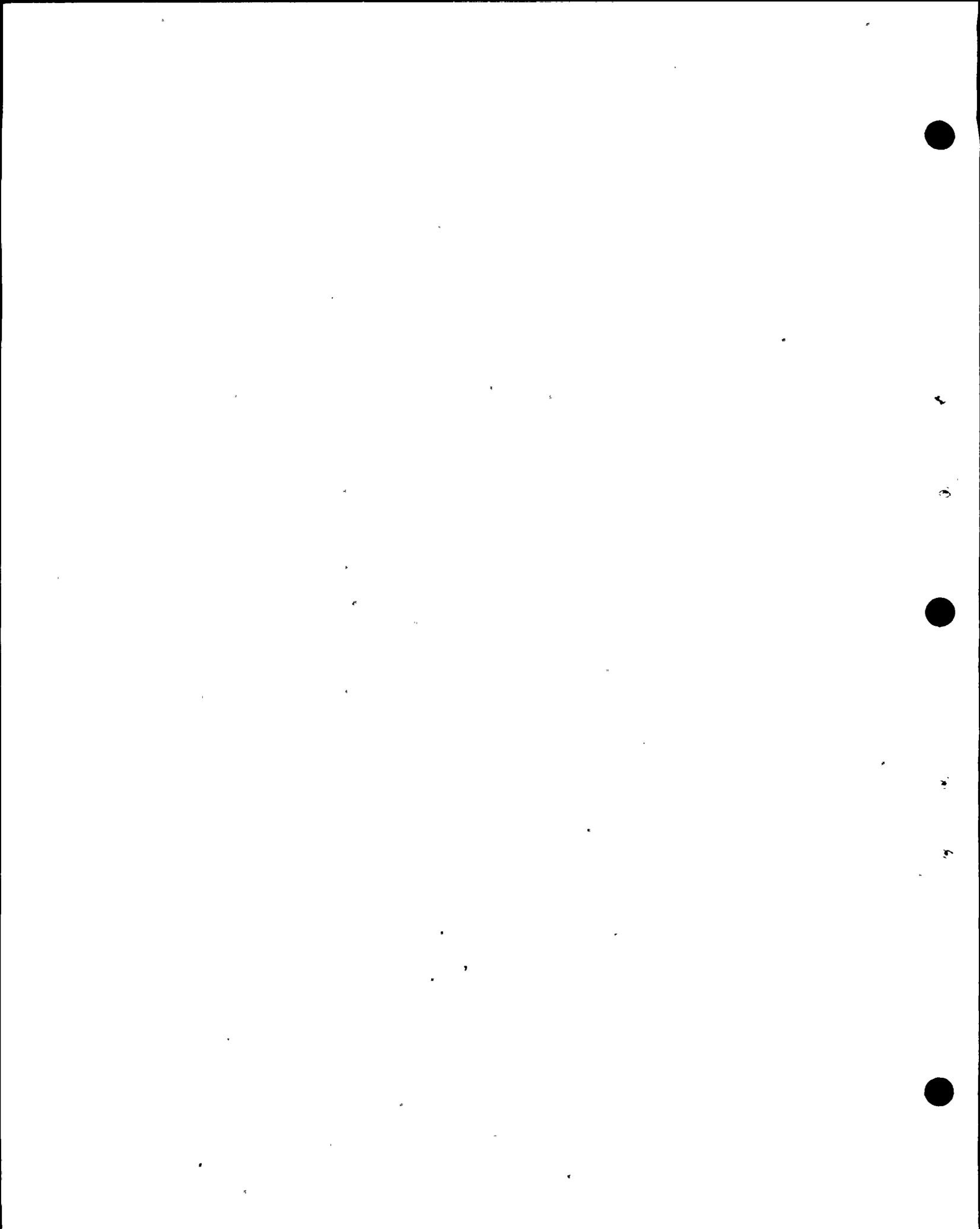
18 MR. NORTON: Yes, I checked with him, because he
19 was sitting here during the entire thing, and I asked him if
20 he was, and he said he was. So I didn't ask him the question
21 about reading it. I think he's done that too, but --

22 WITNESS FRAZIER: Yes, I have.

23 BY MR. NORTON:

24 Q You were here, however?

25 A (Witness Frazier) Yes.



wel 3

1 Q All right. Please continue.

2 A I want to present information along the line of
3 the Hanks and Johnson work that Dr. Seed has just presented.

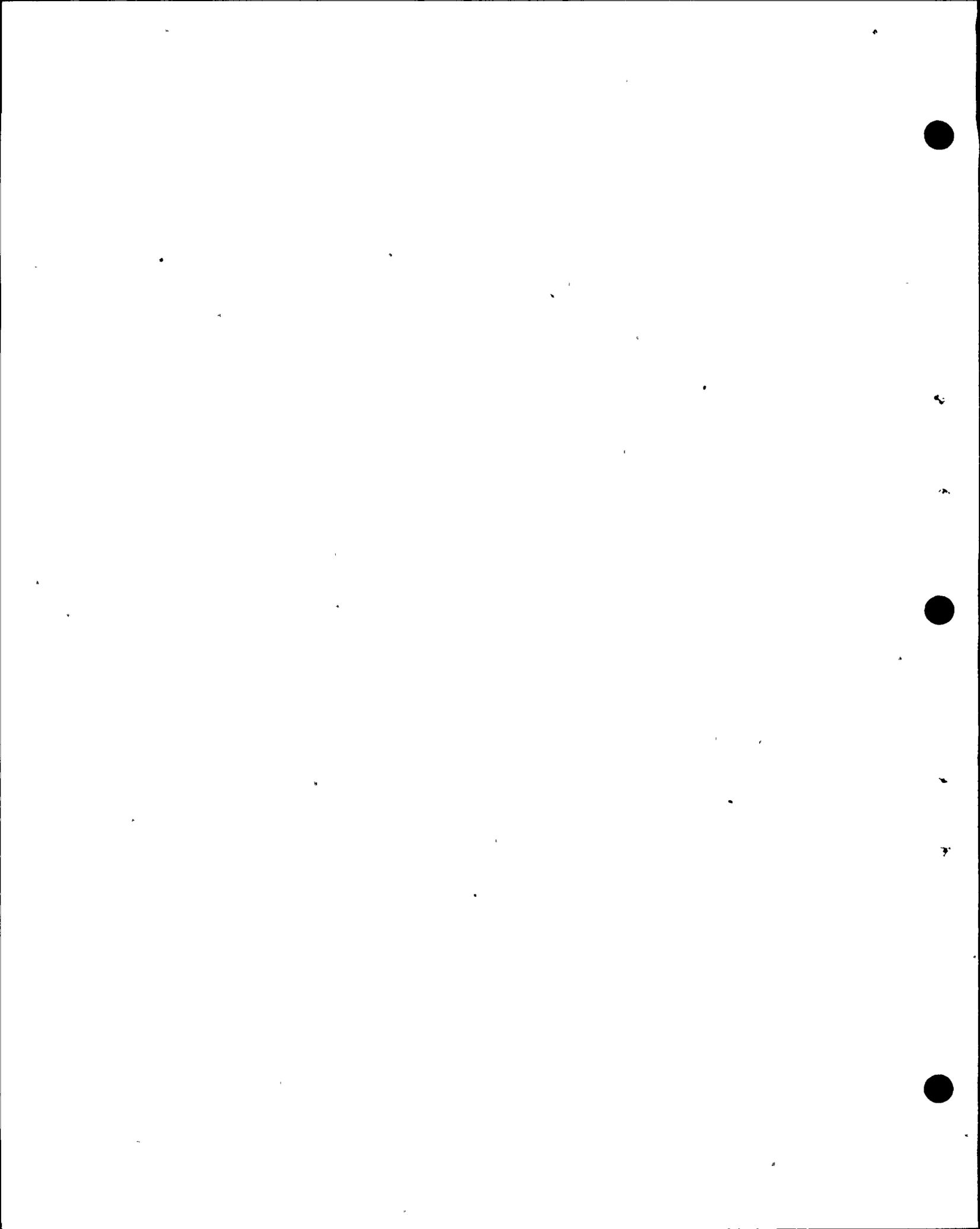
4 The Hanks and Johnson paper include a large
5 number of data points that were available in 1976. Some
6 colleagues of mine have enlarged that data base, and it
7 plots very much as shown on the board here, and have per-
8 formed regression analysis on that data base presented by
9 Dr. Seed, as taken from the Hanks and Johnson paper and
10 added to by Dr. Seed.

11 Several types of regressions were done. The
12 regression, let me point out, is asking the question, what
13 would one expect for peak acceleration close to the causative
14 rupture as a function of magnitude?

15 And the answers -- I'll give you the answers first
16 and then describe a little bit about the study -- the
17 answers are -- they did the regression analysis at
18 magnitude 6.5--and the answers for the mean turn out to
19 range between .3 g and .4 g. So I'm describing numbers
20 quite a bit less than what we've been talking about here.

21 Those regression curves are nearly flat at
22 magnitude 6.5, so one could extrapolate up to magnitude 7.5
23 with a fair degree of confidence.

24 To further investigate this regression of the
25 type of data shown by Dr. Seed -- and incidentally there were



wel 4

1 approximately 200 data points in this regression study, and
2 the regression study went from magnitude 4 on up, where, as
3 you see here, Hanks and Johnson goes from magnitude 3 up, so
4 they only went from magnitude 4 up and they had approximately
5 200 data points. So there is really quite a bit of data.

6 And they tried things like asking: Is the answer
7 we're getting a function of the kind of curve we're trying
8 to regress against?

9 They changed curves. They used log of acceleration,
10 quadratic magnitude, and got an answer of just above .3 g.

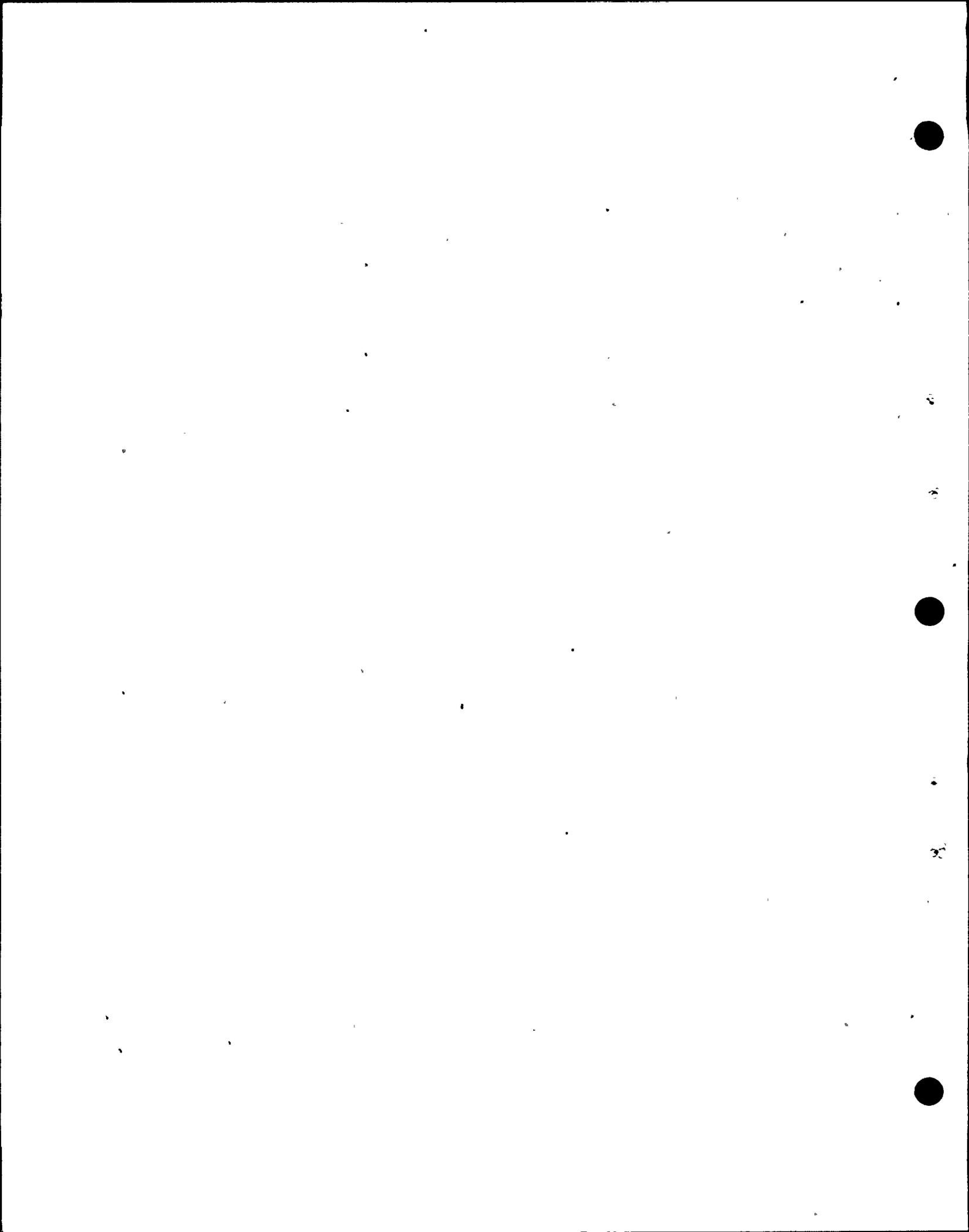
11 They tried exponential functions, and regressed
12 on that, and got within that range of .3 to .4.

13 They tried changing soil conditions, looking at
14 hard sites separately, or throwing out hard sites, including
15 more site selections, and they still got about the same
16 numbers, in that same range.

17 They took results from European earthquakes
18 presented by Dr. Ambraseys in a recent paper which was
19 discussed by our panel, and included that data set, which
20 enlarges the data considerably, and asked the question: How
21 does that change it?

22 Again, it did not change it. It still ranged
23 between .3 and .4 for a mean acceleration for magnitude 6.5.

24 Q I would like now to change topics, if we could,
25 and I'd like to turn to Dr. Blume and ask Dr. Blume if he has



wel 5

1 read the submittals and testimonial criticisms of the use
2 of 7 percent structural damping as opposed to the original
3 5 percent damping that were made by Drs. Trifunac and Luco?

4 A (Witness Blume) Yes, I have.

5 Q I believe one of the criticisms was that there
6 was no data to support 7 percent structural damping in the
7 concrete structure, such as the containment shell, et cetera.

8 Would you care to comment on that, please?

9 A Yes, I would be glad to.

10 All through the various ACRS Subcommittee meetings
11 and full Committee meetings, the question of damping kept
12 coming up, over and over again.

13 It was first pointed out that 7 percent damping
14 was in Reg. Guide 1.61, and the Seismic Committee took the
15 position, well, let's prove it all over again that that's
16 the right number.

17 So we did.

18 Various reports were written, new data were found
19 that were very recent and had not been entered before, and
20 I think report DLL-9 was the first one on damping, and there
21 were several others that followed.

22 It was quite disappointing to me to read in the
23 testimony of both Dr. Luco and Dr. Trifunac, after all the
24 hearings and all the discussions that we have had, they still
25 aren't satisfied that 7 percent damping is a valid number --



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1 in fact, a conservative number, without consideration of
2 radiation damping or energy loss back into the soil.

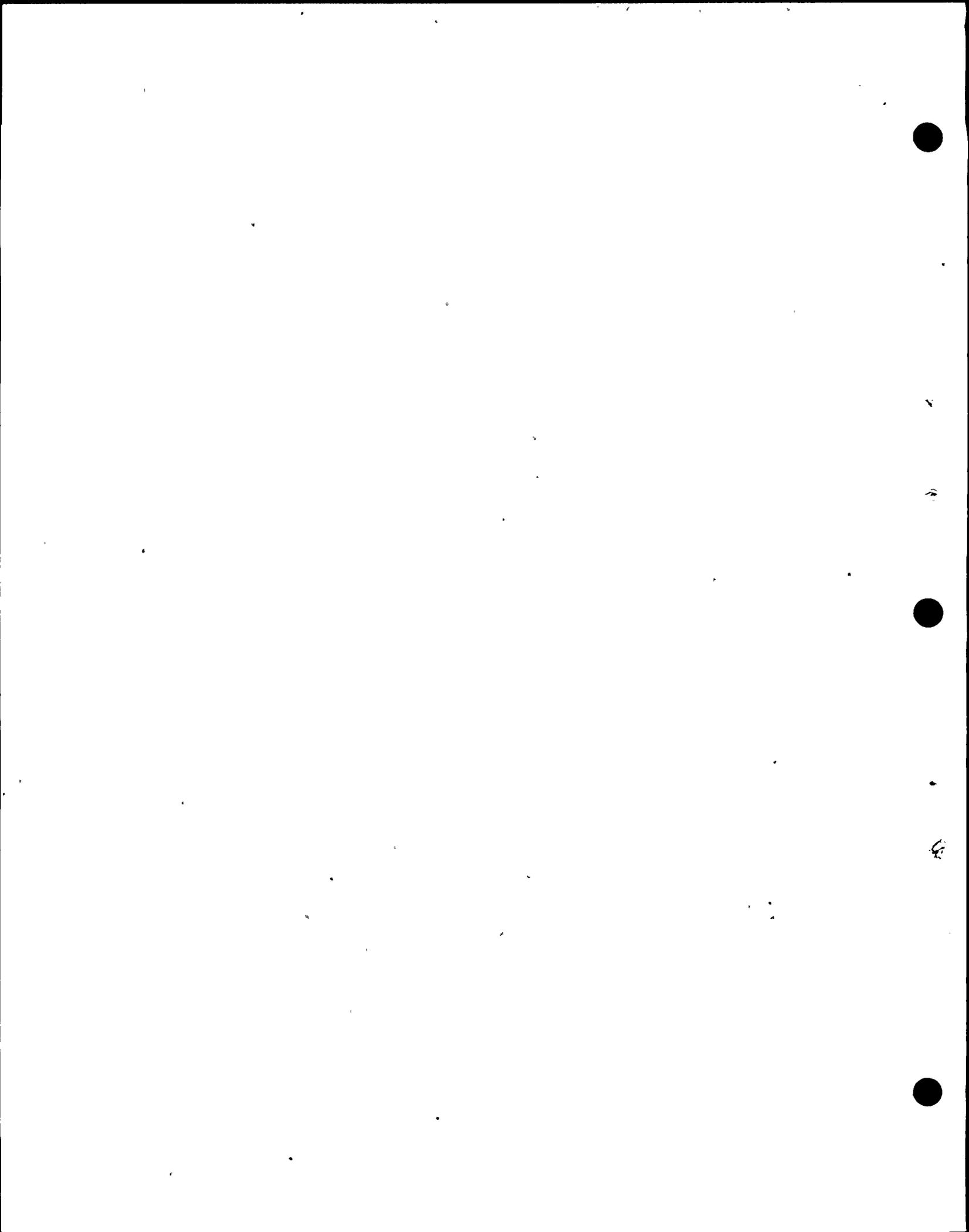
3 Now, in my direct written testimony presented
4 here I guess it's nearly two months ago, I showed several
5 slides from one of our exhibits representing tests that had
6 been made on concrete shear walls by the Portland Cement
7 Association. And that was just an example selected to best
8 represent the conditions at the Diablo Canyon plant, where
9 we have concrete shear walls.

10 Those data show very clearly that at the yield
11 point of the reinforcing bars, at, or near or close to the
12 yield point, damping values obtained under very closely
13 controlled laboratory conditions, were in the order of 7, 8,
14 9 and 10 percent of critical, with absolutely no radiation
15 back into the soil. It was designed such that that could
16 not happen.

17 Other tests made in New Zealand and at U.C.
18 Berkeley show the same type of results.

19 The other ACRS consultants, and the ACRS members
20 themselves, apparently were quite satisfied with the findings,
21 but apparently it did not take with Dr. Luco and Dr. Trifunac,
22 who were still worried about it.

23 MR. FLEISCHAKER: I'd like to object to that, on
24 the basis that the ACRS deliberations are not to be gotten
25 into, and that the decision of the ACRS is contained in this



wel 7

1 letter and it speaks for itself.

2 I'd like to request that that last sentence be
3 struck.

4 MR. NORTON: No objection to striking the last
5 sentence.

6 MRS. BOWERS: The last sentence will be stricken.

7 WITNESS BLUME: Now, Table 3 on page 48 of my
8 direct testimony -- and I'll turn to it merely for reference
9 here -- is a table showing damping values obtained in various
10 structures, in various models, in various reactors, and in
11 some bridge piers. There were two columns: One for
12 microlevels of stress and strain, and one for levels of
13 stress and strain in the region of the yield point.

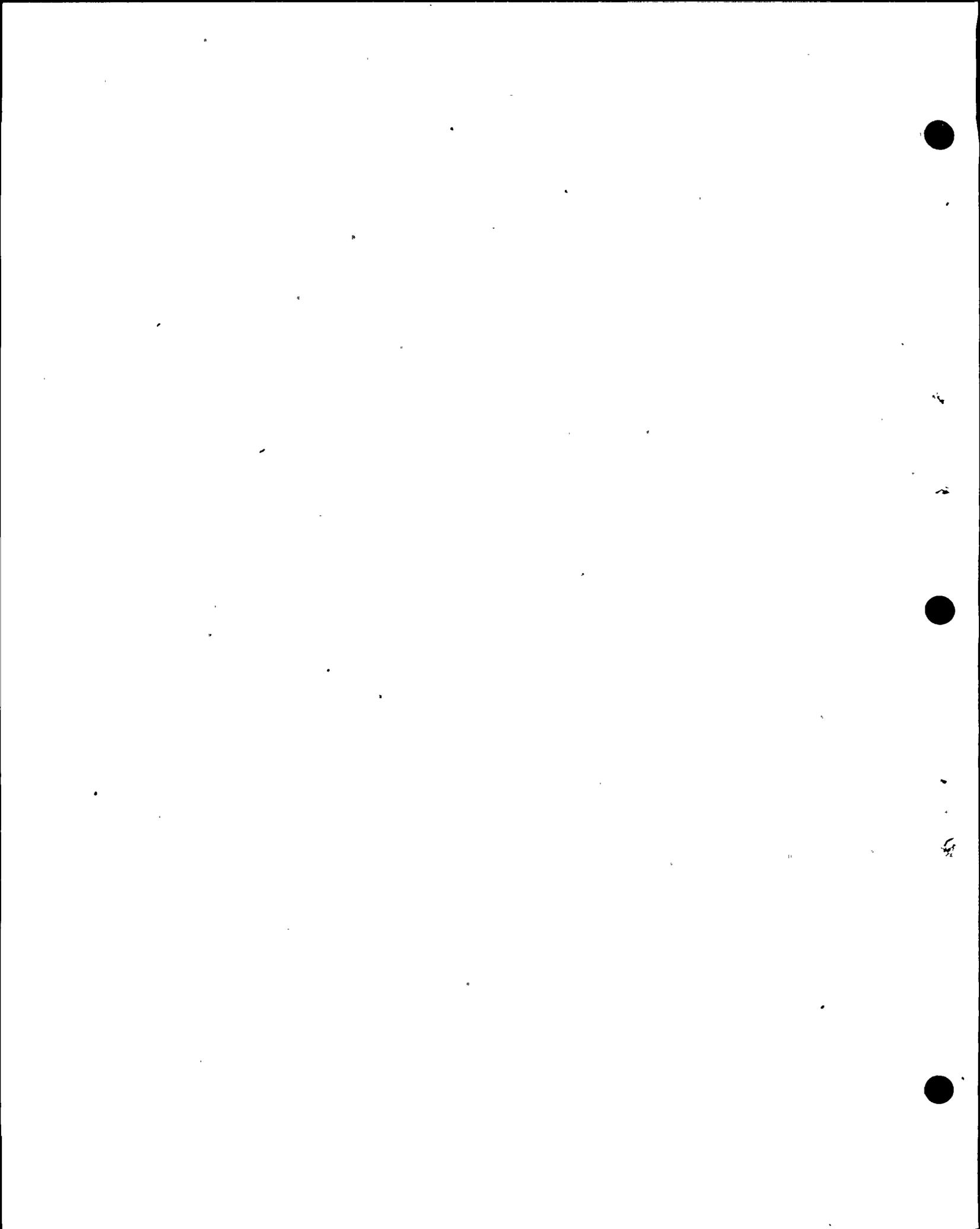
14 I should emphasize at this point that under the
15 extreme Hosgri loading at the plant, stresses are allowed to
16 go up to a yield point, but not exceed it.

17 The values shown in that table in the lower
18 right-hand column -- you don't have to turn to it necessarily,
19 but I'll read some of them -- and these are all cases where
20 radiation damping is either eliminated or greatly curtailed:

21 7 percent, 10 percent, 8 percent, 7 to 10 percent,
22 and up to 9 percent.

23 All of these are at or above the 7 percent in
24 Reg. Guide 1.61 and is used for Diablo Canyon.

25 BY MR. NORTON:



wel 8

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Q Dr. Blume, let me ask you this:

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In your review of the Trifunac and Luco testimony and submittals, did you find any place in there at all, whatsoever, where they disputed the results of the Portland Cement Association shear wall test on the damping?

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A I found one place, I believe, under Dr. Luco's testimony where he sort of admitted that they were reasonable tests without radiation damping. But in other parts of his testimony, and I think --

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Q Excuse me. The question was: Did you find any place where they disputed the results of that testimony?

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A Yes, by inference, at least.

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Q Is there anyplace in there where they were asked about the results of the Portland Cement Association data? Were they ever asked the question, or did they ever specifically discuss it, other than by implication, saying there was no data? Did they specifically address that data?

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A In one place I believe Dr. Luco did refer to some wall tests by PCA.

17

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Q And did he dispute the results or not?

19

A Not at that point, but he did elsewhere.

20

Q And how was that?

21

A In saying that 7 percent was too high a value to use for Diablo Canyon.

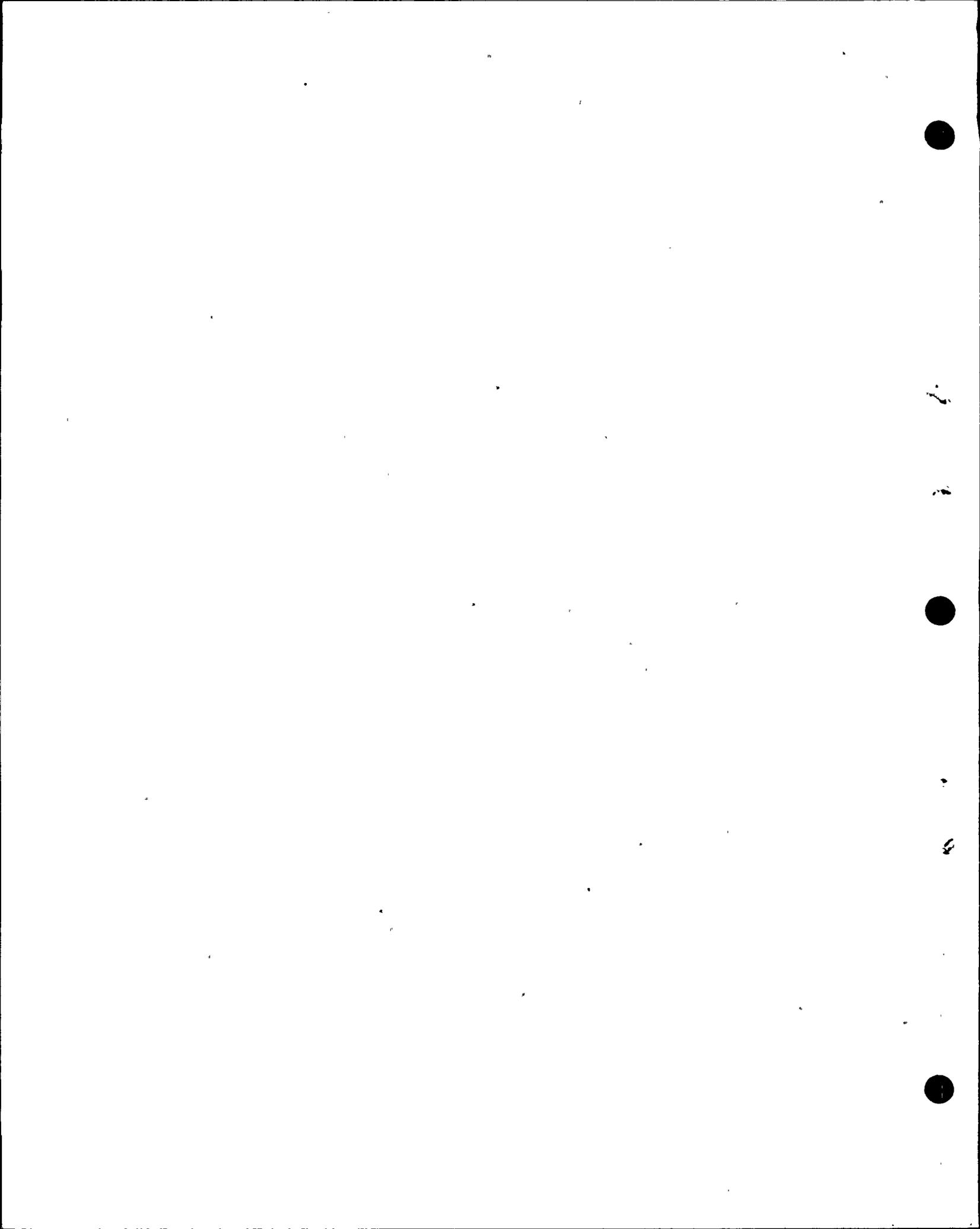
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Q But he was not referring to the Portland Cement

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wel 9 1 Association test, he was just saying that as a general
2 proposition, is that correct?

3 A That's correct.

4 Q All right.

5 A Now, my feeling is that the 7 percent is not
6 only a valid number for extreme stress, but it could have
7 been higher. It could have been 8, 9 or 10 percent at the
8 yield point. And also we have an added bonus in radiation
9 damping which is given no credit at all.

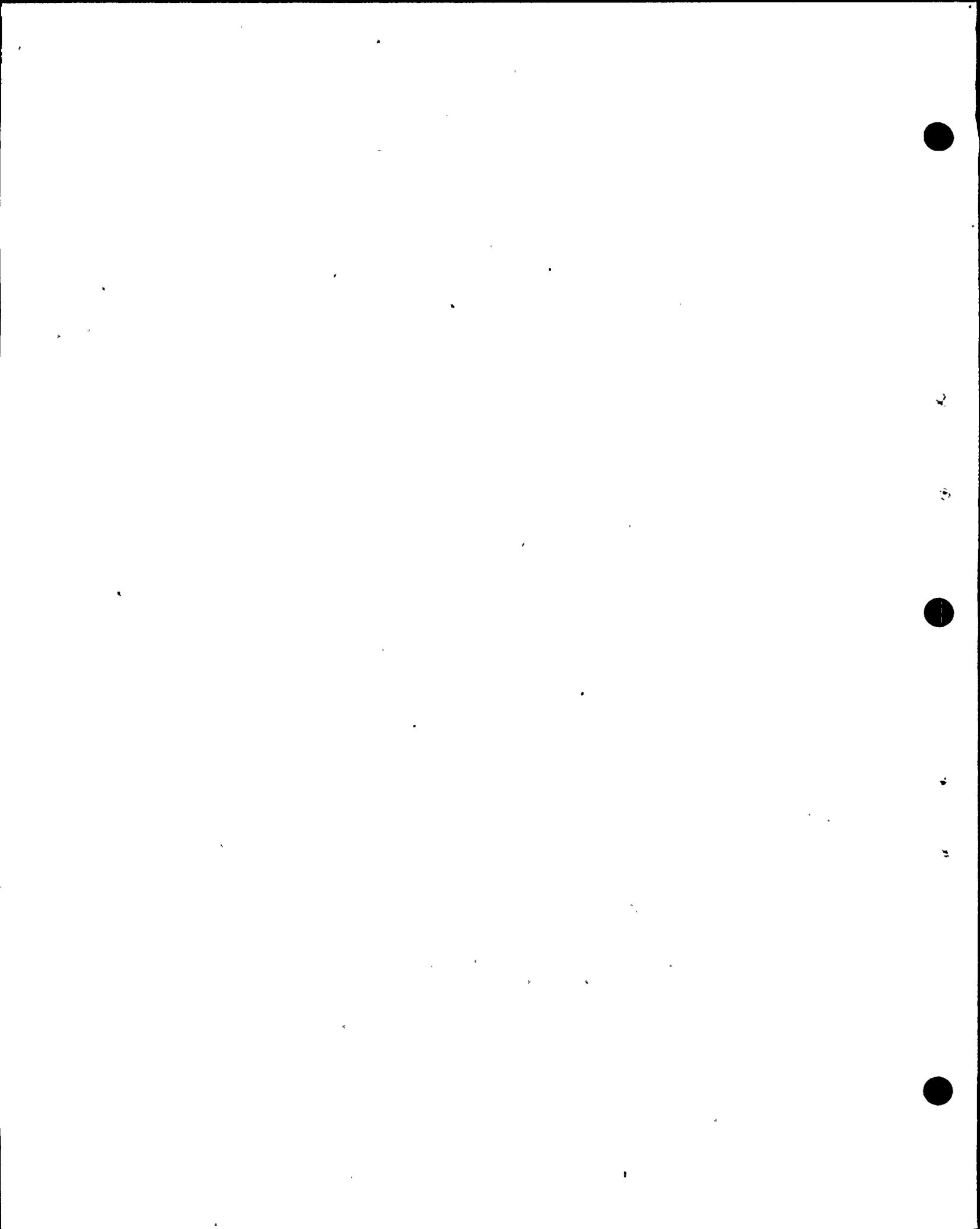
10 So the net result of using 7 percent is
11 extremely conservative for such an extreme earthquake.

12 Q Thank you, Dr. Blume.

13 I think now we'll move into the last subject
14 area, which is the so-called tau effect. And if I can lay
15 the framework for this testimony, it was my understanding
16 of Dr. Trifunac and Dr. Luco's testimony that they felt
17 that the reduction of .75 g to levels between .54 g on up
18 into the .64-.65 g range, as a result of tau, were unwarranted
19 and there was no basis for that due to the site specifics
20 of the Diablo Canyon site.

21 MR. FLEISCHAKER: Excuse me. I think the .50 --
22 one of the spectra was .50 for Newmark, not for this panel,
23 for Newmark.

24 MR. NORTON: Well, I don't know that it makes
25 a great deal of difference if it's .50 or .54, so we will



wel 10

7 use the .50. I'm not sure that anything was designed to .50
2 as opposed to .54, but we'll use .50 for the purposes of
3 this question. I don't mean to quibble about four one-
4 hundredths of a percent.

5 BY MR. NORTON:

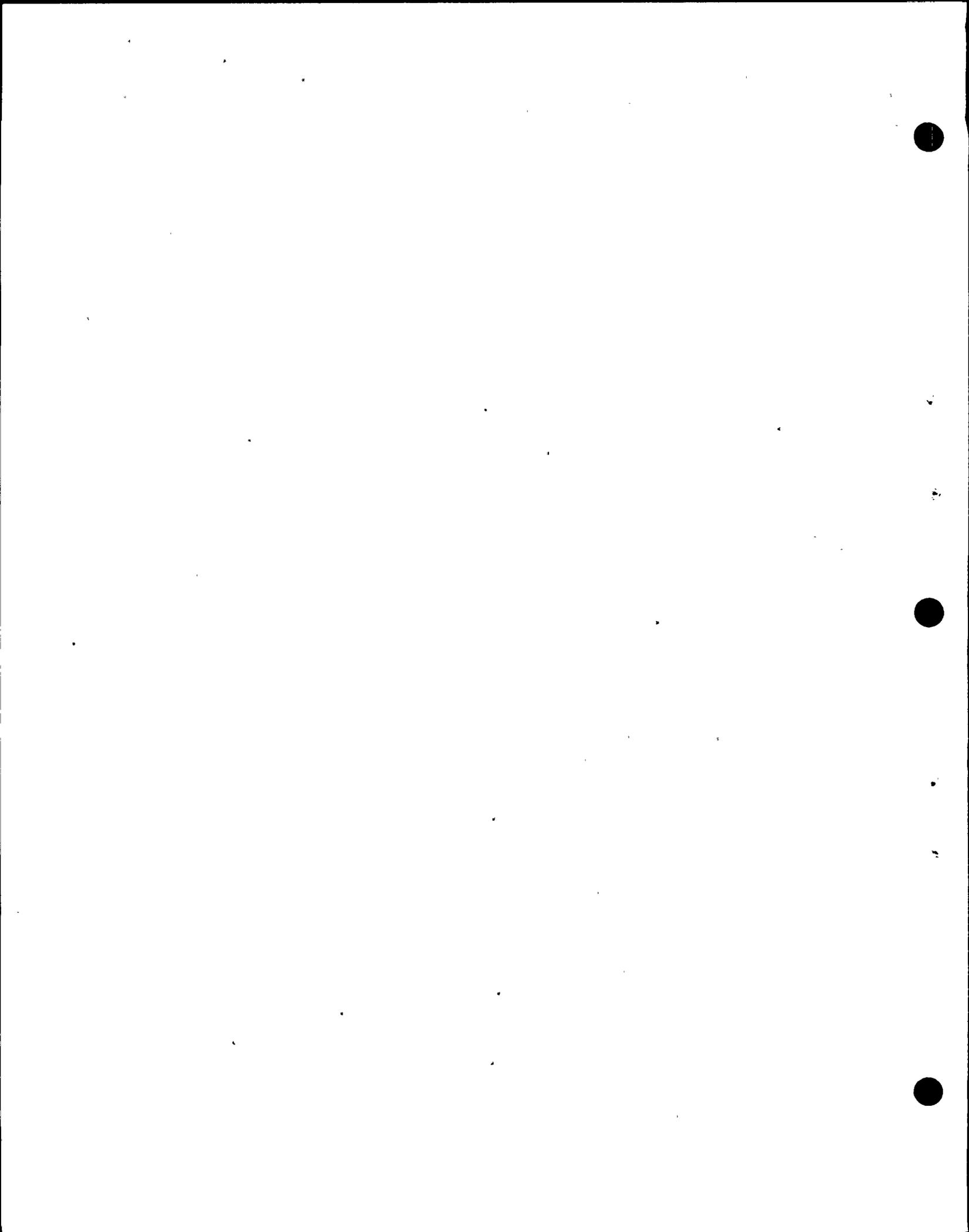
6 Q First, Dr. Blume, I would like you to describe
7 very briefly, if you would, the basis, in your opinion, for
8 the reduction of the response spectra from .75 down to the
9 levels from .50 on back up to .75, depending on which
10 structure we're talking about -- the so-called tau effect.

11 A (Witness Blume) Yes. There are various
12 mitigating effects of large foundations on earthquake
13 intensity or earthquake shaking. This has been known
14 generally in the field of earthquake experts for a long,
15 long, time. It is nothing brand new.

16 Generally, the results have been obtained by
17 observation of what has happened and what has not happened,
18 especially to very large structures.

19 I testified prior in this hearing that the very
20 large buildings in San Francisco suffered very minor damage
21 in most cases, and we attribute part of this to beneficial
22 soil-structure effects with so-called tau effects, which
23 is a fairly new term.

24 I also made reference to the analogy between ships
25 at sea and small boats, where the small boats bob around and



wel 11

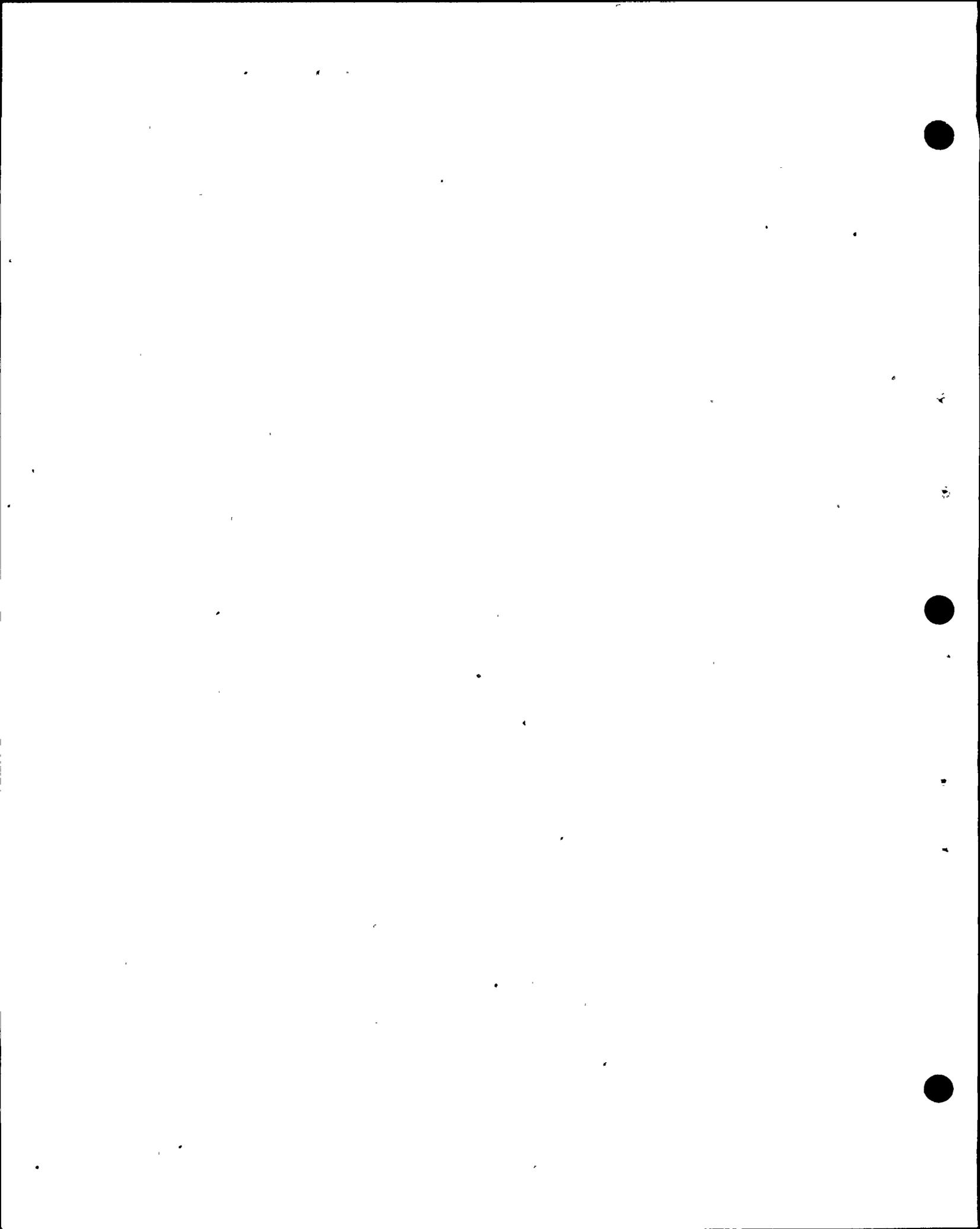
1 feel the motion a lot more than a large ship.

2 There are various ways that engineers could go
3 about tackling this problem. One simple way, and one way
4 that has been used pretty much in the past, is to simply
5 reduce the whole response spectrum to some reasonable value
6 that will account for such things.

7 Another way is to merely reduce the high-frequency
8 portion of the spectrum in some relationship to the geometry
9 of the foundations, the wavelengths and the various
10 assumptions, such as that the waves may be harmonic sinusoidal
11 type motion of a more or less steady-state condition.

12 A third way is to allow for the complexity of
13 the wave pattern, complexity of the soil and rock layering,
14 and cracks, and whatever, that may be present in most
15 foundation sites, to allow for the multitude of incident
16 angles of approach of the waves to the foundation, not only
17 in the azimuthal sense, but also in vertical angles, and to
18 allow for the chaotic type of motion that is not harmonic
19 at all except perhaps at the very start of the earthquake.
20 But when we get into the damaging portions, the motion is
21 chaotic which, in my terminology, is far from sinusoidal.
22 It means it's quite random in nature.

23 Now, the method that was selected in our case
24 was more or less the second method, where we made some
25 assumptions about the smooth waves and foundation size, and



wel 12

1 so on, and went through some calculations and came up with
2 certain reductions in the high-frequency range.

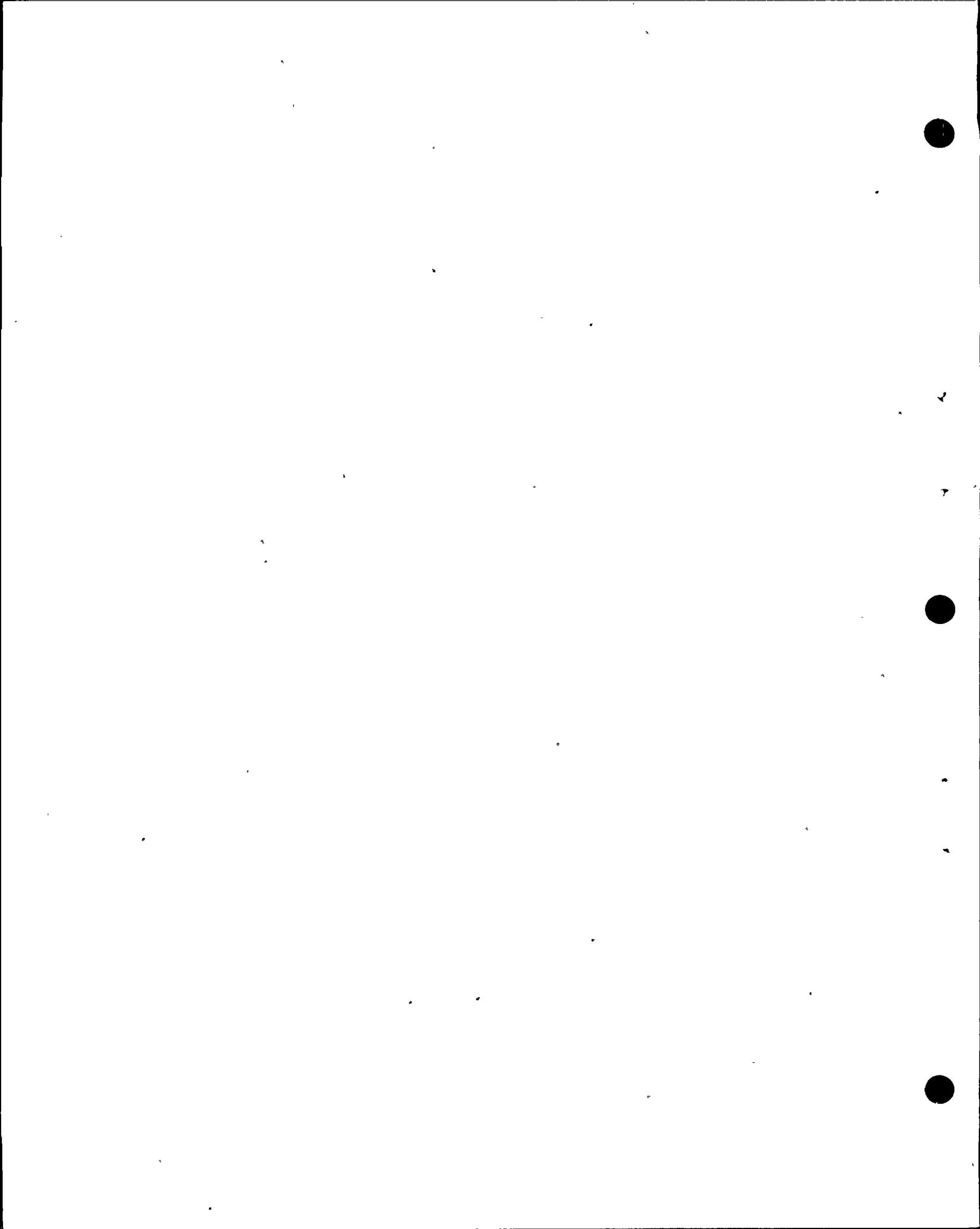
3 The method that is proposed by Drs. Trifunac and
4 Luco is what I would call a fourth method; namely, a rigorous
5 mathematical treatment of the whole subject. And I consider
6 this to be something that is in the research stage, and
7 that even though there are some efforts being conducted
8 along these lines, they have a long way to go to be proven
9 and polished, and that the logical procedure is to do as
10 either Dr. Newmark did, or as we did, which are two
11 independent methods, to make reductions in the high-frequency
12 range.

13 When we did this so-called tau reduction, we
14 were conservative. We determined an equivalent length of
15 foundation, as compared to the length of the earth's waves,
16 by taking the square root of the area of the foundation.

17 For example, if the area of the foundation
18 happened to be 100, we would say the length would be 10, and
19 so on. This was one way of treating circular foundations
20 and rectangular foundations.

21 We completely neglected two mitigating factors
22 that would have reduced the effects even further.

23 One is the fact that these foundations are
24 contiguous, and they are very large, massive foundations,
25 very close to each other. There are just minor separations



wel 13 1

between them. And these separations are filled with certain types of inelastic material.

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If we had taken the entire area of the plant, as was considered very seriously at one time, we would have had far greater reductions from the so-called effect. We chose not to do this in order to be on the conservative side.

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The other thing that we neglected was embedment.

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There is pretty fair embedment with most of these structures, especially the containment and the auxiliary structures. And theoretically we should have made some allowances for the mitigating effects of embedment also. We did not.

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So the results as finally applied -- and we had to use either the Newmark results or our results, whichever governed, whichever created the greater structure -- these results I consider as reasonable, useful and conservative, and I would put the methodology in the category of an engineering equivalent loading such as is used all over the world in all branches of engineering, to use equivalent loads, such as the wind force on a building is so many pounds per square foot, the live load on the floor is so many pounds a square foot, and so on and so forth.

22

There's nothing new about this type of procedure.

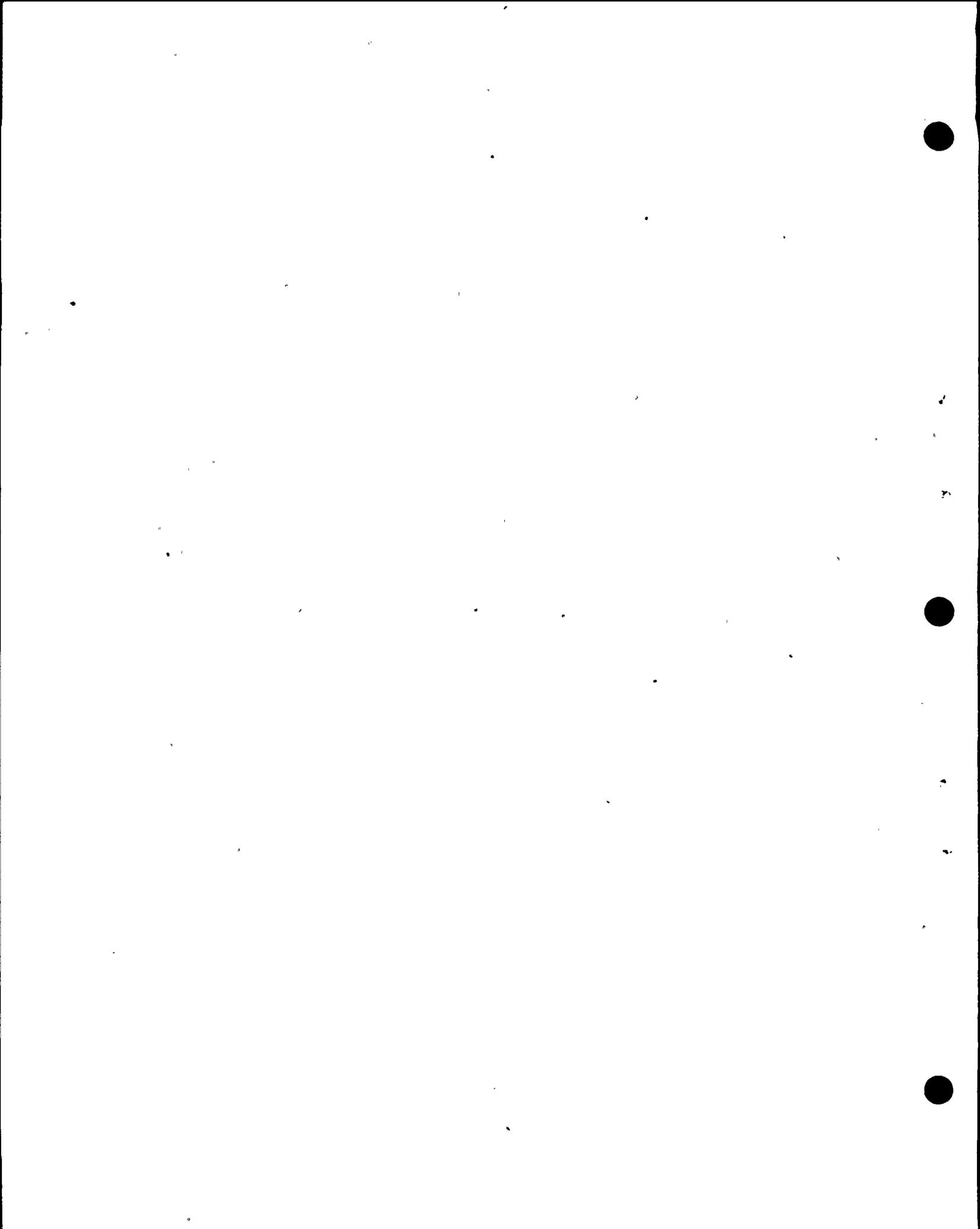
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Q Thank you, Dr. Blume.

24

25

I'd like to turn now to, I guess, Dr. Frazier, and then Dr. Seed, on the same tau question.



wel 14

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Dr. Frazier, your name was used a number of times by Dr. Luco, as you will recall, having sat here, as stating that you had done a study which showed that all of the waves-- or that the waves arriving at the foundation of the containment, and so on, would be vertical waves. And I believe Dr. Luco stated that he didn't believe in tau, because:

7

(a) the waves would be vertical;

3

(b) there was a rocky site and there would be, therefore, a homogenous soil as the waves came up through that rocky site, and that there would be no tau effects because of the site conditions, and the vertical waves seemed to play a very important part in his explanation of that.

13

Did you, in fact, review the comments he made about what your study supposedly showed?

15

A (Witness Frazier) Yes.

16

Q All right. And are you in agreement with the comments that he made about the study, or the conclusions he drew from the study as respect tau?

19

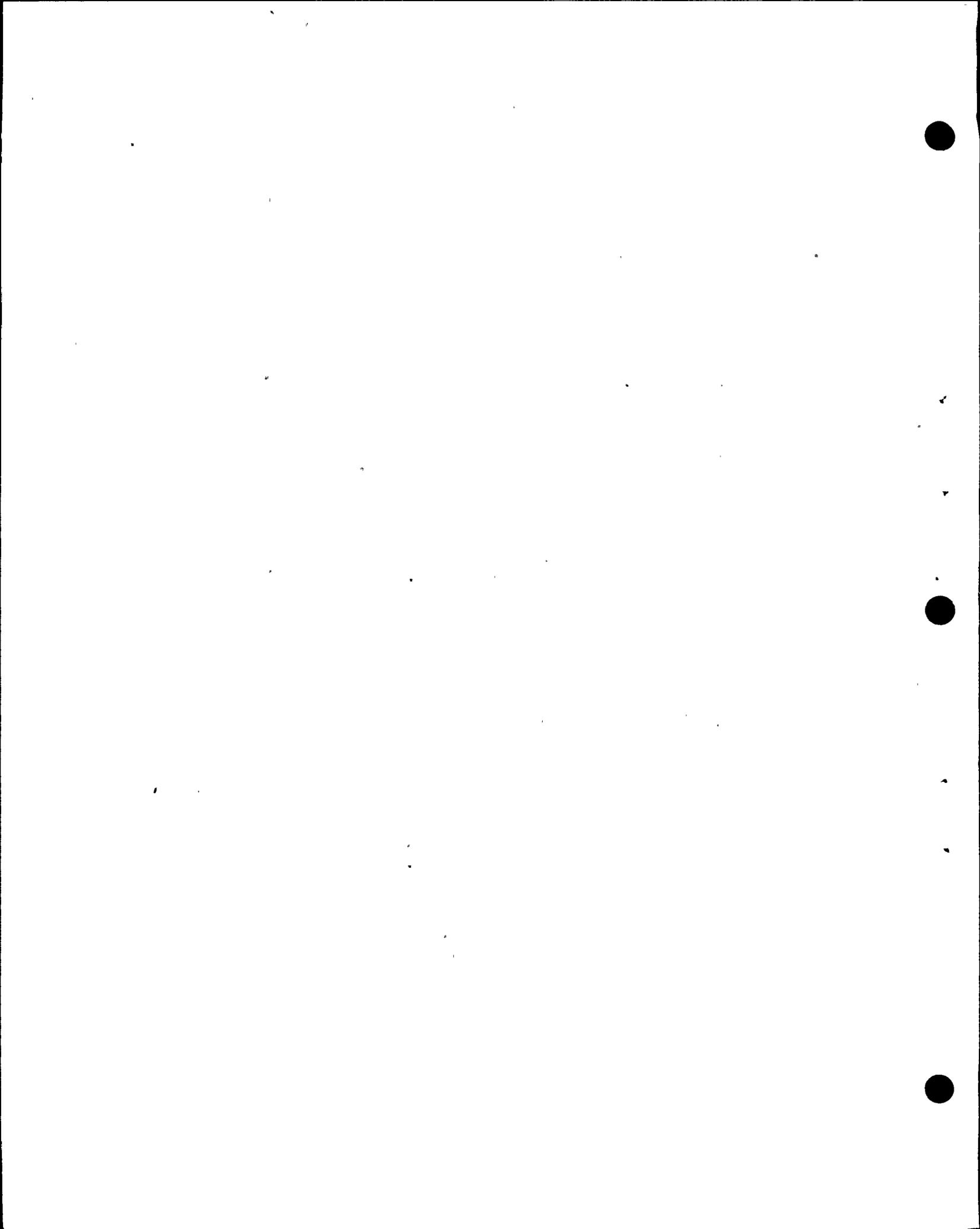
A Dr. Luco actually made two different types of comments.

21

At some times, particularly early on in the hearings, he used the words "vertically emerging," and I think you objected, and then I think he was more careful in the use of the word.

25

So I have mixed feelings about the way I was



wel 15 :

quoted.

2 Q And then that was changed to "almost vertical?"

3 A Yes.

4 Q All right.

5 Would you, then, describe the results of your
6 study as you feel your study?

7 A Yes.

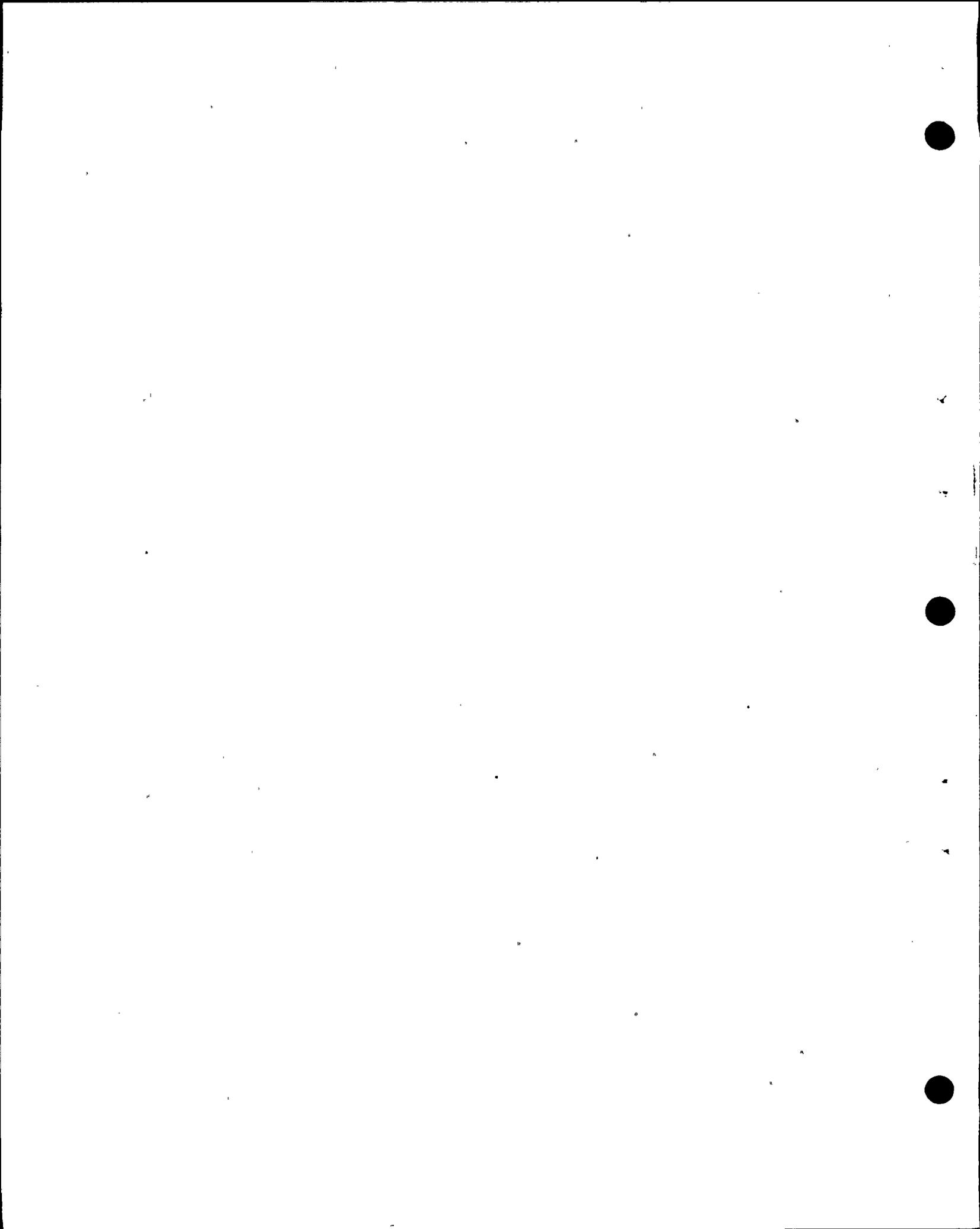
8 We undertook a project to answer a question that
9 had never been asked before. It had never been -- it had
10 been asked before, it had never been dealt with before. So
11 I want to put it into context.

12 It is definitely a research project, and the
13 question we were attempting to answer is:

14 For earthquakes at various distances and various
15 depths, under various geologic conditions, which way would
16 the waves be coming in? What type of waves would be coming
17 in at a structure, and what direction would they come from --
18 or from which they would come.

19 The results of the study -- we used a very
20 sophisticated theoretical procedure to deal with this kind
21 of question, and the results of the study basically indicate
22 that all types of waves come from all types of directions.

23 It was very interesting, and somewhat of a
24 surprise to me, to find that for frequencies greater than
25 2 hertz -- which I'll refer to as high frequencies -- for



wel 16 1

2 frequencies greater than 2 hertz, the majority of the waves
3 come in at angles steeper than 45 degrees. I call that
4 steeply emerging waves.

5 Now, Dr. Seed has been telling engineers that
6 for as long as I've known Dr. Seed, since I've been a
7 graduate student. And I've always been skeptical.

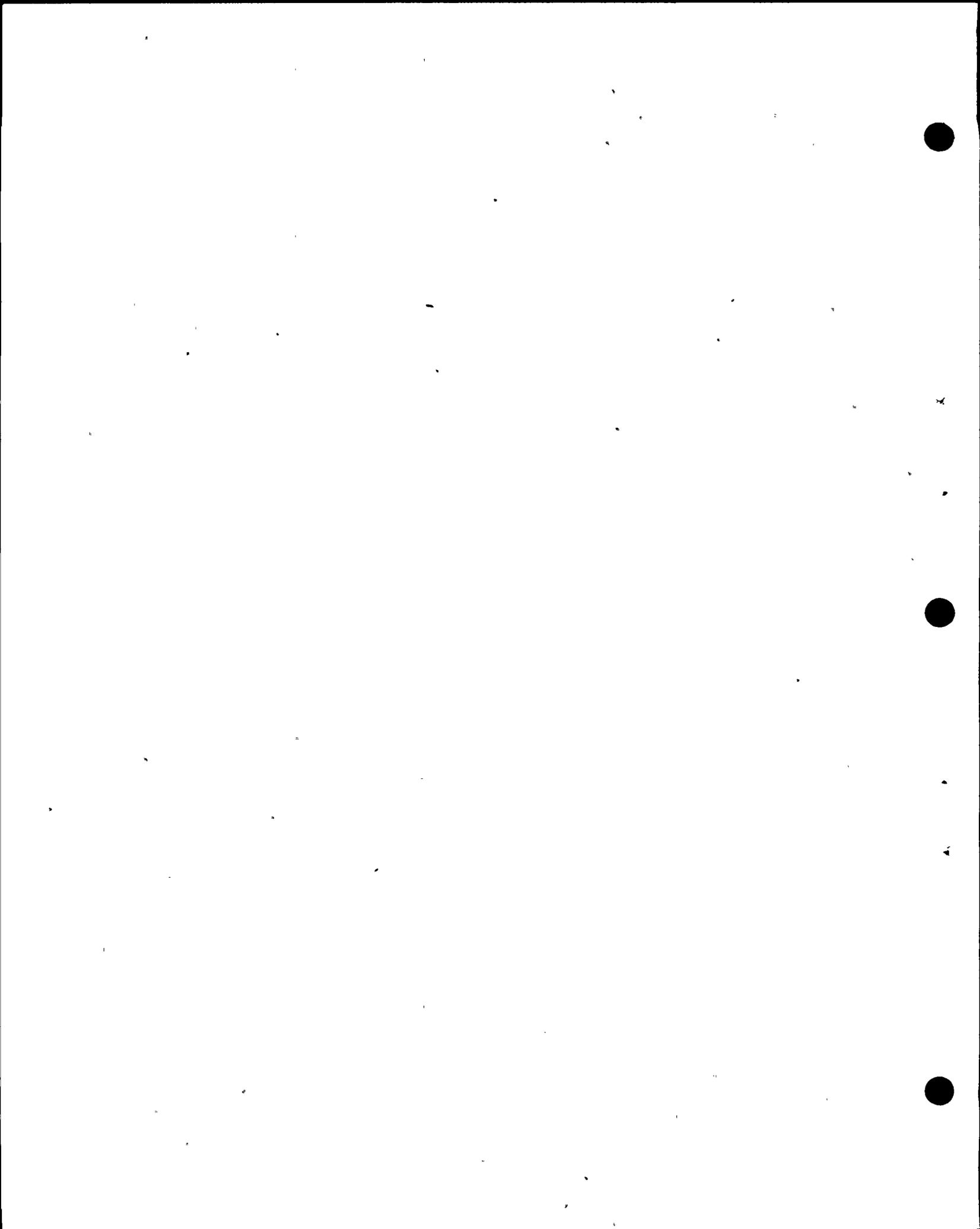
8 I'm much less skeptical now, that waves, indeed,
9 do come in fairly steep -- the high-frequency waves.

10 Now, the reason for this is fairly simple:

11 High-frequency waves that try to reach a structure
12 running horizontally, what happens to these waves is that
13 they must travel in shallow regions of the earth -- that is,
14 shallow meaning less than, say, 1 kilometer.

15 Well, the attenuation properties of shallow layers
16 in the earth are so severe that a 10-hertz signal can be --
17 the amplitude of a 10-hertz signal can be cut by -- can be
18 reduced by factors much greater than 2 or 3 in very short
19 distances, like a kilometer. In fact, you can get factors
20 of 10 reduction in a kilometer, of those high-frequency
21 waves.

22 The shallow regions of the earth just aren't
23 capable of carrying those waves very well, and so what the
24 waves do is they seem to dive down deep and travel fairly
25 efficiently where the material is more competent and able
to carry these high-frequency waves, and come up fairly



wel 17

1 steeply at the site.

2 Now, that was the basic conclusion of the work
3 that we did, or the basic results that we got.

4 Let me put that into some findings we had.

5 First of all, two findings are contrary to Luco's
6 understanding of the study:

7 One is that -- we did studies varying the
8 distance to the earthquake, and varying the depth of the
9 earthquake. What we found was that more distant earthquakes
10 are just as -- they satisfy the same rule, that the waves
11 come in steeply. In fact, they're slightly more in that
12 direction; the farther away the earthquake, the more steeply
13 they come in.

14 Now, that bears on the Hollywood Storage question.
15 When Dr. Luco was referring to the Hollywood Storage
16 situation in which there was a record in the basement of
17 the structure and one out in the parking lot, and they,
18 indeed, did measure different things; namely, the one in
19 the base of the structure was considerably less, he said,
20 well, that was a very distant earthquake.

21 Well, the distant earthquake, from my study,
22 would indicate that the waves would actually be coming
23 in slightly steeper than a close-in earthquake, because
24 that's the only way those high frequencies can get there,
25 is go down there where there's an efficient travel path to



wel 13

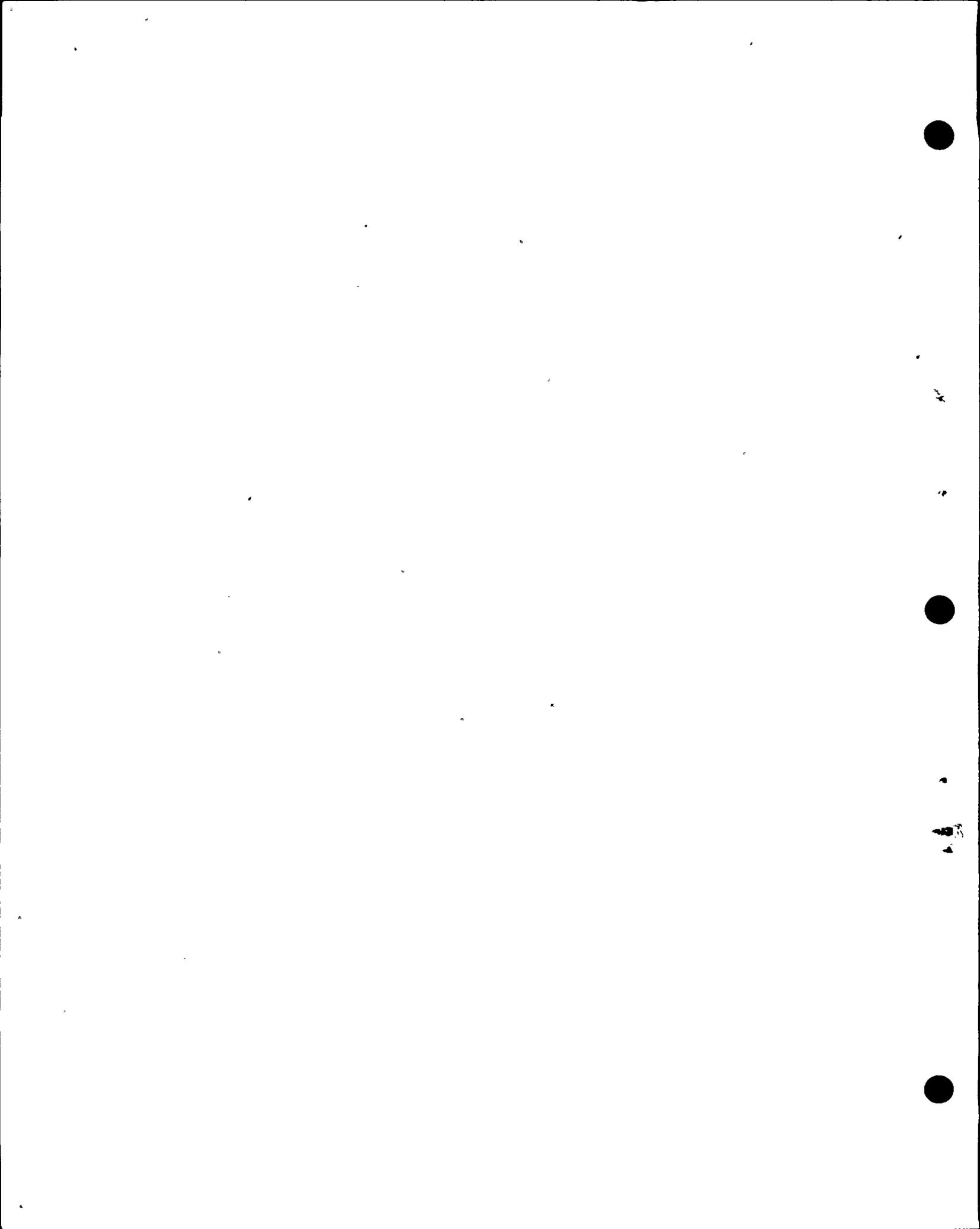
1 get there, and then come up fairly steeply.

2 The second thing that the results indicate that
3 is a little contrary -- I guess I don't need the word "little"
4 is contrary, the inferences of the testimony is that if you
5 had soft soil underneath the structure, things would be
6 different.

7 Well, the study indicates that if you had soft
8 soil underneath the structure, the waves would actually be
9 coming in steeper, not shallower.

10 We've done some studies in which the upper layers
11 were changed, the wave speeds were changed. And, indeed,
12 in these cases, they come in steeper.

13 Now, to put this into context, this study that
14 was done, first of all, I've already said it's the first
15 study of its kind ever done. I'm very proud of the study.
16 It is a theoretical study. We have horizontal--ideally
17 homogeneous horizontal layers in the earth. The real earth
18 doesn't look like that. The real earth has a lot of
19 heterogeneities in the earth. That is, geologic layers don't
20 cooperate with us theoreticians and lay themselves down
21 horizontally. Rather, we do the historical perspective
22 of how they were actually laid in there, and particularly
23 near faults, where they tend to be bending and folded. And
24 it's generally quite a mess down there for the theoretician
25 to have to deal with.



wel 19

1 And this was an idealized horizontal layered
2 system.

3 I think the study is indicative of the gross
4 direction the waves come from, fairly steeply, and I think
5 that the heterogeneities in the earth would tend to alter
6 the results from our theoretical analysis.

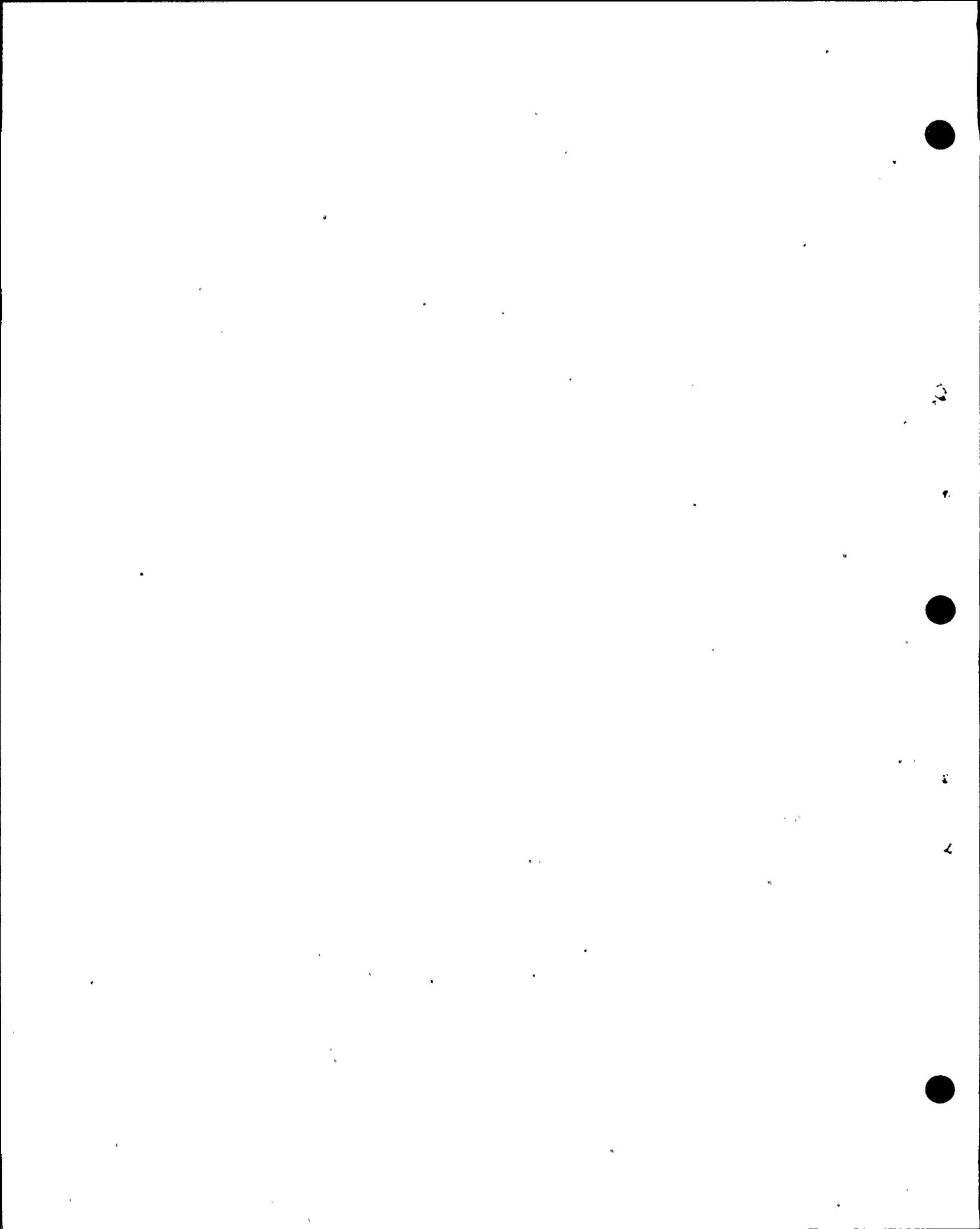
7 The way in which it would alter it is scatter
8 the waves. It's like trying to look through a piece of
9 glass, and you've got particles in the glass, and objects
10 tend to look like they're in places where they're really
11 not coming from.

12 So what would happen due to the heterogeneities
13 in the earth, I think the waves would come in at all kinds
14 of directions, and arrive at different times and from
15 different directions. It would make the thing much more
16 complicated.

17 Now, let me carry that just a little bit further.
18 That is where I think the theoretical analysis is limited.

19 When I was a graduate student, I was involved in
20 attempting to measure -- instrument an earth dam, and do
21 theoretical calculations to explain motions of an earth
22 dam due to seismic excitation.

23 As part of the project, I stationed instruments
24 along the base of a very large earth dam -- it's the Fort
25 Peck Dam in northern Montana -- and I spaced these



wel 20

1 instruments at about 1000 feet apart. And, naive as I was,
2 I thought I would take the data from those records and feed
3 it into this big dam, and calculate all of the results of
4 the dam. And when I started recording ground motions, I
5 found that at 1000 feet apart, these instruments were not
6 measuring the same thing, and I could not find a way to use
7 a simple wave mechanics explanation for how to explain the
8 motions at the base of the dam.

9 So, out of frustration, I spaced instruments at
10 50 feet spacing, and repeated the experiment, thinking that,
11 gee, if I can understand at 50 feet spacing some direction
12 of arrival of these waves, or something of this type, then
13 I could maybe get a better handle on what the overall
14 motions coming in at the base of this dam were.

15 And what I found when I spaced the instruments
16 at 50 feet was that, indeed, even at 50 feet I was unable --
17 I could lay the traces on top of each other, and I could
18 see similarities, particularly at very low frequencies. But
19 when I got up into the higher frequencies of interest for
20 the dam, I found that I could not explain the behavior of
21 the recorded data in terms of simple wave mechanics.

Madelon Els22

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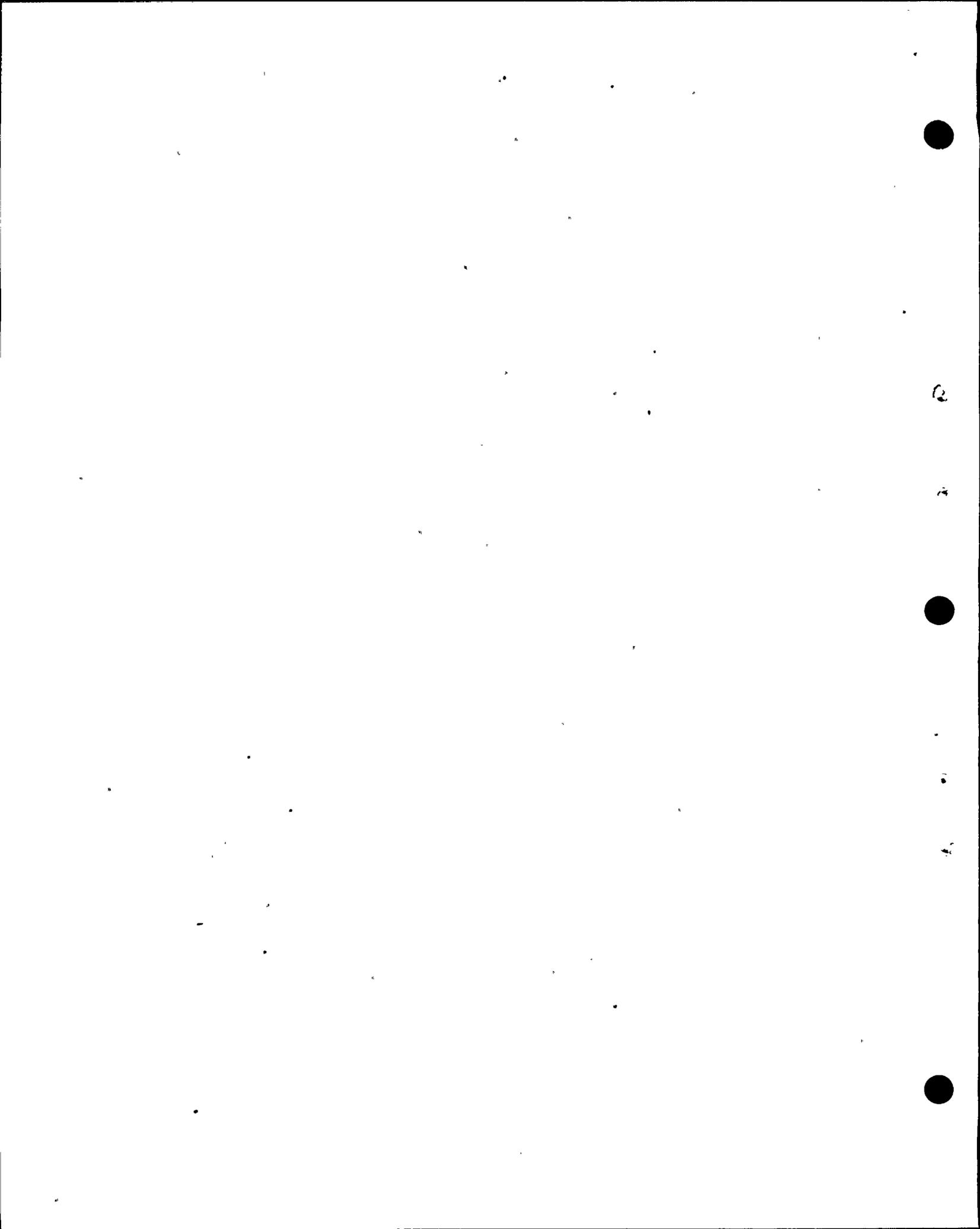


3 Madelon
15 WEL
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1 That is to say that there was a lot of hetero-
2 geneity involved in the process of the waves getting into
3 my recording devices, and it was messing up my experiment.
4 It was being very uncooperative. And as I've been familiar
5 with other data, I've seen this happen many times. And I
6 think that other people on the panel here have seen this
7 behavior many times, particularly in my consulting work with
8 what was then the Atomic Energy Commission for buried nuclear
9 explosions, and I've continued that work and still work in
10 that area, discriminating between earthquakes and explosions.

11 One of the data bases that we use to discriminate
12 between earthquakes and explosions for the purposes of con-
13 firming or making policy on what the Soviets are shooting,
14 whether they are abiding by a treaty or not, is that we have
15 large seismic arrays. And one of these seismic arrays is in
16 Northern Montana. It's called the LASA ray. And another one
17 is in Norway.

18 And there are literally hundreds of instruments
19 in these arrays. And what we do is from a distant earthquake
20 or distant explosion the waves are coming in very steeply at
21 these arrays. And when I say steeply, the first several
22 seconds, sometimes minutes, of the wiggles that we record are
23 coming in at angles within 15 degrees of vertical, very steep.
24 That's what wave mechanics tells us, they're coming in within
25 15 degrees of vertical.



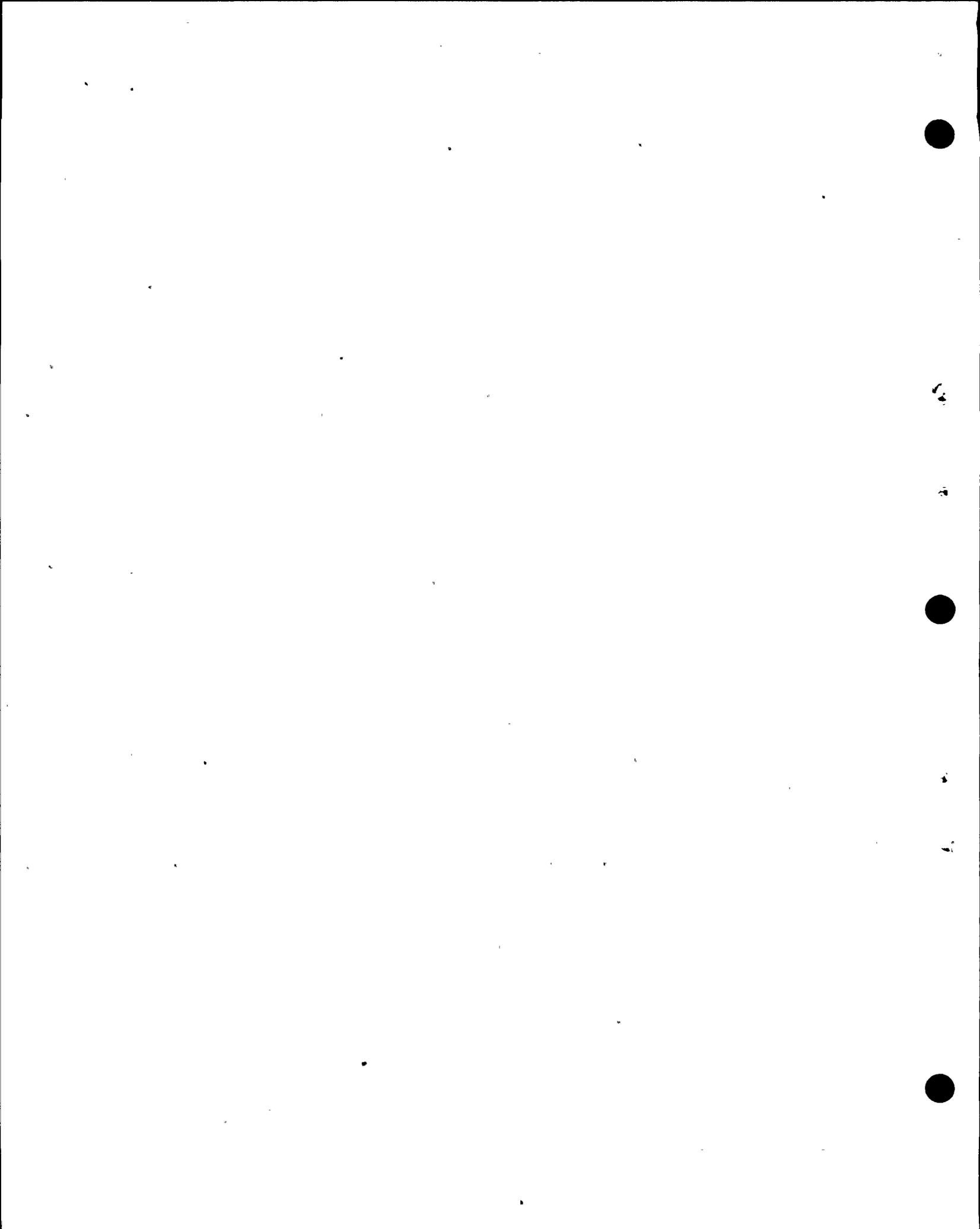
mpb2 1

2 Well, we can take these arrays and by proper
3 processing of the data we can beam form and tell exactly
4 where they were coming from and get better signal to noise
5 ratios out of it and then we do various things with it.
6 But the confounding thing about that data is that inevitably
7 adjacent instruments don't look as similar as the theory
8 tells us it should.

9 So what the policy on these arrays has been is
10 that we take a circle of instruments spaced around what we
11 call a station, and the circle of instruments involves maybe
12 ten or more instruments at various spacings. And we average
13 them, we just add them together and average them and say
14 well, that's kind of representative of what the station is.
15 And then several kilometers away, sometimes tens of kilometers
16 away, they have another station with several instruments and
17 they average those, trying to get some representative measure
18 of ground motion at these points.

19 So what I'm saying is that the localized measure-
20 ment of ground motion from point to point is not as simple
21 as wave mechanics tells us it is for homogeneous earth. And
22 it's been a confounding problem for us for some time. And
23 it's that phenomenon, that's one of the pieces that go into
24 our tau effect.

25 I think I'll stop there and say that that's my
experience with the data. And I could go further and describe



mpb3 1 how that gets into tau.

2 I think that Dr. Seed would be very appropriate
3 to carry that further.

4 Q I take it, then, from what you just testified,
5 that your results which said the waves will be coming in
6 very steeply or almost vertically, then you're really talk-
7 ing about waves that are less than 45 degrees to vertical?

8 A That's about all I can say. I can say that the
9 majority of the high frequency waves above two hertz from
10 my analysis -- and I think the analysis is credible in this
11 sense, even with the scattering -- I think the majority of
12 the high frequency waves are coming in steeper than 45 degrees.

13 Q Okay.

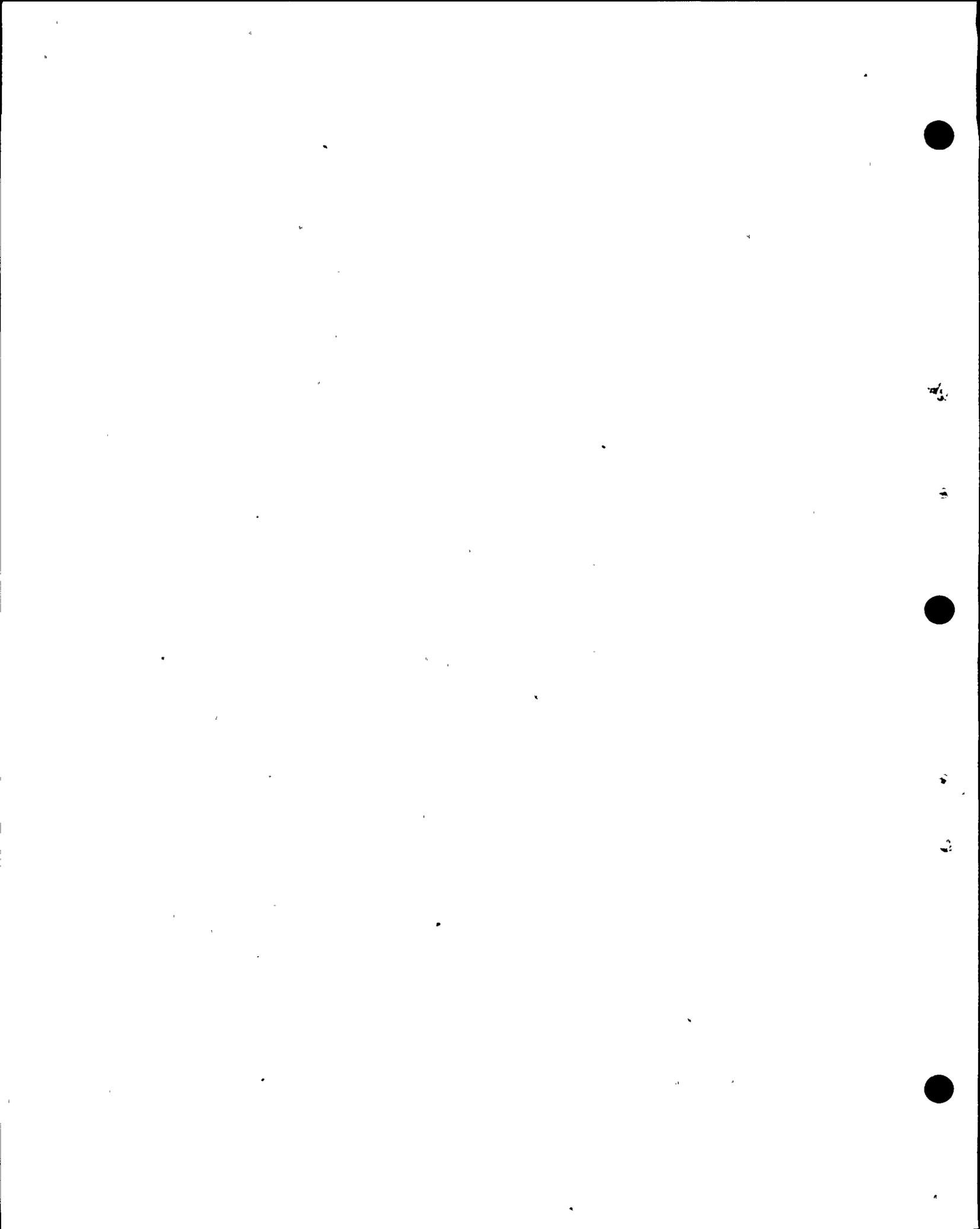
14 All right, Dr. Seed, we're going to talk about
15 LUSHs for a while now. But I guess we'd better explain right
16 off the bat what LUSH is.

17 We've heard the term PLUSH and we've heard the
18 term FLUSH, and that all stems, as I understand it, from the
19 term LUSH.

20 Could you tell us what LUSH stands for?

21 A (Witness Seed) Yes.

22 LUSH is a soil-structure interaction computer
23 program which has been widely used for studying the response
24 of structures like nuclear power plants and including nuclear
25 power plants to earthquake effects. LUSH is sort of a parent



mpb4

1 program which was developed about five years ago.

2 Since that time there have been improvements on
3 the program. And one of the more recent improvements is to
4 make the program probabilistic in form rather than determin-
5 istic, so we put a P in front of the LUSH and made it
6 probabilistic-LUSH, which gave us PLUSH.

7 And then a little bit later on we -- or a little
8 before that, in fact, we speeded up the program and made it
9 more efficient, so we call that fast-LUSH, which gave us
10 FLUSH.

11 We have another form which solves axis symmetric
12 problems, so we put A in front of the LUSH and call that
13 ALUSH.

14 And I suppose the word LUSH lends itself to a
15 lot of different acronyms that we might think of.

16 Q But in fact the letters -- L stands for Dr.
17 Lysmer, U stands for Udaka, who was here around the Harding-
18 Lawson panel, the Japanese gentleman who is a very good
19 ping-pong player.

20 A Yes.

21 LUSH really came from the first letters of the
22 authors of the program. We were Lysmer, Udaka, Seed, and
23 Hwang. And they just made a nice combination.

24 Q All right.

25 Now, your experience in soil-structure interaction



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mpb5 1 analysis, I'd like to talk about that a little bit.

2 About how many published papers have you written
3 on soil-structure interaction?

4 A Golly, that would be hard to say.

5 Let me say that I've published totally over 200
6 papers on various problems of soils and earthquakes and
7 structures. I would estimate -- and I must say this is
8 purely an estimate -- maybe about 30 of those are on soil-
9 structure interaction of some form. I couldn't vouch for
10 the 30.

11 Q And what is a state of the art reviewer or state
12 of the art speaker? Could you tell me what that means?

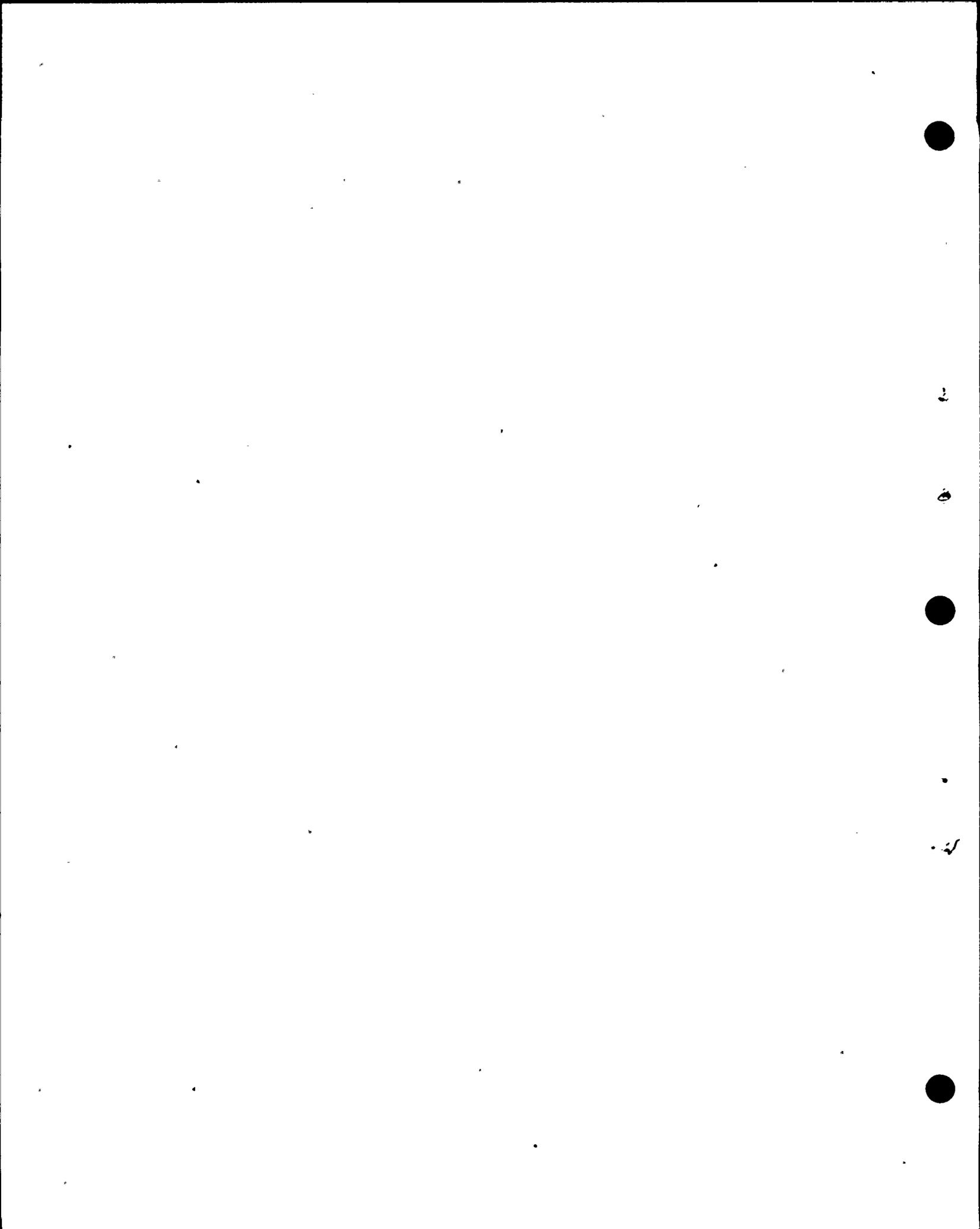
13 A Yes.

14 Very often at a major conference some person will
15 be invited to present an opening address on the state of
16 knowledge in a particular field.

17 Q And are those persons who are invited inexperienced
18 in the area, or are they generally considered the recognized
19 experts in the area?

20 A They are, I suppose -- I'm going to get trapped
21 here -- but I must say they are generally recognized experts
22 in the field.

23 Q And isn't it a fact that you were the state of
24 the art reviewer for the special ACRS meeting on soil-
25 structure interaction in 1975?



mpb6 1 A Yes, that is true.

2 Q And were you not the state of the art speaker
3 on soil-structure interaction at the 1973 ASCE speciality
4 conference on structural design of nuclear power plants?

5 A Yes.

6 Q And were you also the invited summarizer of the
7 session on soil-structure interaction at the 1975 ASCE
8 speciality conference on structural design of nuclear power
9 plants?

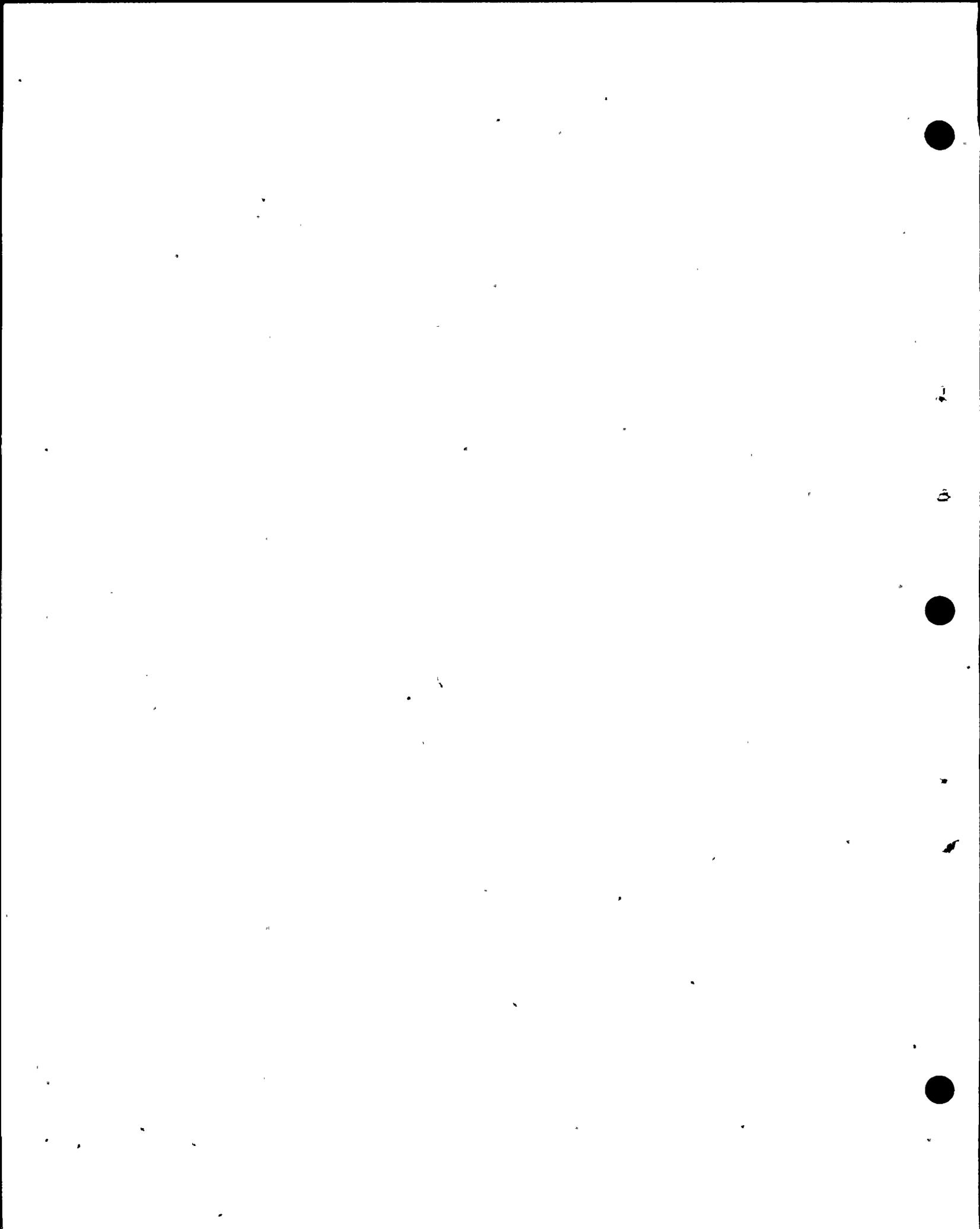
10 MR. FLEISCHAKER: Before we answer that, I have
11 an objection because this is not appropriate rebuttal.

12 Dr. Seed was qualified as an expert. His
13 curriculum vitae and resume are in the record, and nobody
14 here has challenged his credentials as an expert in the area
15 of soil-structure interaction.

16 MR. NORTON: Well, Mrs. Bowers, to the contrary,
17 Drs. Luco and Trifunac --- and particularly Dr. Luco, I should
18 say, I should limit that to him, has stated that Dr. Seed's
19 SSI does this and does that, and we're going to contest what
20 Dr. Luco said about that.

21 Dr. Seed is going to come up with some very
22 different statements about what his SSI at Diablo Canyon
23 shows. And I'm laying the foundation for this gentleman to
24 say this.

25 MR. FLEISCHAKER: That foundation has already



mpb7

1 been laid and it's in the record and his credentials have
2 been established. And it isn't appropriate to run through
3 Dr. Seed's credentials as an expert here on rebuttal testi-
4 mony.

5 I mean it's in the record, it hasn't been challeng-
6 ed. The record speaks for itself. And if Mr. Norton wants
7 to get to the substance of the rebuttal testimony, I have no
8 objection to that. But I have objections to further continued
9 examination of this witness's credentials. They're not
10 challenged.

11 MR. NORTON: Well, Mrs. Bowers, I think I have
12 the right whether he challenges the credentials or not. I
13 can understand why he wouldn't challenge the credentials.

14 I have a right, however, to show for the record
15 and for the Board that this man happens to have a peculiarly
16 specialized expertise in soil-structure interaction as it
17 relates to nuclear power plants. And that's what I'm doing.

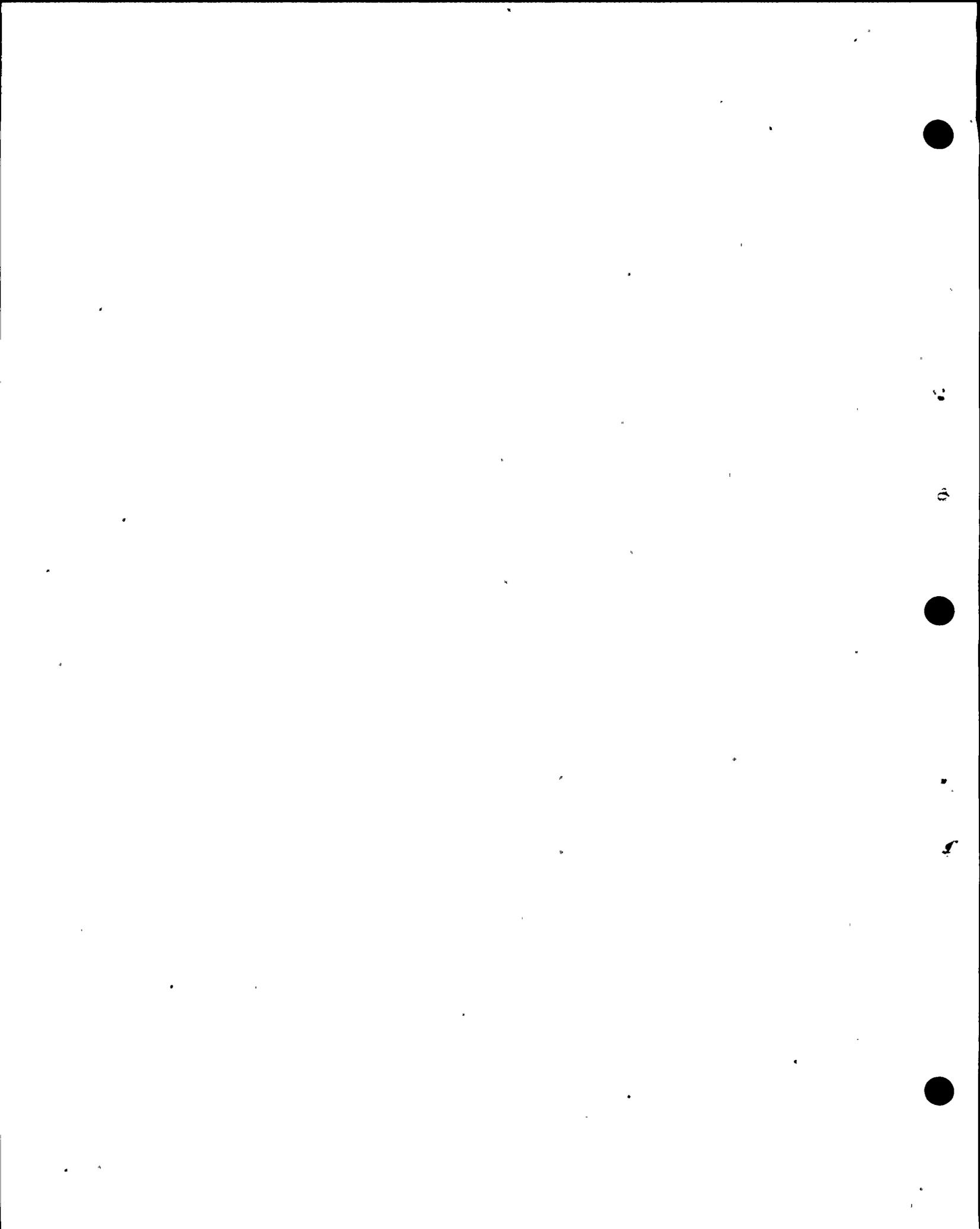
18 MRS. BOWERS: Well, we agree that you have a
19 right to pursue the special qualifications, and the objection
20 is overruled.

21 But aren't you about done?

22 MR. NORTON: Yes. I've got three more to go.

23 BY MR. NORTON:

24 Q Dr. Seed, were you not the state of the art speaker
25 on soil-structure interaction at the International Conference



mpb8 1 on Structural Mechanics In Reactor Design in 1977?

2 A Yes.

3 Q Were you not invited to present the special
4 seminar on soil-structure interaction effects on the design
5 of nuclear power plants at the Federal Institute of Technology
6 in Switzerland in 1978?

7 A Yes.

8 Q And, finally, were you not also invited to present
9 a special one day seminar on soil-structure interaction on
10 the design of nuclear power plants by the Licensing Authority
11 of West Germany in 1978?

12 A Yes.

13 Q In how many nuclear power plants has LUSii or
14 a permeation of that program been used in soil-structure
15 interaction analysis?

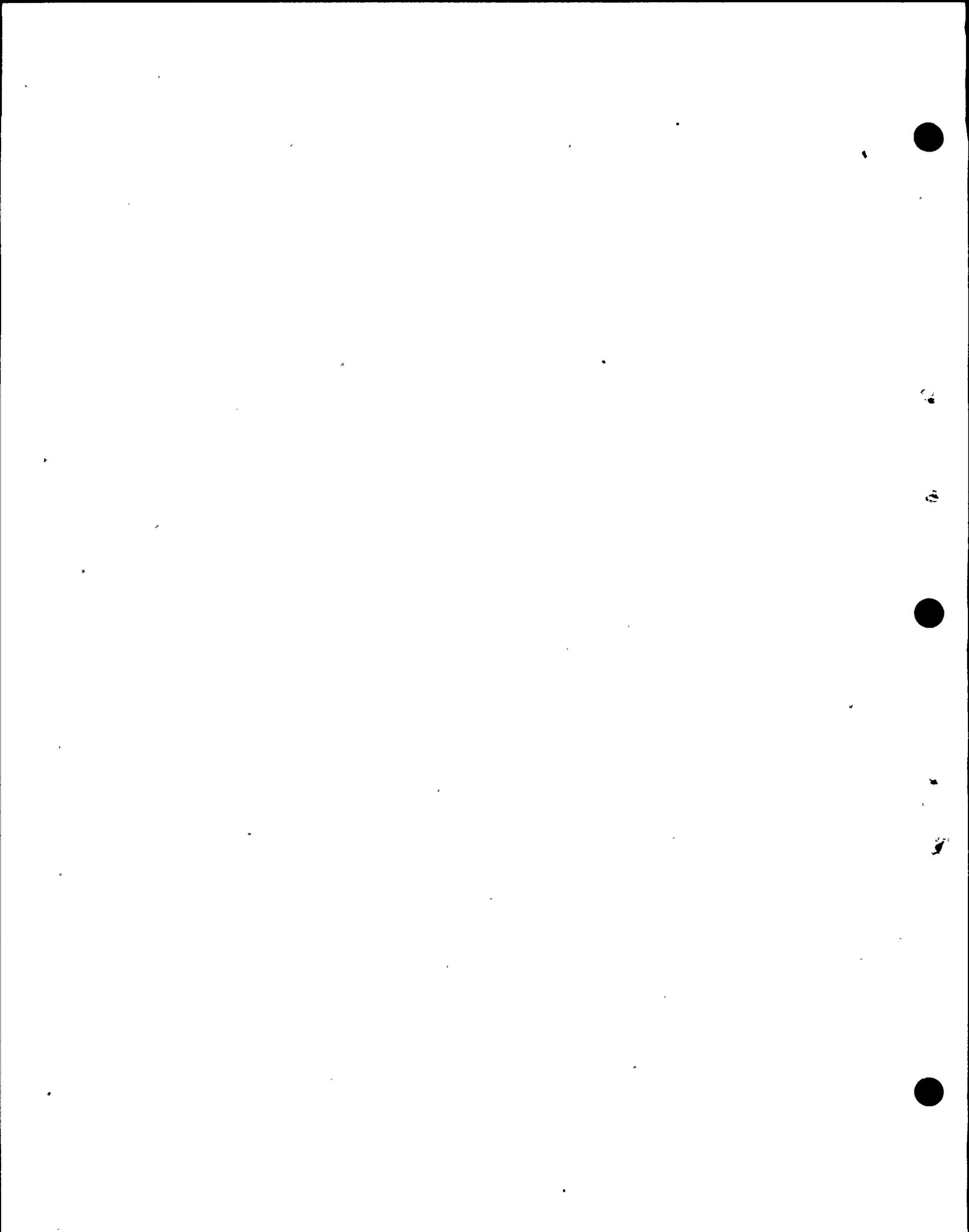
16 A Oh, golly, it would be hard to tell. There
17 probably are about 3- or 400 copies of the program that have
18 been sold to companies in this field of activity throughout
19 the world, and how often they apply the program and how
20 many plants each one designed, and whether some of them use
21 it or don't use it, I wouldn't know.

22 Q All right.

23 A I would just say many.

24 Q All right.

25 Now, you heard -- well, let me ask this question



mpb9 1 first:

2 When you talk about a significant impact of
3 soil-structure interaction analysis, what kind of percents
4 are you talking about where it's significant in the language
5 of the art?

6 A Oh, soil-structure interaction in some cases,
7 in some forms can affect the results by several hundreds of
8 percent.

9 Q And you would call that significant?

10 A I would call that very significant.

11 Q All right.

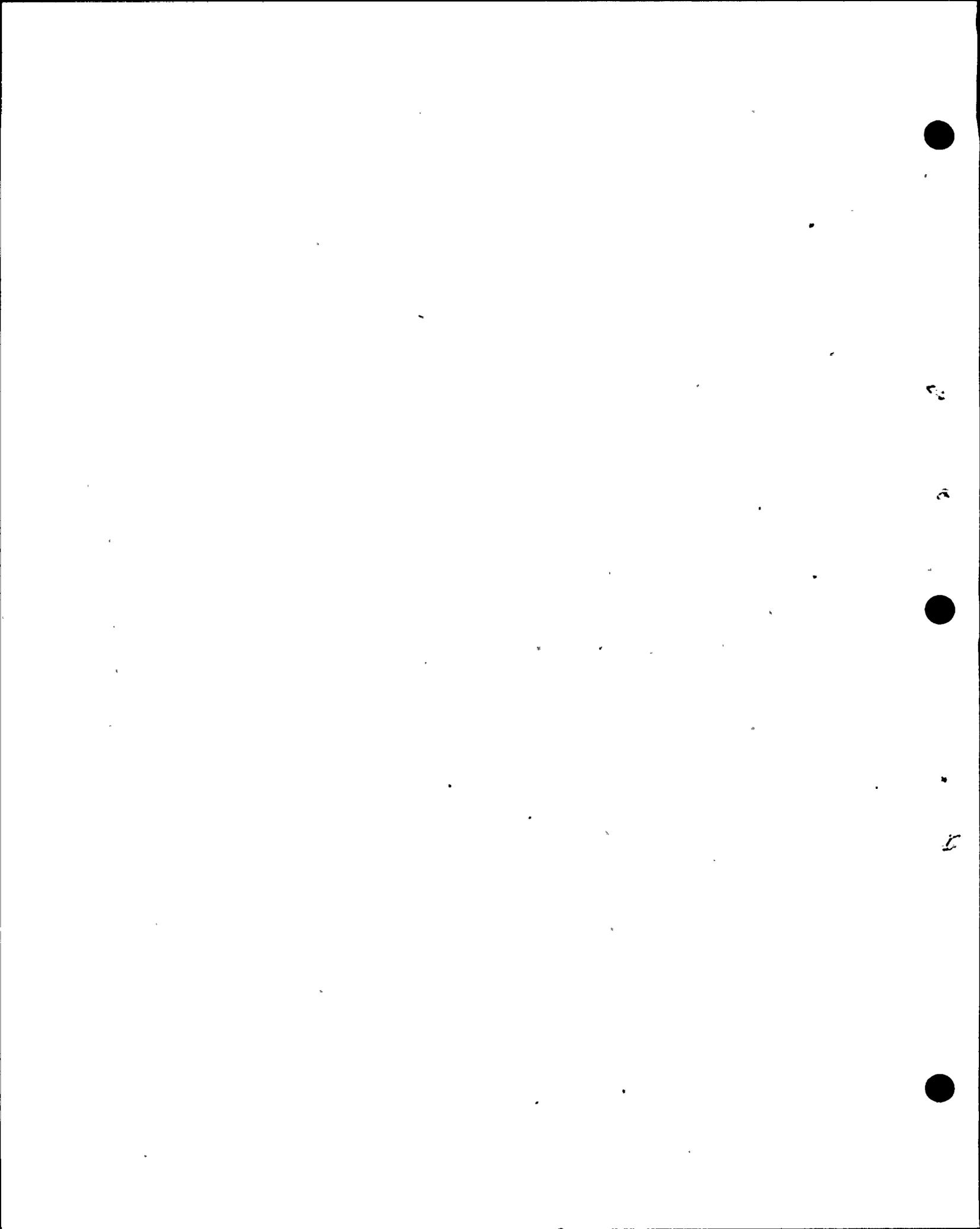
12 If you did a study on something and it came out,
13 let's say it showed 30 percent, would you call that a signifi-
14 cant soil-structure interaction analysis?

15 A I would call that a small effect, as these things
16 go.

17 A very significant -- well, it depends. Signifi-
18 cant depends on the context in which you are doing something.

19 Q All right.

20 And so if you did a soil-structure interaction
21 analysis on something and someone else had done a fixed base
22 analysis study on it to come up with an acceleration, and you
23 came up with, say, a number that was 20 percent different,
24 would you call that a significant difference, or would you
25 say that's a small minor difference?



mpb10 1 A Well, if that matter was determining the differ-
2 ence between getting a license or not getting a license, I
3 would call that extremely significant.

4 Q And in this particular case ---

5 MR. FLEISCHAKER: You're getting all the answers
6 you want, Bruce.

7 MR. NORTON: Yes, I am, Mr. Fleischaker. Please
8 quit laughing and bear with us.

9 BY MR. NORTON:

10 Q And in this particular case, Dr. Seed, you did
11 an SSI on Diablo Canyon and compared it to Dr. Blume's fixed
12 base analysis, did you not?

13 A (Witness Seed) Yes.

14 Q And what did you label the results in that case?
15 When you said the effects of soil-structure interaction
16 analysis, what words did you use?

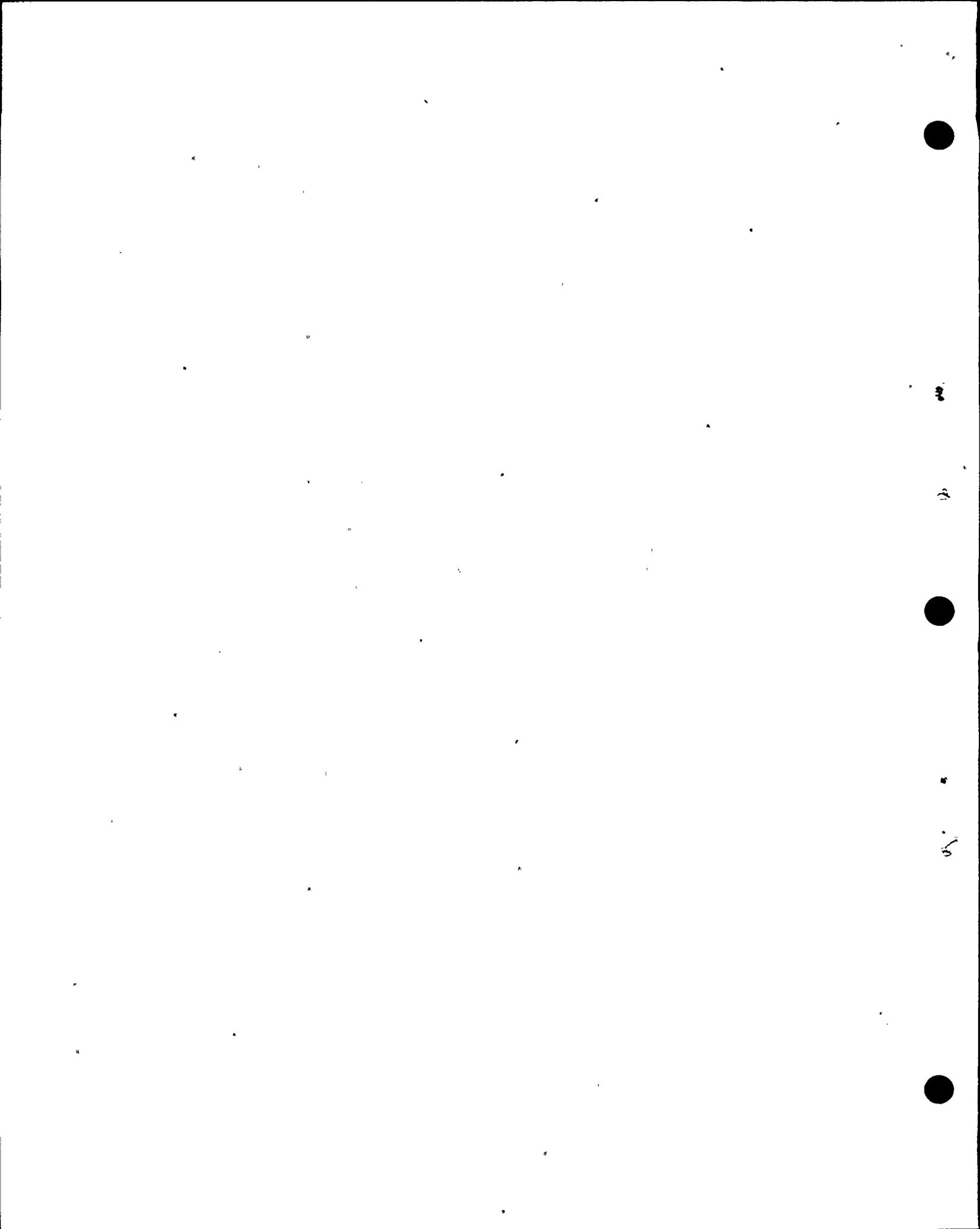
17 A I said the effects were very small.

18 Q And when you said the effects were very small,
19 did you actually determine a percentage at that time in your
20 own mind?

21 A Yes. They were of the order of 20, 30 percent in
22 some frequency ranges.

23 Q 20 to 30 percent and you labeled those as quite
24 small?

25 A - Yes.



mpb11 1

Q All right.

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And you read Dr. Trifunac's testimony -- I guess you read it because you weren't here -- you read his testimony where he stated that your studies showed that the effects of soil-structure interaction analysis at Diablo Canyon show that there were none, is that correct?

A He didn't quite use those words. He implied it.

Q Do you recall the words that he used? Very little, would those be the words?

A No significant soil-structure effect is what he said.

Q All right.

Now, would you correlate "no significant" with "small", which are the words you used? Would you -- correlate isn't the word -- but compare?

A Yes.

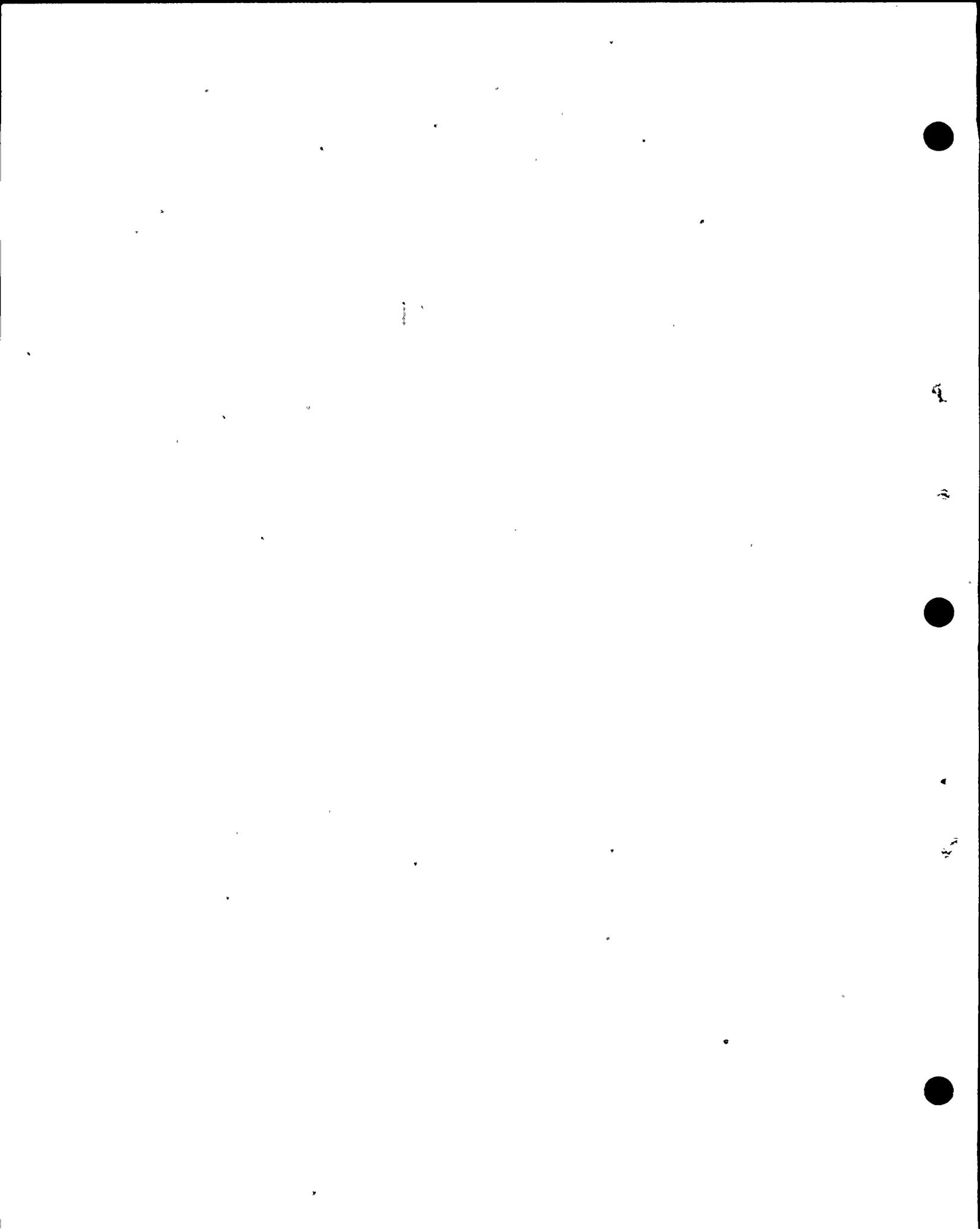
Can I read a few words that I wrote about this so that I can put this in my own words --

Q Certainly.

A -- and try to explain what is involved here?

Q Certainly.

A On the question of the tau effect I would like to note that Dr. Luco correctly states in his testimony -- and this is on pages 8878 to 8880 -- that there are three factors which in general will tend to make the motions



mpbl2 1 developed in the foundations of the structure less than those
2 developed in the free field. He identifies these as first,
3 soil-structure interaction effects, secondly, wave scattering
4 effects, thirdly, the effects of horizontal components of the
5 incoming seismic waves.

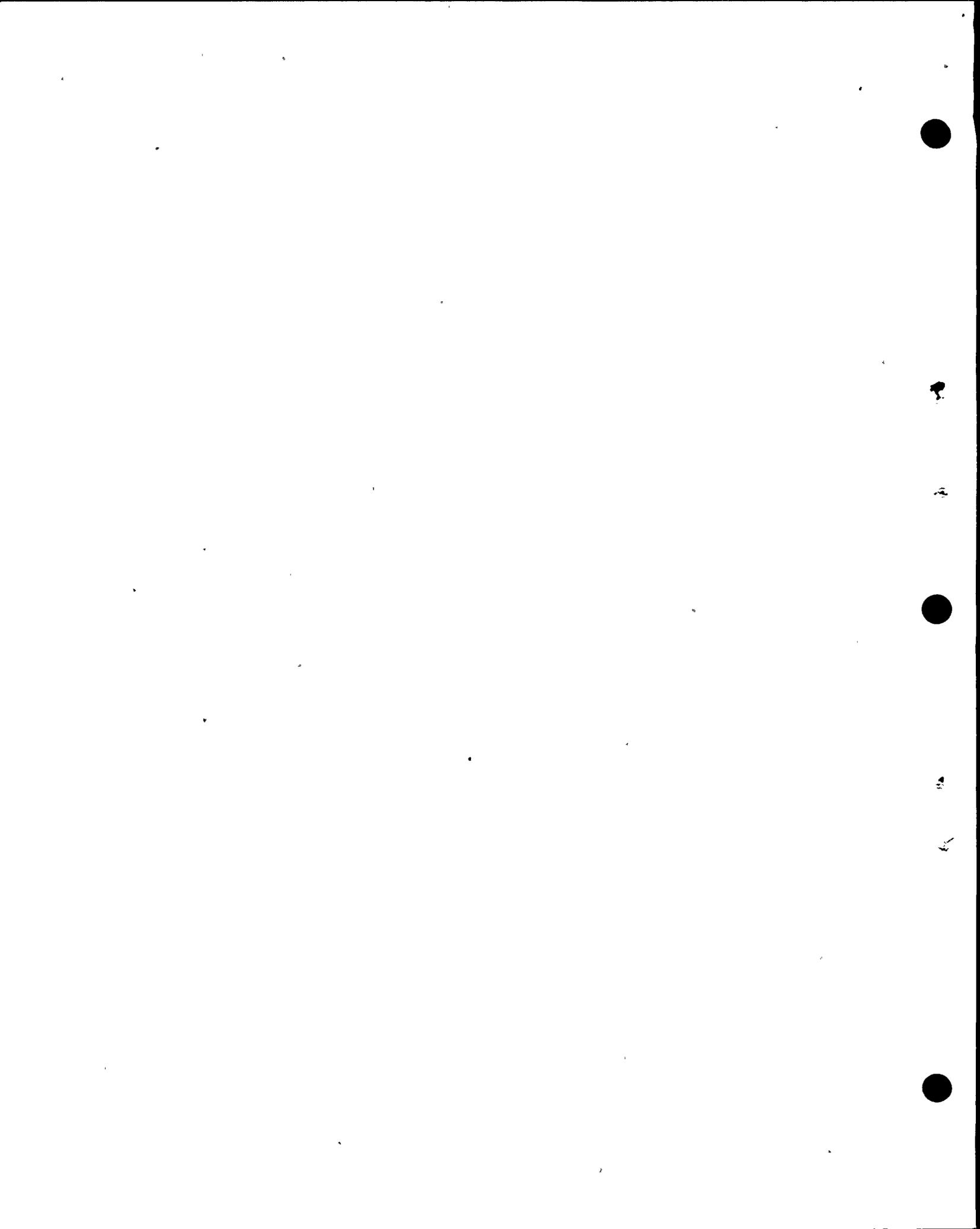
6 To this list I would suggest we add the effects
7 of nonhomogeneity of the foundation materials, as Dr. Frazier
8 has just discussed. Dr. Luco goes on to conclude that each
9 of the effects he mentions will be small for the Diablo
10 Canyon Plant and concludes that -- and I quote:

11 "We are left with no physical mechanism
12 to explain a reduction of the motion at the
13 foundation levels as compared with the free field."

14 End of quote.

15 Later on he cites a study which I have made to
16 support these conclusions. On page 9034 of the transcript
17 he states:

18 "I think it is very...to make any
19 comparison we must remain with a consistent
20 system, and Seed and Lysmer have used a
21 consistent system. They kept the structure
22 the same. And their conclusion is that there
23 is no significant soil-structure interaction
24 effect and there is no significant tau effect.
25 That's all I am saying."



mp013 1

End --

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Q That was -- excuse me.

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That was a quote?

4

A End of his quote.

5

Q Okay.

6

A That's all his quote.

7

I think that last quotation is a misinterpretation of our report, which in fact includes after analyzing the response of the model of the Diablo Canyon containment structure to three different forms of base excitation, first of all, vertically propagating waves allowing for soil-structure interaction, secondly, a rigid base excitation in which free field motions are used as a base excitation, and thirdly, a form of base excitation in which the motions are represented by a family of horizontally propagating Rayleigh waves.

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We conclude the following -- and I'll use my words now:

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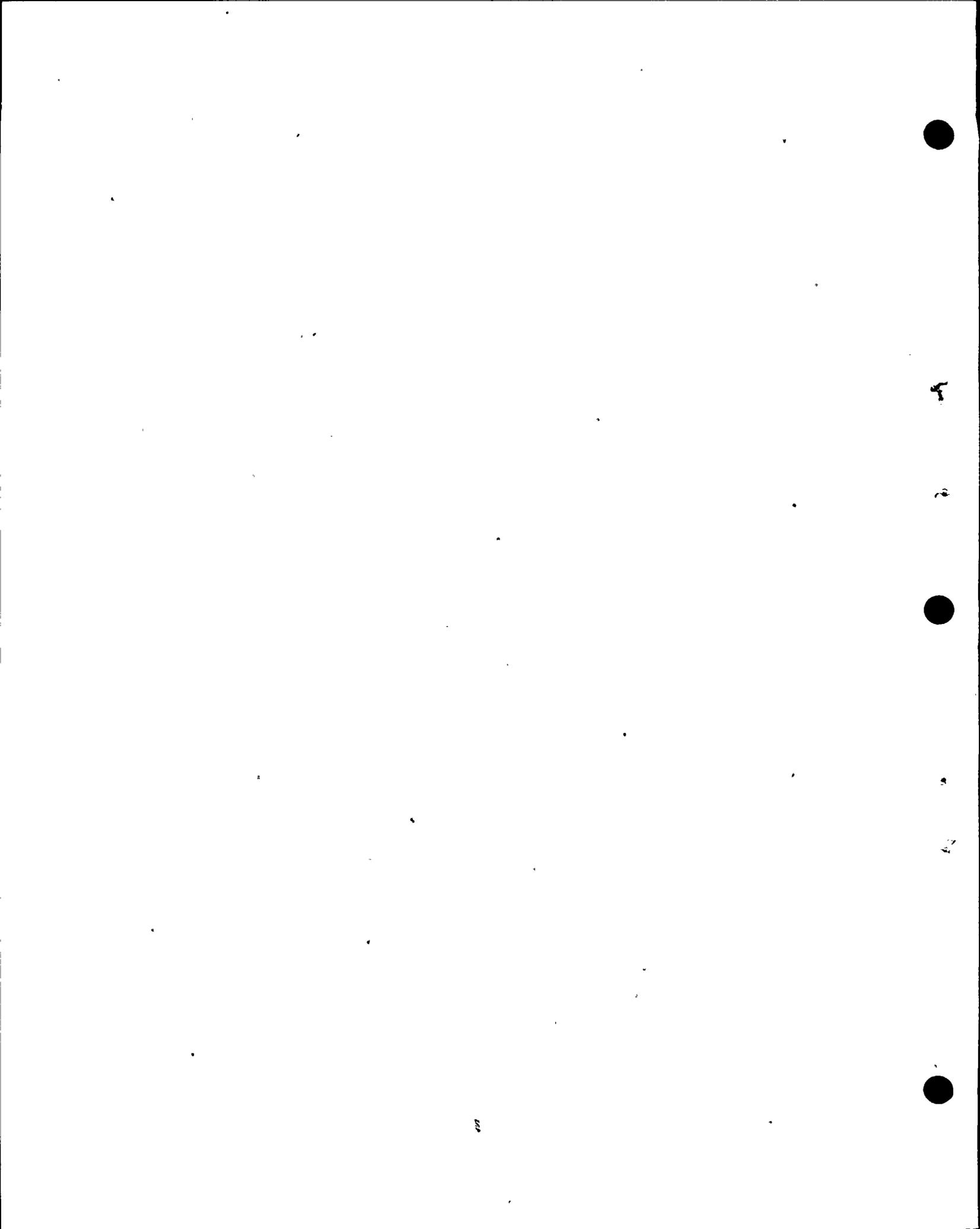
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The good agreement between computed responses obtained by the three different methods illustrated in the preceding plots would seem to indicate that the effects of soil-structure interaction are very small for the case considered. In fact, this conclusion would seem to be even more apparent if a comparison is made between the response spectra for motions in the free field and motions developed



mpbl4 f at Nodal Point 63 at the center of the base of the founda-
2 tion.

3 Such a comparison is shown in Figure 13.
4 Figure 13 I have on a viewgraph, and it is the fourth of
5 the figures I would like to show on the screen and to hand
6 out.

7 Q All right.

8 We marked that as Exhibit 64. However, if it is
9 in your report, I believe your report is in evidence now and
10 we don't need to pass out copies. We can put it on the
11 viewgraph and you can explain it, but we don't need to mark
12 it as an exhibit.

13 A It is in the report, and it is Figure 13. And
14 I don't know whether my report is in evidence or not, but I
15 am --

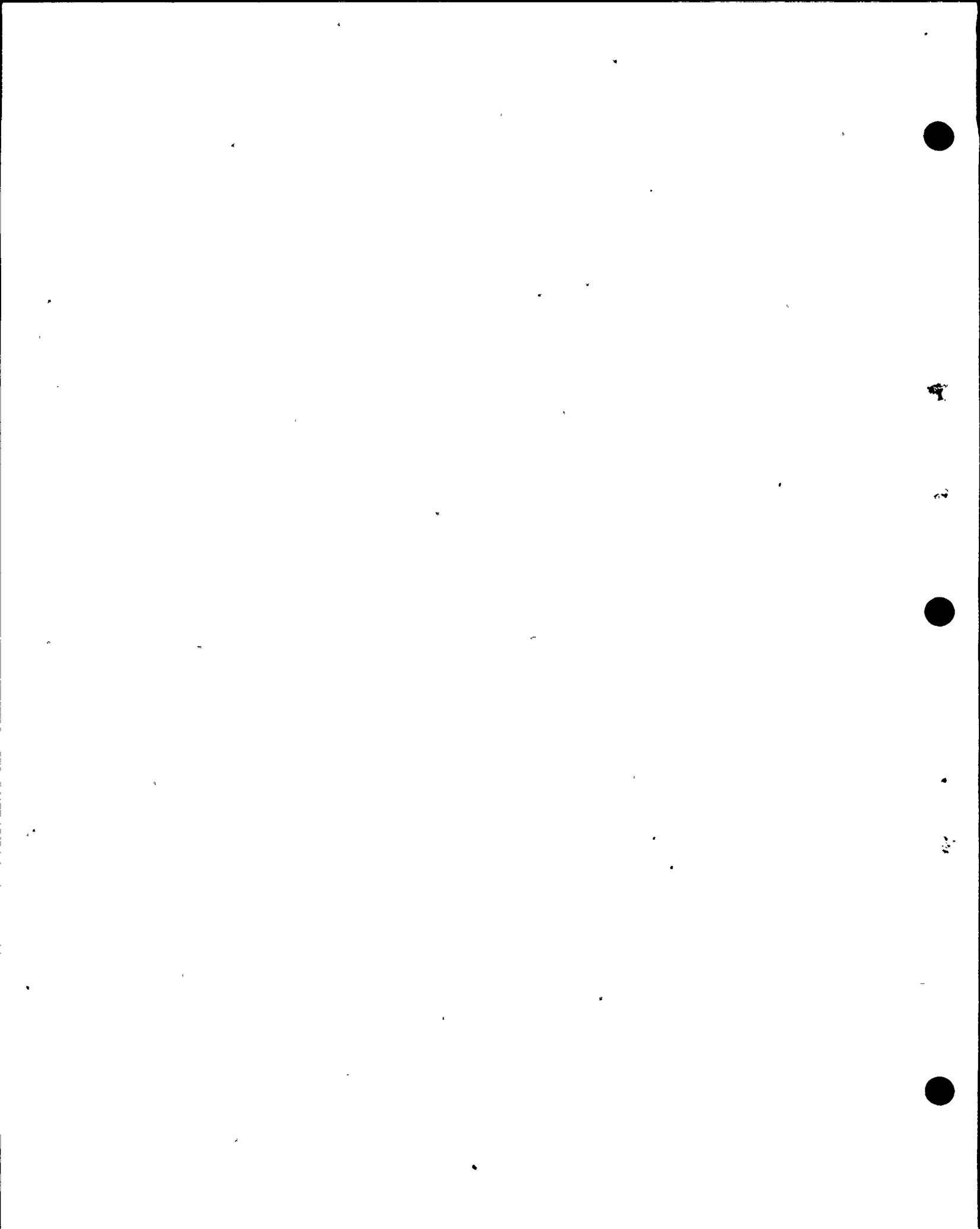
16 Q I am relatively certain it is, and we'll check
17 that while we're looking at the viewgraph.

18 A All right.

19 MR. FLEISCHAKER: This is, I think, Joint
20 Intervenors Exhibit 58?

21 WITNESS SEED: The report involved is called
22 Analysis of Soil-Structure Interaction Effects During
23 Earthquakes for the Diablo Canyon Nuclear Power Plant by
24 H. Bolt and Seed and John Lysmer.

25 MR. FLEISCHAKER: Was that in June or July of '78?



mpbl5 1

WITNESS SEED: July 7, 1978.

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MR. FLEISCHAKER: I think that was 58, Joint.

3

Intervenors' Exhibit number 53.

4

MR. NORTON: Is it in evidence, that's the question we're checking now.

5

Our records indicate that it is in evidence.

6

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MR. FLEISCHAKER: Yes. That's consistent with my recollection.

8

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MR. NORTON: Okay.

10

MR. FLEISCHAKER: I don't have it here unfortunately.

11

12

MR. NORTON: That went in December 21st. That's long enough ago to make all of our recollections fuzzy.

13

14

(Slide.)

15

WITNESS SEED: May I go to the screen?

16

MR. NORTON: Take a microphone with you.

17

WITNESS SEED: The appropriate figure to look at on this particular Figure 13 is this one shown here, which shows the results of an analysis for vertically propagating P and S waves traveling upward, vertically upward toward the base of this structure.

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BY MR. NORTON:

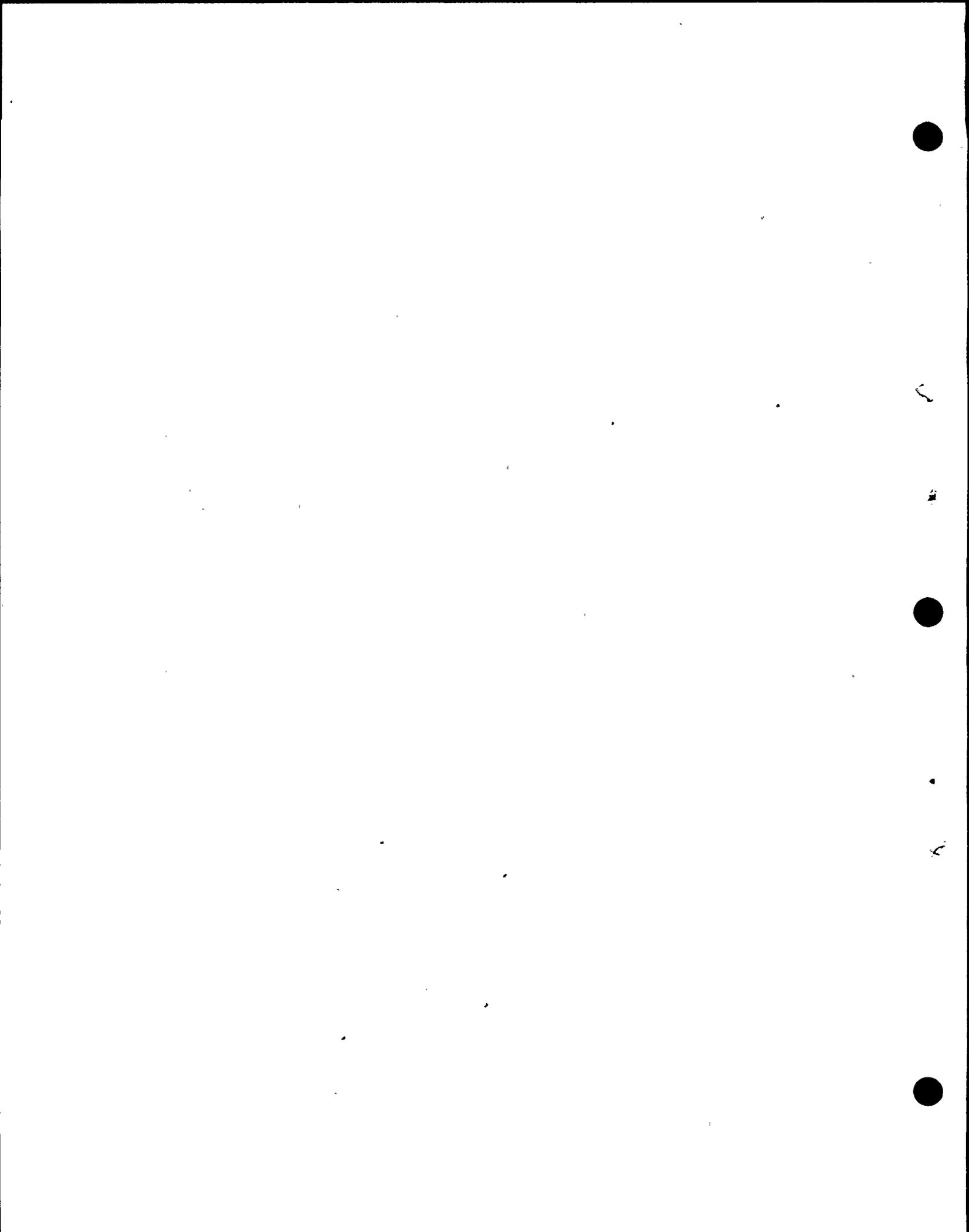
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Q Excuse me.

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You're referring to the plot which is in the upper left-hand corner of the four.

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A (Witness Seed) Of the four, yes.

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And you will notice that there is a solid line on that plot which shows motions in the base of the structure and there is a chain-dotted line which shows motions in the free field adjacent to the structure. And you will notice probably also that the motions at the base of the structure for frequencies between 20 and about 4 cycles per second are smaller than those in the free field.

And I look at that and I see they are smaller. How much smaller this is than that is -- this is about 50 percent of that. And as you go through four cycles there is no difference at all.

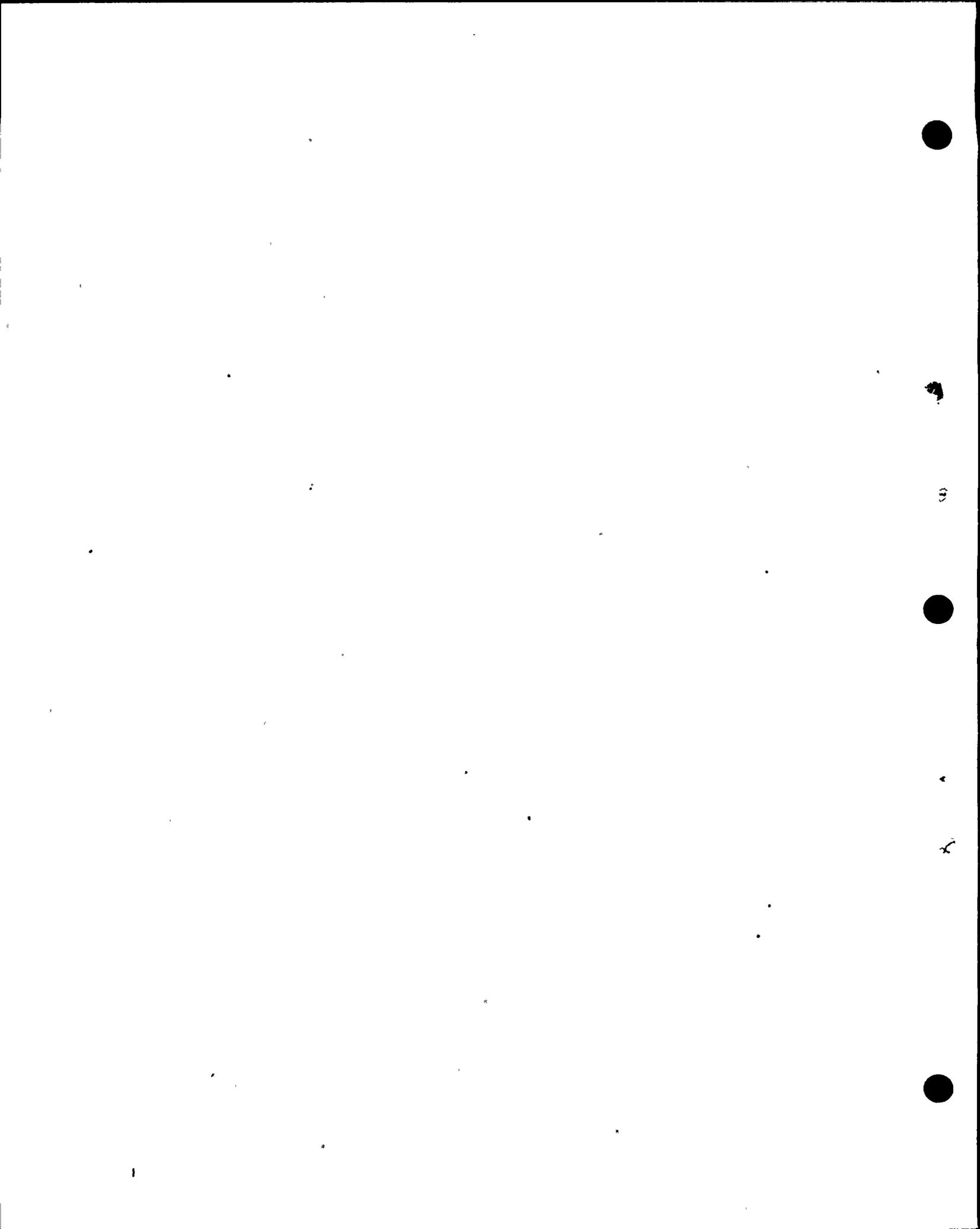
On the average I estimate that the difference between the motions in that frequency range between those developed in the free field shown by the upper line, and those in the base of the structure shown by the lower line is on the average about 20 percent. I call that a small effect.

Q Nevertheless a 20 percent reduction.

Now if in the free field you had a .75, then you would reduce that by 20 percent. And if my math is correct, that's about .15. So you would reduce that down to about .5, is that correct?

A That is correct, for that effect alone.

Q And that's for soil-structure interaction effect



mpbl7 1

only.

2

A That's right.

3

Q Okay.

4

A Thank you.

5

I'll go back and finish my statement.

6

Q Now you have heard -- excuse me, do you have more prepared on that? All right, I'm sorry. I was going to go on to some other things, but please finish.

8

9

A I would like to note that, first, that there is a significant difference between the words "very small" in our description of soil-structure interaction effects and "no significant effect" as used by Dr. Luco, especially if we're discussing the difference between .75 and .60g.

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To show this difference -- I've shown this on the figure.

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Secondly, I would like to note that the analytical procedures in the analytical model that we used in this particular study involved vertically propagating waves, and that this kind of analysis could not possibly show any tau effect, since it was not designed to include these effects. Accordingly, the results do not show that there is no significant tau effect as Dr. Luco states.

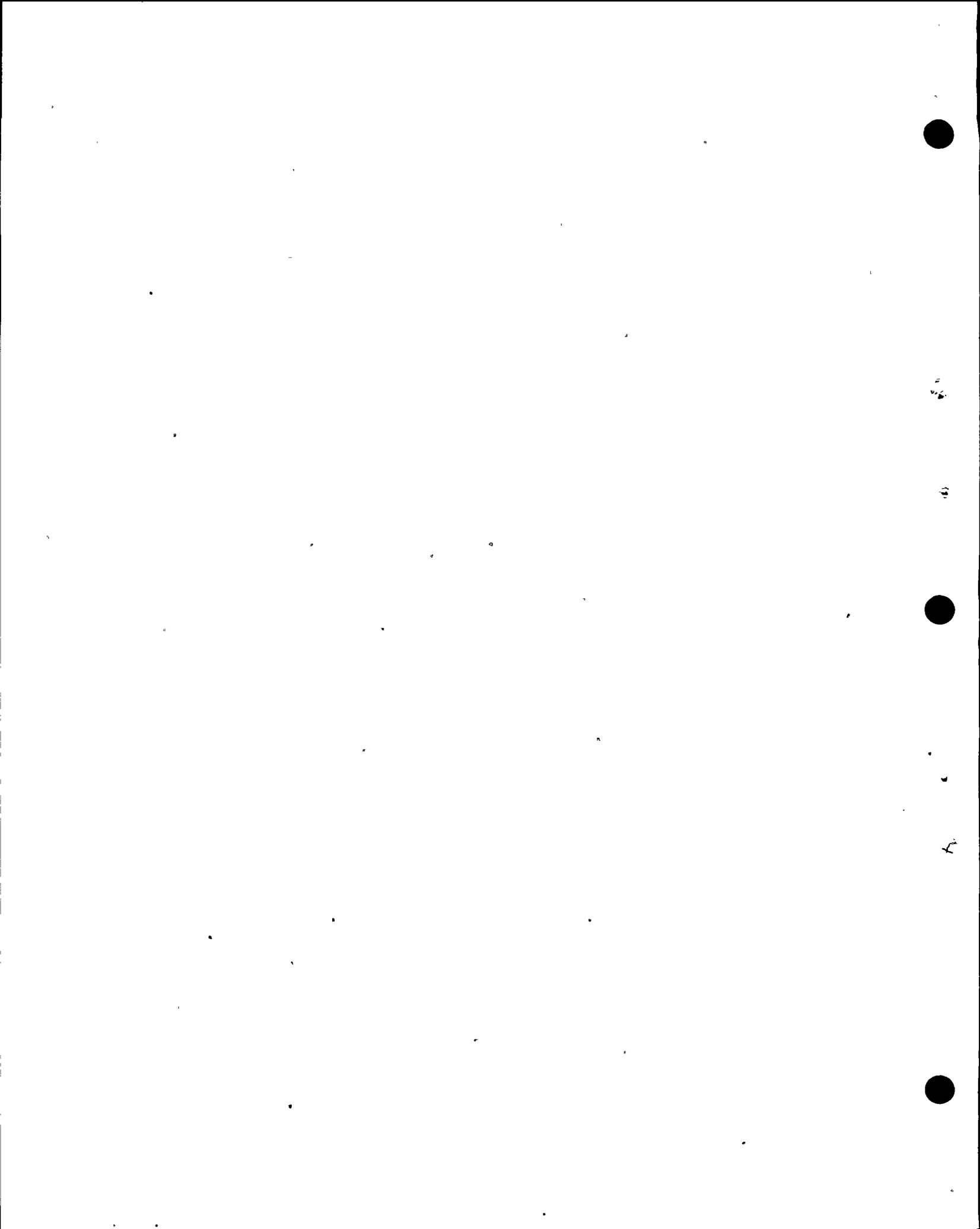
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The results don't show that because they were not designed to try to show that.

25

Q In other words, it's not that your study proves



mpb18 1

2 that there are no tau effects, it simply doesn't show tau
3 effects because it wasn't designed to show tau effects.

4 A This particular model does not show tau effect,
5 as I understand them.

6 Now let me say what tau effects are.

7 Tau effects result primarily from the fact that
8 the wave motions are not all perfectly vertical as they
9 approach a foundation slab. And they are also due to
10 nonhomogeneity of the soil or rock formations on which the
11 foundation is constructed.

12 These effects were not included in our analytical
13 studies. Therefore on top of the reduction for soil-
14 structure interaction, one would presumably add some further
15 reduction for the effect of nonvertically inclined waves
16 and the effect of nonhomogeneity in the foundation.

17 Q All right.

18 Let's -- because we got into a little bit of a
19 hassel about vertical and almost vertical, and now you're
20 using the term "nonvertical" which one could interpret, I
21 suppose, to mean horizontal, let's be careful. And if you
22 could go to the viewgraph and take a blank piece of viewgraph
23 paper and a marker, perhaps you could illustrate by way of
24 example or by way of drawing what you mean by a tau effect
25 as a result of -- and let's use the phrase or let's use the
definition that Dr. Frazier used of steeply emerging waves,



23



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mpbl9 1 which he defined as being less than 45 degrees. Let's use
2 for example 30 degrees, show 30 degree emerging waves, 30
3 degrees off vertical emerging waves, if you would.

4 A (At the viewgraph.)

5 If you want me to show you that in schematic form,
6 I want to point out that it will be in a schematic form.
7 It's not meant to be a rigorous analysis. It's perhaps the
8 simplest possible approach that one could use to illustrate
9 the kind of effects that would result from waves approaching
10 at an angle of what you said, 30 degrees.

11 Q All right.

12 And this is to show a tau effect, or a portion
13 of the tau effect, is that correct?

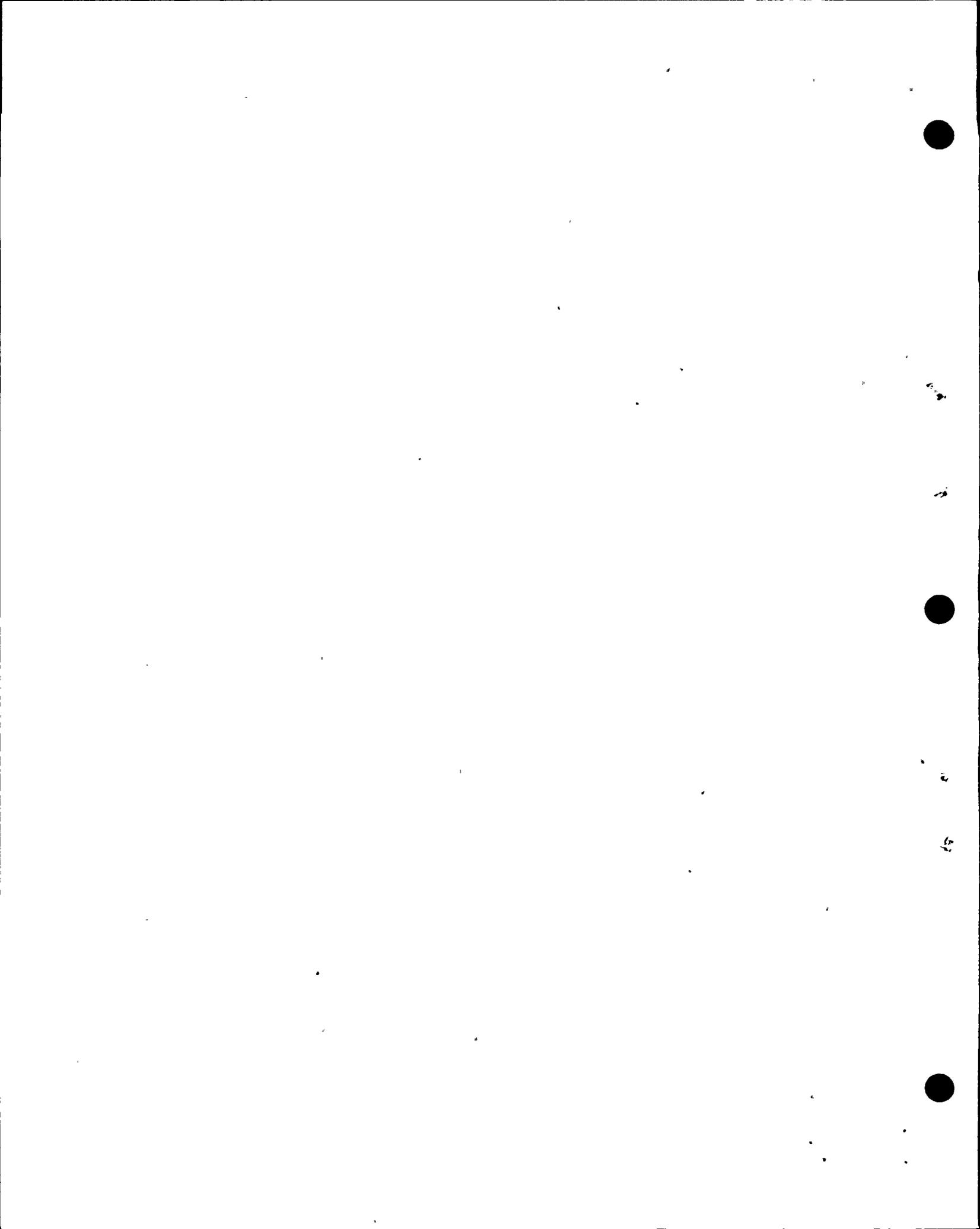
14 A That's correct.

15 Q All right.

16 Would you please do that?

17 A We might have a ground surface somewhere up
18 there on which there would be a slab, a base slab, which
19 would be of concrete. And I'm going to shade this to indicate
20 that it is in fact a rigid slab.

21 And then we would have waves approaching, and the
22 waves would be coming in at some angle to the vertical, and
23 I'm going to show this wave approaching at an angle of
24 30 degrees to the vertical. And such waves would be coming
25 in all over the base of the slab in this form. And there



mpb20 1

would be waves coming there and other waves coming in at the same angle approaching the base of the slab all over the base.

2

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Q And you would describe this as a steeply emerging wave?

4

5

A This I would describe as a nonvertically incident wave within the context of between zero and 45 degrees as described by Dr. Frazier.

6

7

So as a simple example, I will make this angle 30 degrees.

8

9

Q Okay.

10

And could we give the base slab a dimension?

11

12

A Yes.

13

Let's suppose the base slab is 200 feet, which seems to be not unlike the dimension of the containment structure, shall we say.

14

15

Now these waves would be approaching in this direction from below. And so we would need to know something about their velocity. And they would be traveling for the velocities measured in the formations at Diablo Canyon --

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Q Excuse me.

21

I think in the testimony of Dr. Trifunac he used the number 3500 feet as the waves' velocity.

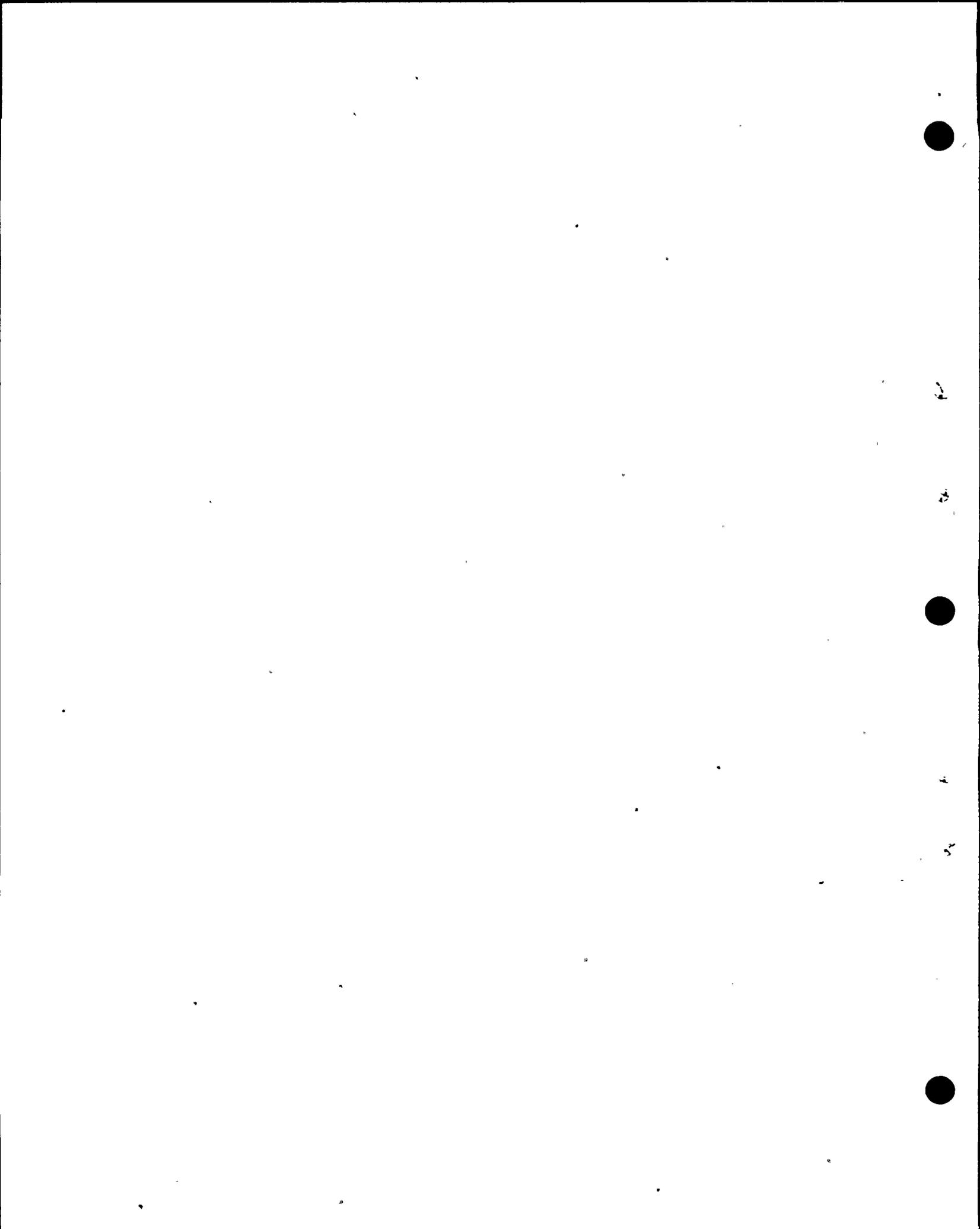
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23

A (Witness Blume) We've been using around 3700, I believe.

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mpb21 1

Q All right.

2

What I was thinking is you've put 5000, which is far higher.

3

4

A (Witness Seed) I used 5000. Actually I will show what effect I find, and I would make the point later that the lower the velocity the more significant the effect would be. So by using 5000 I play down the effect.

5

6

7

8

Q All right.

9

(Power outage.)

10

Q Dr. Seed, I will pick it up.

11

What has happened, for the record, is that perhaps the last five to ten minutes was lost because we had a power failure in the recording device.

12

13

14

Dr. Seed, what you had done is you had just started drawing this diagram which is now completed, and you had basically described what you were doing as you were drawing the figure.

15

16

17

18

I think the best thing to do is to go back to the beginning.

19

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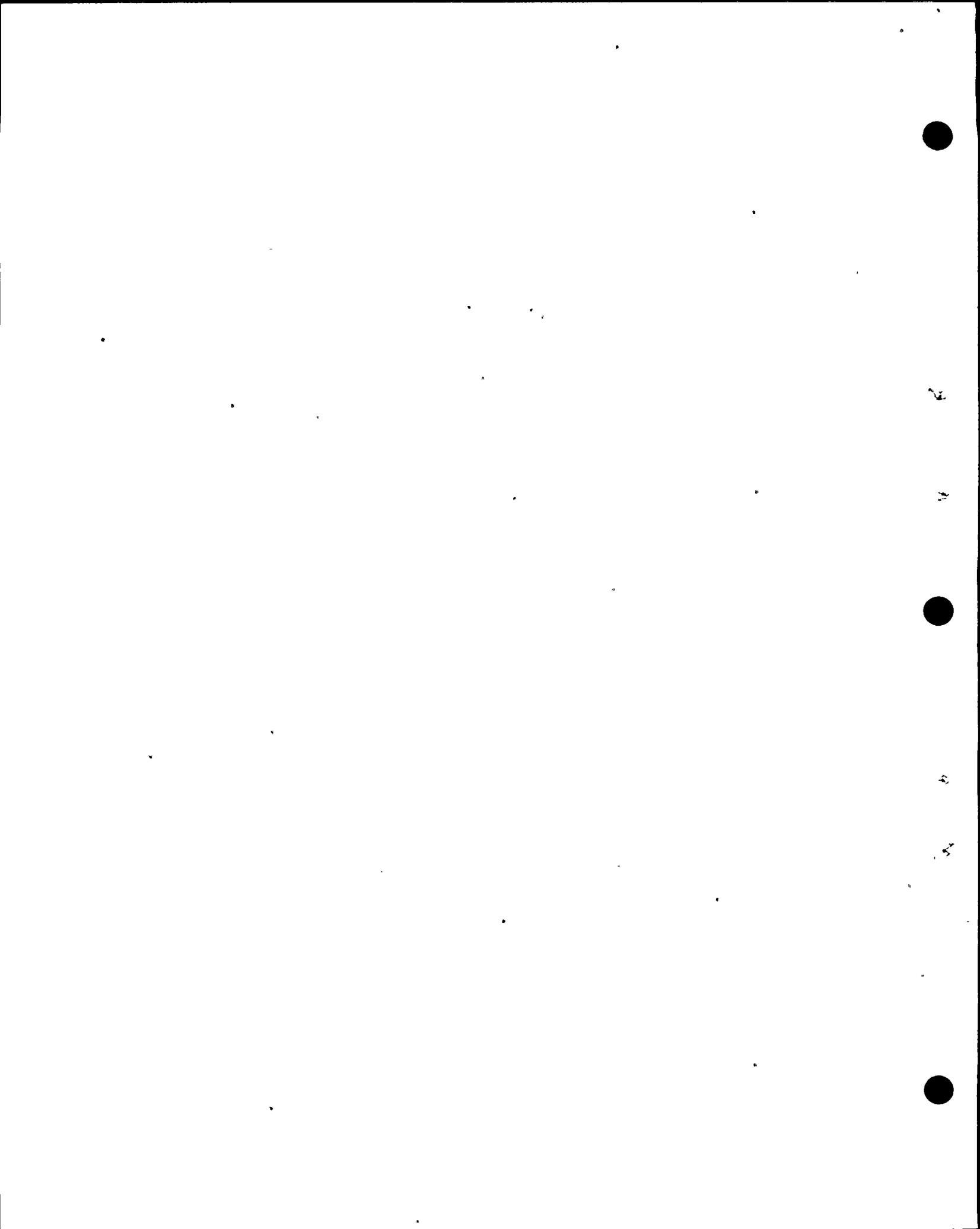
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Prior to the power failure you had put the slab on the ground, marked the two ends of A and B, and given the dimensions 200 feet, and showed the waves emerging at 30 degrees, and you were in process of writing down 5000 feet per second, showing the shear wave velocity of the waves through the rock.

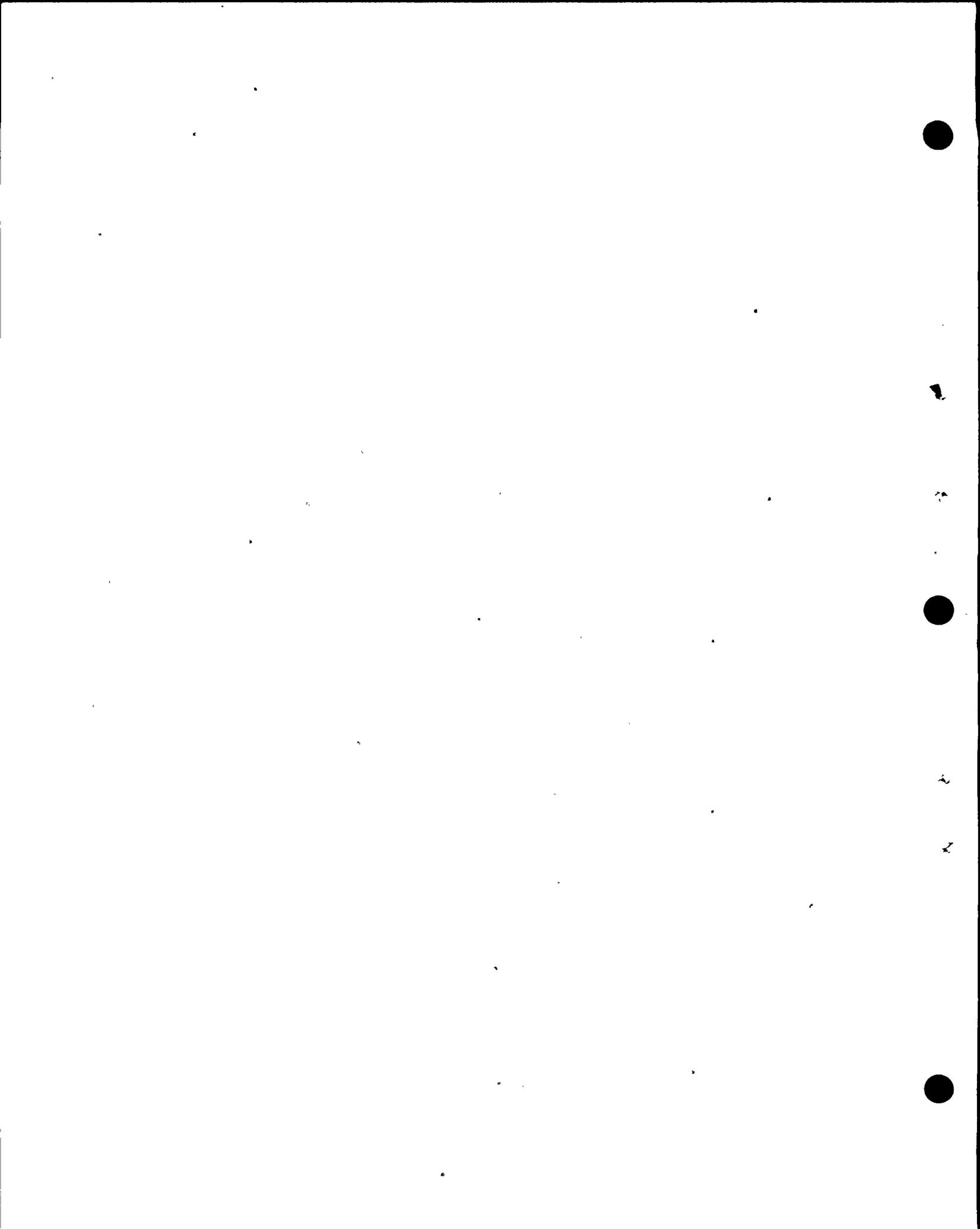


mpb22 ;

Now I think you're going to have to explain
the entire remainder of the diagram over again for the
record.

end Madelon
WRB flws

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1D

RB/wbl

1 A (Witness Seed) All right. The purpose of
2 the other part of the diagram which is now on the blackboard
3 is to show that there is a time lag between the wave reach-
4 ing Point A and similar parallel motion coming up parallel
5 to it reaching Point B. Where the peak acceleration is
6 developed by a wave front like A-D, where the peak accelera-
7 tion is developed at Point A, then it has not yet arrived
8 at Point D, and there's a time lag--

9 Q Excuse me, Dr. Seed; I think you must misspoke.
10 You said it had not yet arrived at Point D.

11 A B.

12 Q Yes.

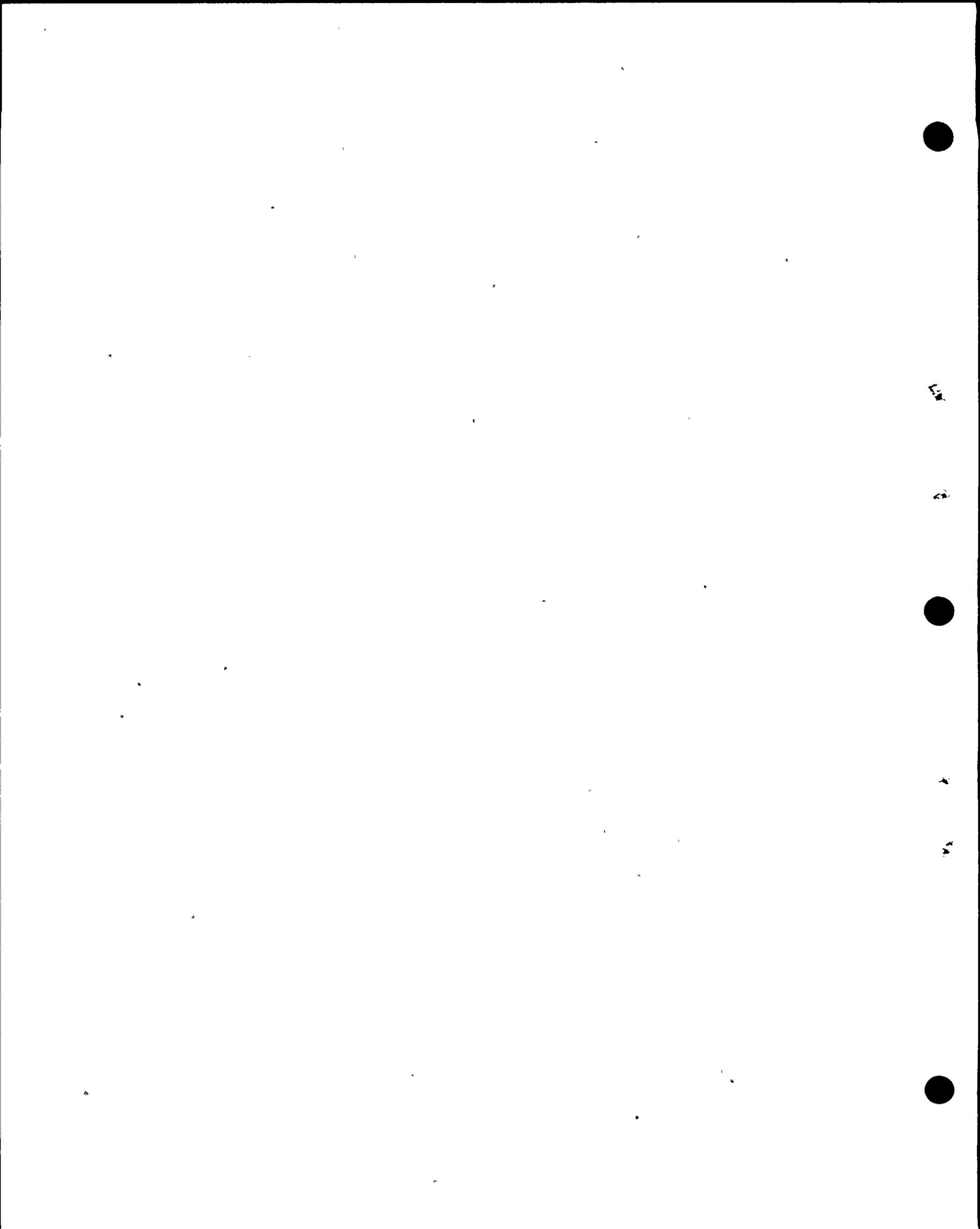
13 A And there's a time lag in that same motion
14 arriving at Point B.

15 The time lag is the time it takes for the wave
16 to travel from D to B, and that time lag will be equal
17 to the length D-B, which is equal to 100 feet in my little
18 sketch divided by 5000 feet per second, which is the
19 velocity of wave propagation that results in a time lag
20 of 0.02 seconds.

21 Q Excuse me for interrupting a moment, Dr. Seed.

22 You said the length of D-B is 100 feet. Do you
23 do that by taking the cosine of 30 times AB; is that how
24 you come up with that number?

25 A No. I do it by taking the length AB multiplied



1 by the sine of 30.

2 Q The sine of 30; I'm sorry.

3 So it is one-half. That's where you come up
4 with 100.

5 A That's right.

6 Q The Judge who reviews the record might wonder
7 how you got that number, as I just did.

8 A All right. I'm sorry to have to correct you.

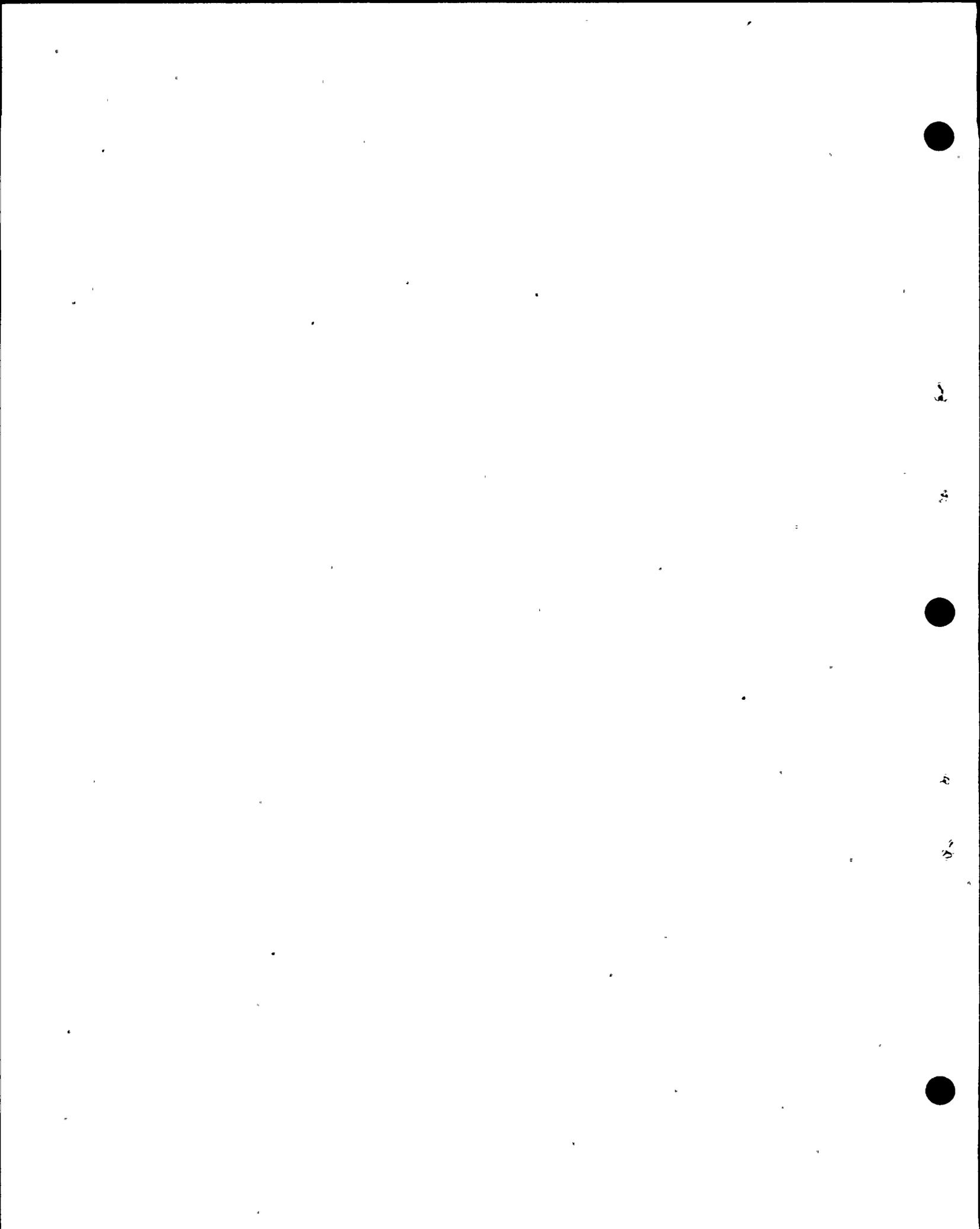
9 So we have D-B is 100 feet. And we have the
10 time lag of .02 seconds.

11 Now down on the bottom of this figure is
12 shown a portion of the time-history of motions of waves
13 reaching the ground surface at any point. And the purpose
14 of showing this is to show that if Point B is lagging
15 behind Point A that when Point A is getting the maximum
16 acceleration then Point B is getting something less than
17 the maximum acceleration. And by the fact that Point B
18 is .02 seconds behind Point A the difference between the
19 acceleration at Point A and Point B will be that when
20 Point A has an acceleration of A-max Point B has an
21 acceleration with these numbers of 60 percent of A-max.

22 Q All right.

23 If we could, then: what you're doing here is
24 describing a portion of what makes up tau?

25 A Yes.



1 Q And, if we could: let's put some numbers on it;
2 let's say A-max is -- and I'm hesitant to use an odd number
3 like .75 because it makes the math that much more compli-
4 cated, so for this purpose let's take .8.

5 A All right. .8.

6 Q Or .6. Let's take .6.

7 A All right.

8 Q That would do just as well.

9 If A-max was .6 I take it you're saying you
10 would average. What would you come up with?

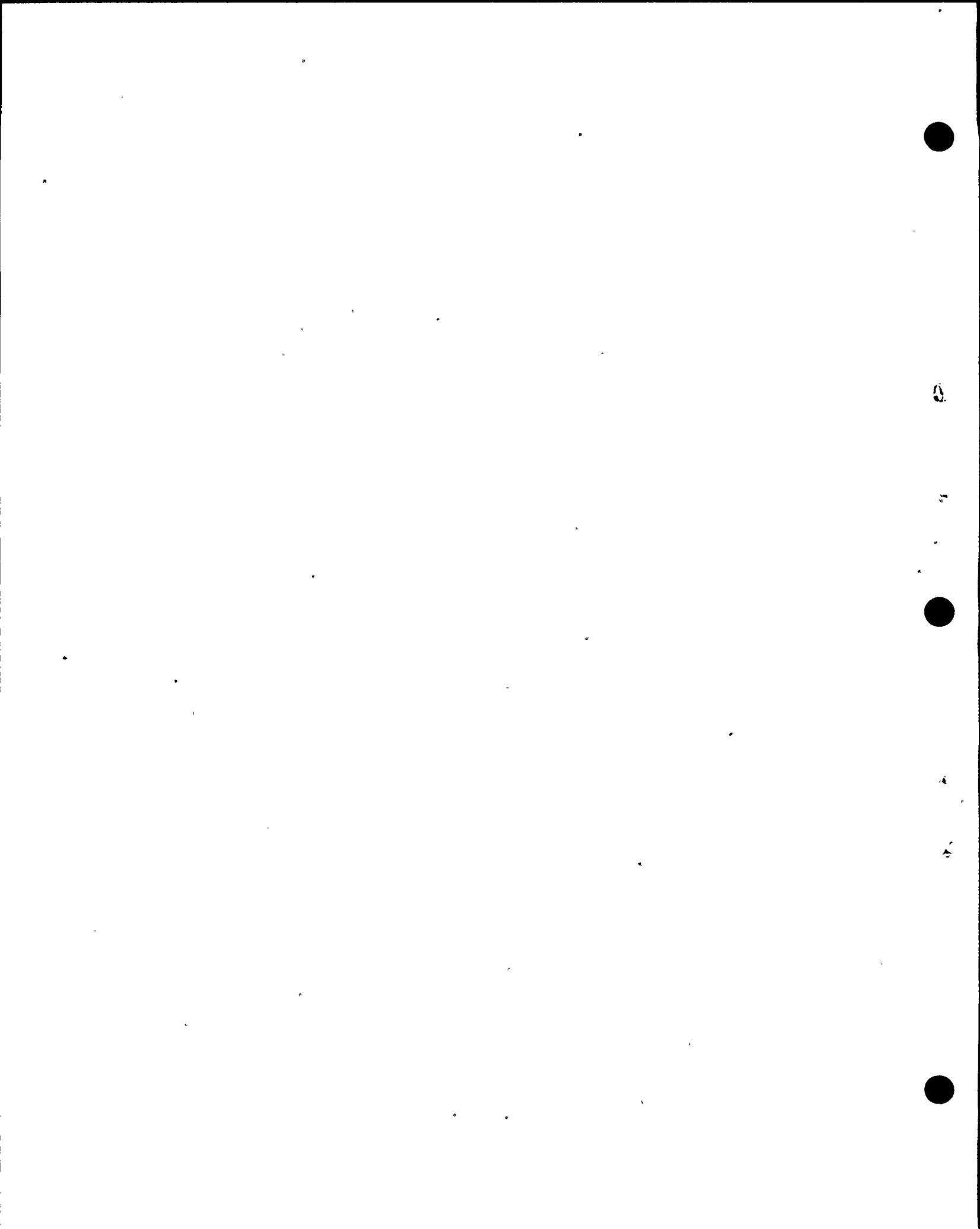
11 A Well, if A-max was .6 and that was developed at
12 Point A, at the same instant of time Point B would be
13 feeling 60 percent of that, or .36 g, and the average
14 acceleration along the base slab would be the average of
15 .6 and .36 which would be 0.48g.

16 In other words, the average acceleration along
17 the slab would be 20 percent less than the maximum accelera-
18 tion at any point under the slab.

19 Q All right.

20 Now let me see if I understand the fundamentals
21 correctly.

22 If I lower the feet per second that the wave
23 is traveling to what it is at Diablo Canyon, say 3700
24 feet, or even say 4000 feet, it would give me another
25 increase, or a decrease, I should say, in what the slab is



1 seeing.

WRB/vb4

2 A It would give you a greater time lag and,
3 therefore, a greater reduction in the average motion in
4 the slab.

5 Q All right.

6 And, likewise, as I increase the angle, say to
7 35 degrees or 45 degrees it again would increase the
8 distance, the time lag.

9 A That's right.

10 Q And similarly, of course, if I reduce it from
11 30 degrees -- obviously if I reduce it down to totally
12 vertical, then I would get zero time lag.

13 A That's right.

14 Q All right.

15 A --And that's the kind of analysis we did previously.
16 And that's why I say the analysis I performed could not
17 possibly have included a tau effect, because it was only
18 for vertically propagating waves.

19 Q That's right. Okay.

20 A Now may I, in all fairness to Dr. Luco and
21 others, say that I haven't shown the peak acceleration in
22 this slab. The actual peak acceleration in the slab would
23 develop when the maximum acceleration is developed at the
24 center of the slab. And at that time Point A would be in
25 advance of that point, Point B would be behind that point,



6



1 and the average would be somewhere in here (indicating).

2 At that instant the average acceleration of
3 the slab would be 10 percent less than the maximum accelera-
4 tion for the figures I have used.

5 Q All right.

6 And at that point instead of then getting
7 .5 if A-max equalled .6 you would get something like .54?

8 A Right.

9 Q Okay.

10 In any event, a 10 percent reduction?

11 A That's right.

12 Q Okay.

13 Now one other thing you talked about, and I
14 believe it was Dr. Frazier's lead-in to your talking about
15 the tau effect was heterogeneities in the earth.

16 Could you explain to the Board what you mean
17 by heterogeneities in the earth, and perhaps draw a graphic
18 example?

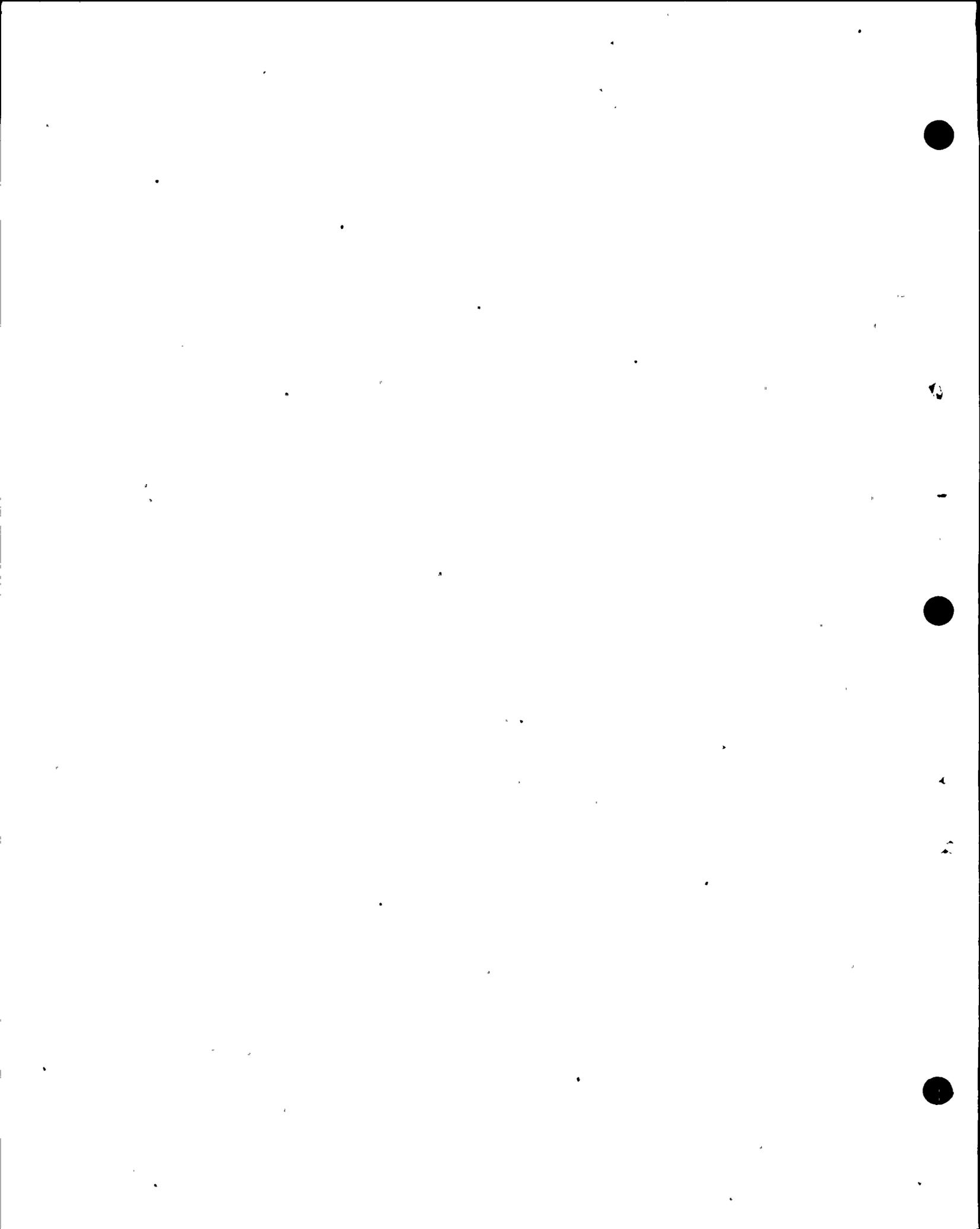
19 MR. NORTON: Incidentally, may we mark that
20 as Applicant's Exhibit 64?

21 (Whereupon the document referred to
22 was marked for identification as
23 Applicant's Exhibit No. 64.)

24 MR. NORTON: We would ask at this time that
25 61, 62, 63 and 64 be moved into evidence.

B/wb5

XXXXXX



1 MRS. BOWERS: Mr. Fleischaker?

2 MR. NORTON: Those are Dr. Seed's that he has
3 used today.

4 MR. FLEISCHAKER: No objection.

5 MRS. BOWERS: Mr. Ketchen?

6 MR. KETCHEN: I have no objection. But I have
7 a request. I missed one word on the graph there, and could
8 you tell me what it is? It's the one adjacent to the
9 triangular -- out to the left.

10 MR. NORTON: A-max.

11 WITNESS SEED: A-max.

12 MR. KETCHEN: Thank you.

13 I have no objection.

14 MR. NORTON: We will make copies of the Vu-graph,
15 of course.

16 MRS. BOWERS: Applicant's Exhibits 61, 62, 63
17 and 64 are admitted in evidence.

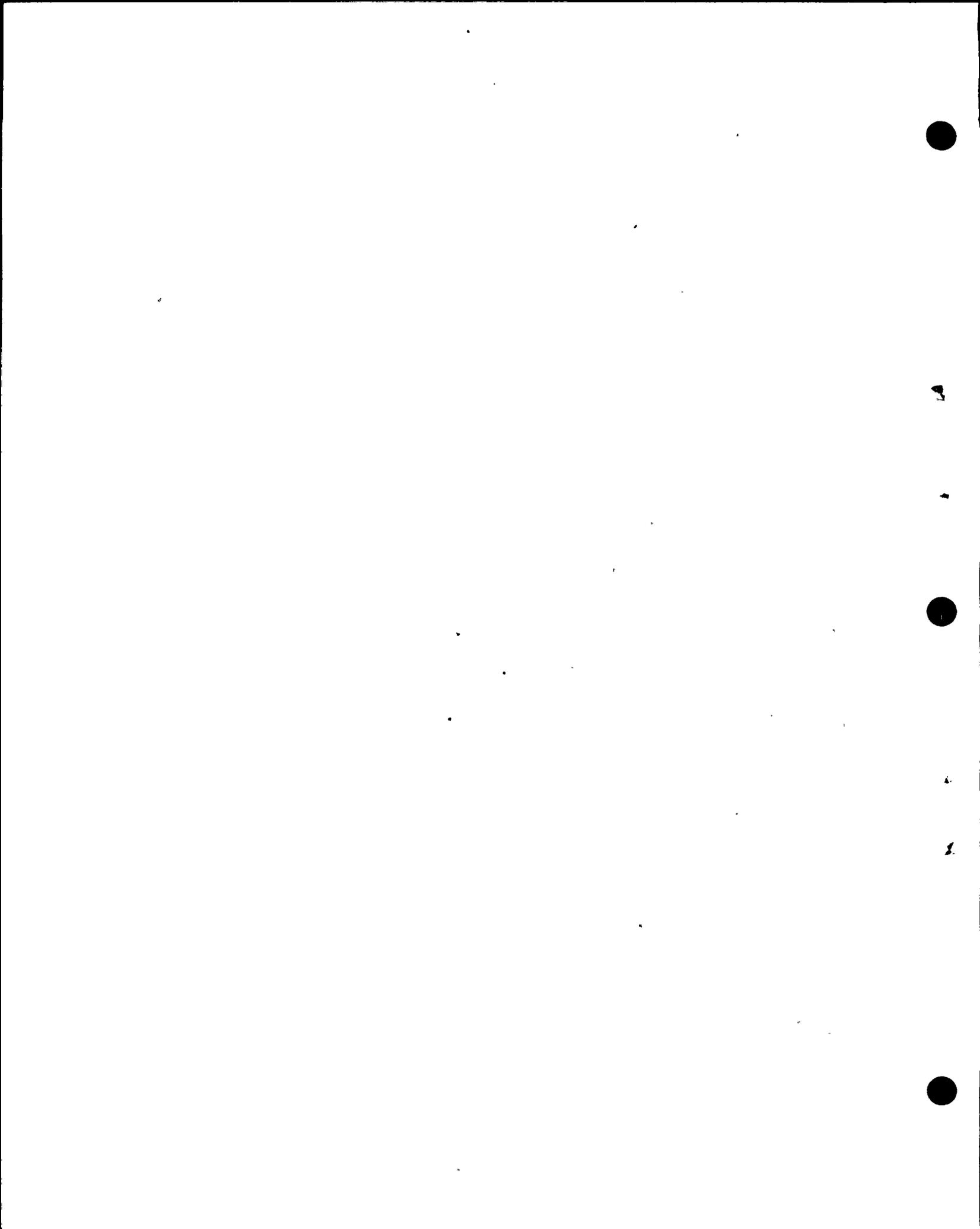
18 XXXXXX

19 (Whereupon the documents referred to,
20 heretofore marked for identification
21 as Applicant's Exhibits 61, 62, 63 and
22 64, were admitted in evidence.)

23 MRS. BOWERS: I'm sorry to do this, but could
24 we take just a couple of minutes and have a bench conference?

25 MR. NORTON: Yes. Just a moment.

I would like to say Bernadette Marver is making



1 the copies. She was very offended that everybody else was
2 in the record and everybody kept referring to her as
3 "Somebody."

4 (Whereupon a bench conference was had)

5 MRS. BOWERS: All right. Shall we proceed?

6 BY MR. NORTON:

7 Q Dr. Seed, while you're finishing this drawing--

8 MR. NORTON: We're drawing Applicant Exhibit 65.

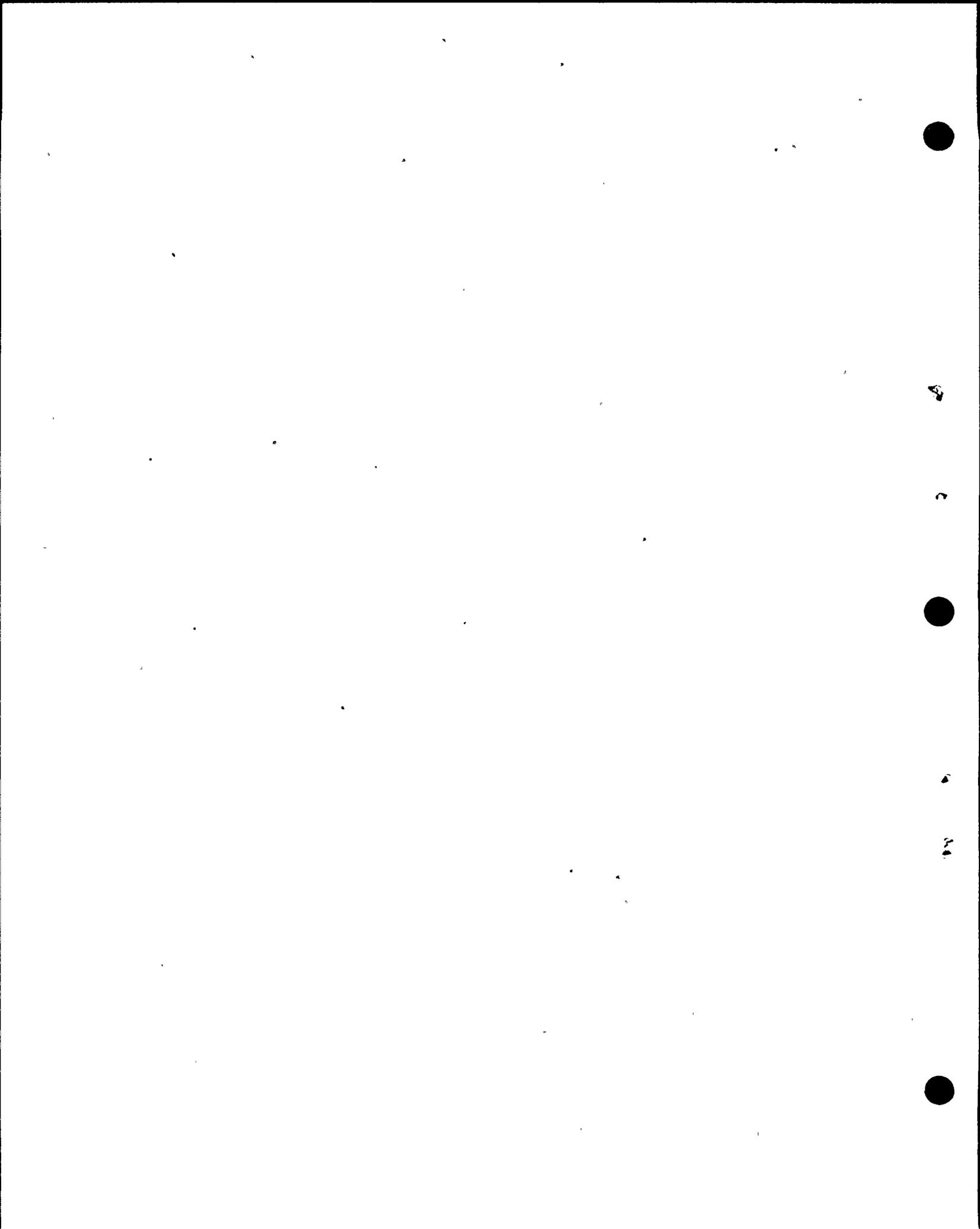
9 (Applicant Exhibit No. 65 marked for
identification.)

10 What I had asked Dr. Seed was to talk a little
11 bit about the heterogeneities and how that has an effect,
12 heterogeneities in the soil beneath the facility and how
13 that has an effect on tau.

14 BY MR. NORTON:

15 Q Dr. Seed, do you want to go ahead?

16 A (Witness Seed) The purpose of this sketch is
17 to illustrate how the heterogeneity, or the non-uniformity
18 of the rock or soil formations underlying the structure
19 will affect the base motions that develop at the base of the
20 structure. And it's drawn for a very simple case with an
21 idealized state that at some point down below the surface
22 of the earth, perhaps this might be a couple of miles or so,
23 a wave starts off traveling with a given velocity vertically
24 upwards. In the course of traveling perhaps two miles
25 to the ground surface it inevitably will hit strata of



1 different rock formations, and it would be impossible for
2 me to draw in this simplified sketch all the possible
3 rock formations that it might encounter on its travel
4 from two miles down toward the rock surface. So I've
5 just shown some schematically.

6 The purpose of this sketch is to illustrate
7 that a wave that starts off at the lefthand end and is
8 going vertically upward to a point on the lefthand end of
9 the base slab will probably arrive there at a different
10 time than a wave that starts off at the righthand end and
11 travels vertically upwards. Even though we are not now
12 dealing with non-vertically incident waves, we are taking
13 the idealized case of perfectly vertical waves, even under
14 those conditions in reality there is virtually no possibility
15 that these waves will all arrive at the base slab at the
16 same time.

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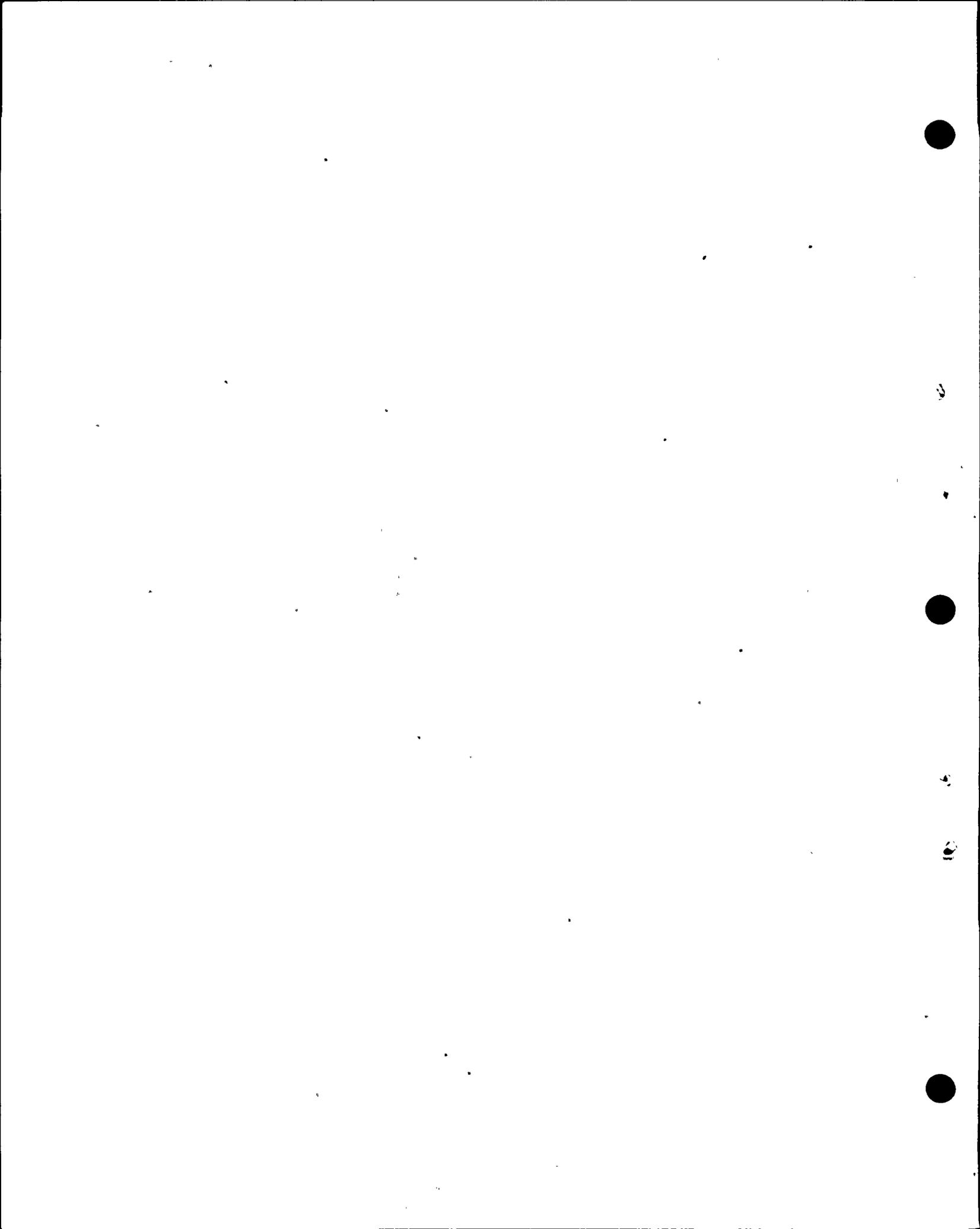
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LD2
WRB/mpbl

1 This is what we call incoherence. The term
2 incoherence has been used for the fact that they don't all
3 arrive at the same time. Or another term to use is that
4 the motions would be out of phase by the time they arrive
5 at the base slab. And therefore the motions on the base of
6 that slab at any given instance will all be different. And
7 what the base slab will feel may be the integrated sum of
8 those motions which will be less than the peak of the motions
9 at any point.

10 Q Okay.

11 And some of the reasons for that, I take it,
12 would be that the different strata would have different,
13 say, velocities, even if the strata within each strata were
14 homogenous, it would have a different velocity than the
15 strata above it and below it.

16 A That's right.

17 Q All right.

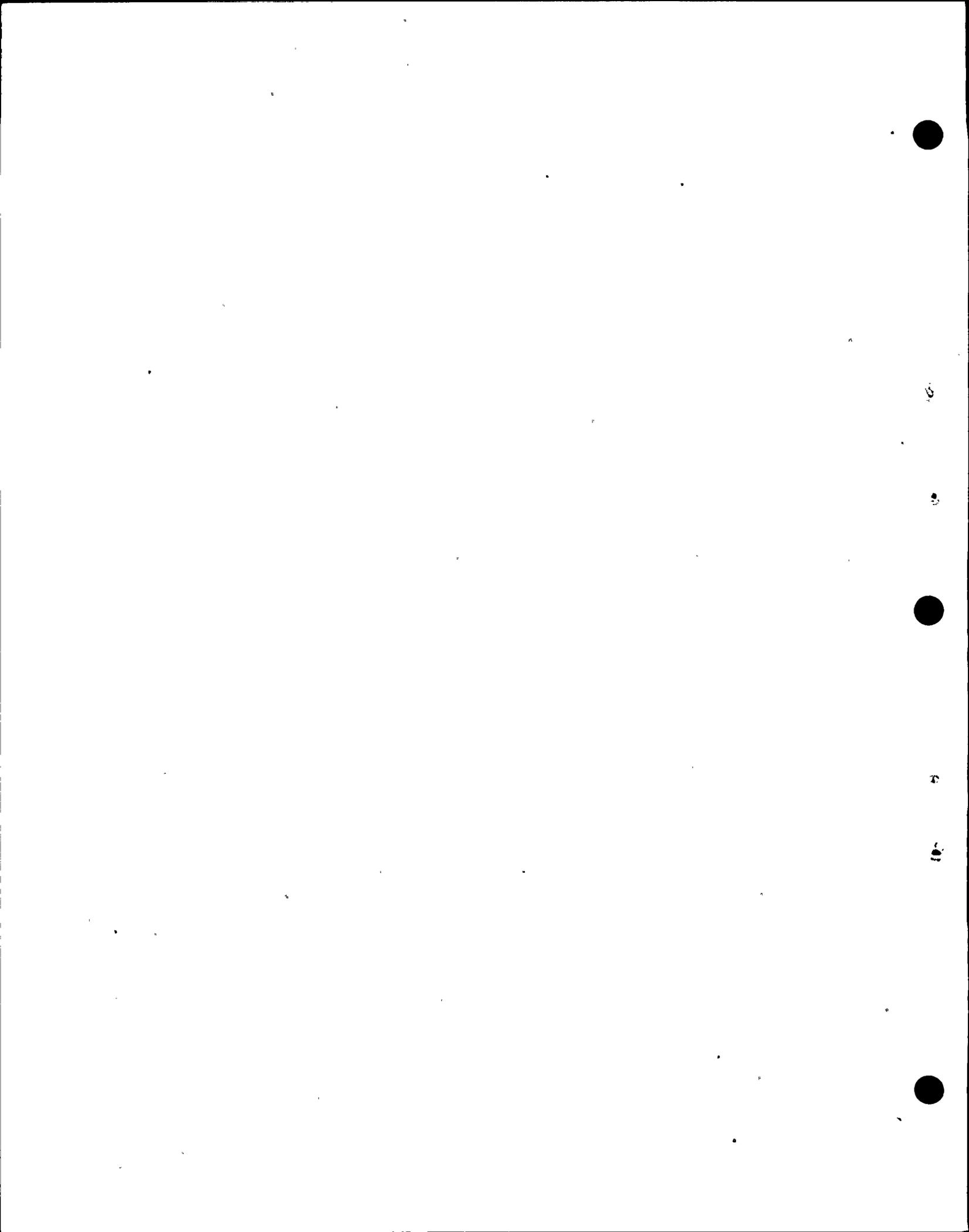
18 So by example you might put 2500 feet per second
19 for one strata and 5000 for another, and so on and so forth.

20 A That's right.

21 Q And because of their varying thicknesses that
22 would -- part of the wave would be traveling faster than
23 another part of the wave, is that correct?

24 A That's right.

25 Q And in addition to that, aren't the various



WRB/
mpb2

1 strata within themselves heterogeneous? Isn't there hetero-
2 geneity within the strata itself in terms of broken rock
3 versus solid rock, et cetera?

4 A That's right.

5 All those effects are included in this general
6 term "non-homogeneity".

7 Q Or incoherence.

8 A Leading to incoherence of the motions at the
9 base of the slab.

10 Q All right.

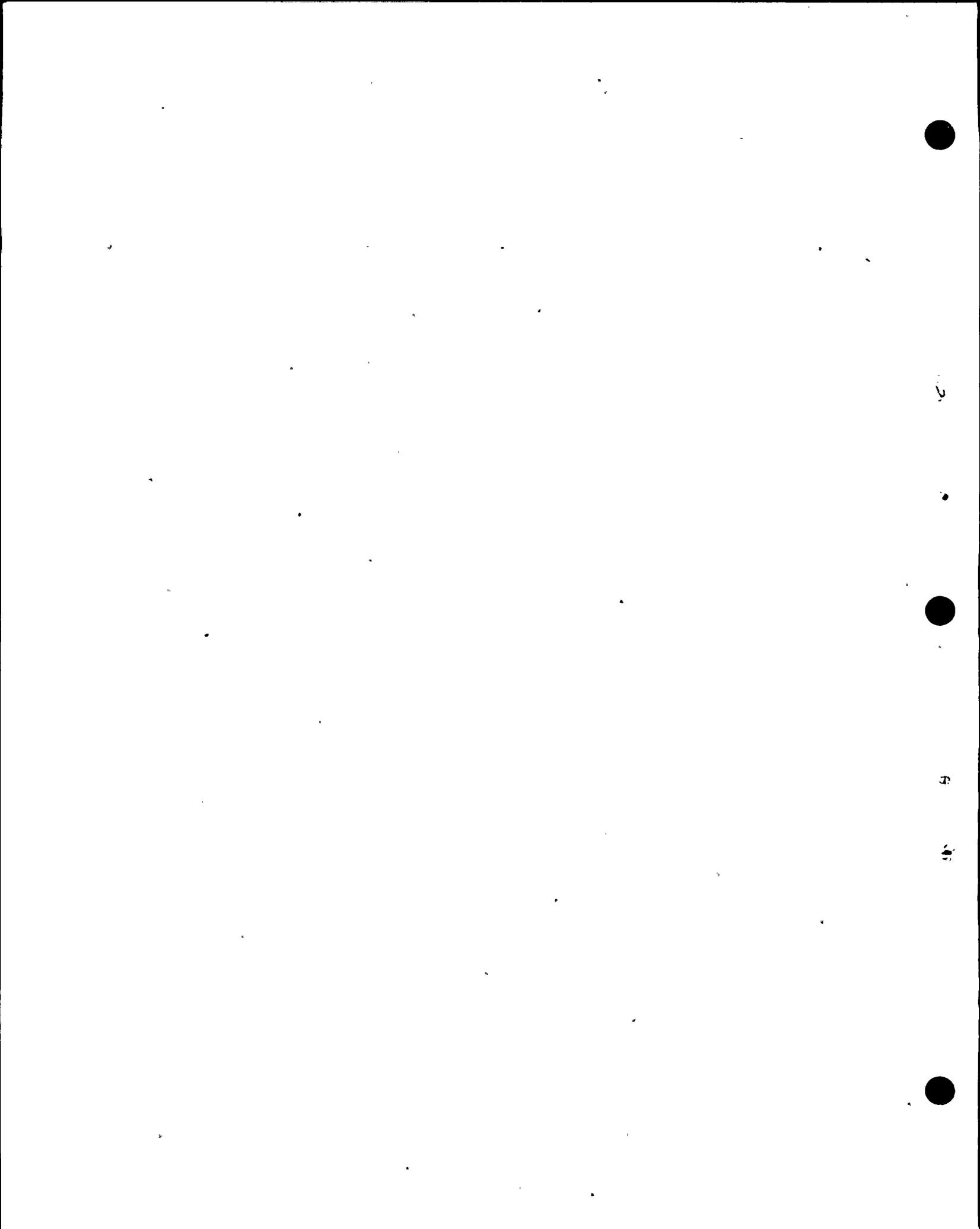
11 Is there any way of assigning either by your
12 judgment and your experience a value of reduction from the
13 peak ground motion to the integrated average that you talked
14 about? Is there any way of assigning a value of one percent,
15 100 percent?

16 A There's no way of computing this. The only way
17 we have any idea about these effects is by measurements of
18 the type that Dr. Frazier discussed, by putting instruments
19 50 feet apart on the ground surface and seeing how different
20 the motions are.

21 But I would think that to allow for this non-
22 homogeneity that a ten percent reduction would be a very
23 conservative value to be taking.

24 Q Very conservative and very reasonable?

25 A Yes.



WRB/
mpb3

1 Q All right.

2 Then in sum, if I understand where we are so far,
3 you've said that there could be a 20 percent reduction from
4 the peak for soil-structure interaction analysis.

5 A That's right, between frequencies of 4 and 25
6 cycles per second.

7 Q All right.

8 And there could be a ten percent reduction for
9 the tau effect as a result of the angle of incidence of the
10 waves.

11 A Yes, typically of that order of magnitude.

12 Q I appreciate these are order of magnitude reduc-
13 tions.

14 A Yes.

15 Q And a ten percent reduction on that order of
16 magnitude for the heterogeneities at the surface underneath
17 the facility.

18 That totals, of course, 40 percent reduction.

19 Now let me ask you:

20 If the site at Diablo Canyon is conducive to a
21 ten percent reduction for heterogeneities in the rock, I
22 mean there's already reason --

23 A I believe all sites are conducive to a ten percent
24 reduction for heterogeneities.

25 Q Okay.



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WRB/
mpb4

1 So in sum, then, Dr. Seed, I take it that you
2 would not have any problem accepting a reduction for tau
3 effect taking into account the soil-structure interaction,
4 the vertical or the non-almost-vertical waves and the
5 heterogeneities in the rock below the site, you would have
6 no problem with reducing, as has been done in this case, for
7 the tau effect?

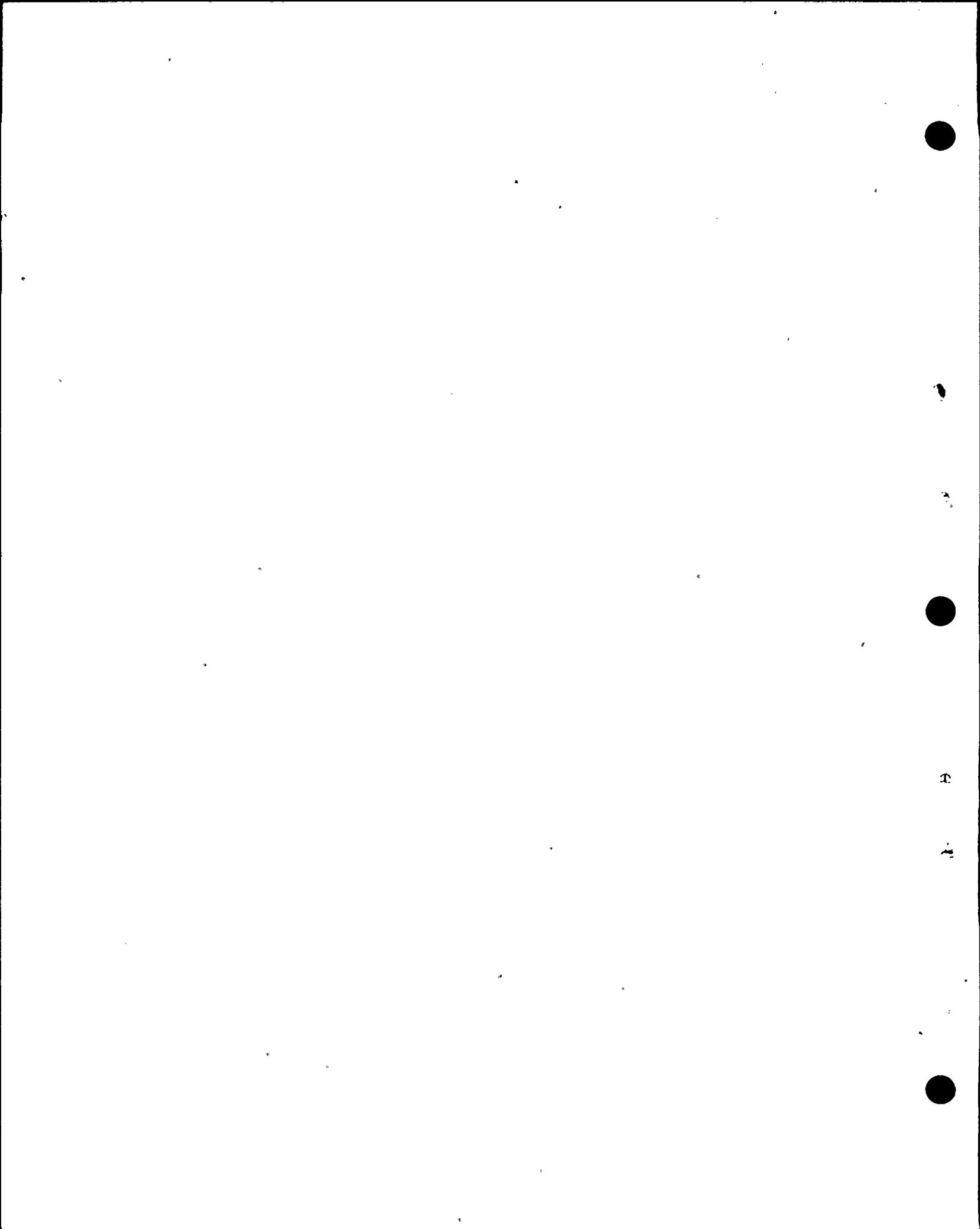
8 A Yes.

9 I don't really call soil-structure interaction
10 a tau effect, but since there is no SSI being included in
11 the analysis that is being made for Diablo Canyon, it seems
12 to me legitimate to include it as a tau effect in this case.
13 And so the total sum of the 20 percent for SSI plus two ten
14 percents for non-verticality of waves, plus -- and non-
15 homogeneity of foundations adds up to about 40 percent all
16 together.

17 To be conservative I think it would be appropriate
18 therefore to reduce the peak acceleration in the free field
19 by something on the order of 20 to 30 percent, and that would
20 be a very conservative reduction to be taking. And this is
21 what is being incorporated in the Diablo Canyon analysis by
22 applying a tau effect to a rigid base analysis.

23 I believe it is justified and a scientifically
24 defensible approach therefore.

25 Q Thank you very much, Dr. Seed.



WRB/
mpb5

1 MR. NORTON: Mrs. Bowers, this concludes our
2 rebuttal in this area, and in fact concludes our rebuttal
3 all together.

4 MRS. BOWERS: Mr. Fleischaker?

5 CROSS-EXAMINATION

6 BY MR. FLEISCHAKER:

7 Q Dr. Frazier, I have just a couple of questions
8 for you.

9 In these theoretical studies that -- well, first
10 of all, when you testified before the ACRS, did you in fact
11 testify that most of the high frequency energy would be
12 arriving at the site -- excuse me -- did you in fact testify
13 that most of the high frequency energy arriving at the site
14 would be nearly vertically incident?

15 A (Witness Frazier) I would have to review my
16 testimony and check the use of the words that I used in
17 particular.

18 Q Well, is that your current opinion?

19 A In the sense that if we're dealing with questions
20 of horizontally propagating SH waves that might induce
21 torsion in the structure, then I would say that my theoretical
22 work indicates that the waves are so steeply emerging as to
23 preclude significant torsional excitation.

24 Q Did you actually arrive at a figure for the angle
25 of incidence for the energy?



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WRB/
mpb6

1 A Well, there's a misconception -- or there may
2 be a misconception in your question.

3 I don't get a figure for a particular wave.
4 But I learned from the studies that percentages of energy
5 arrive at different angles. And so at any particular angle
6 the best I can do is to discuss percentages of waves coming
7 in at different angles and how that percentage might change
8 as a function of frequency.

9 So I cannot state an angle.

10 Q All right.

11 Let me ask you a different question:

12 This array that you had below the dam where you
13 had the accelerometer -- well, what kind of instruments did
14 you have out there?

15 A In that study I was working with both accelero-
16 meters and what we call geophones, which are velocity
17 transducers, and the velocity transducers were buried.

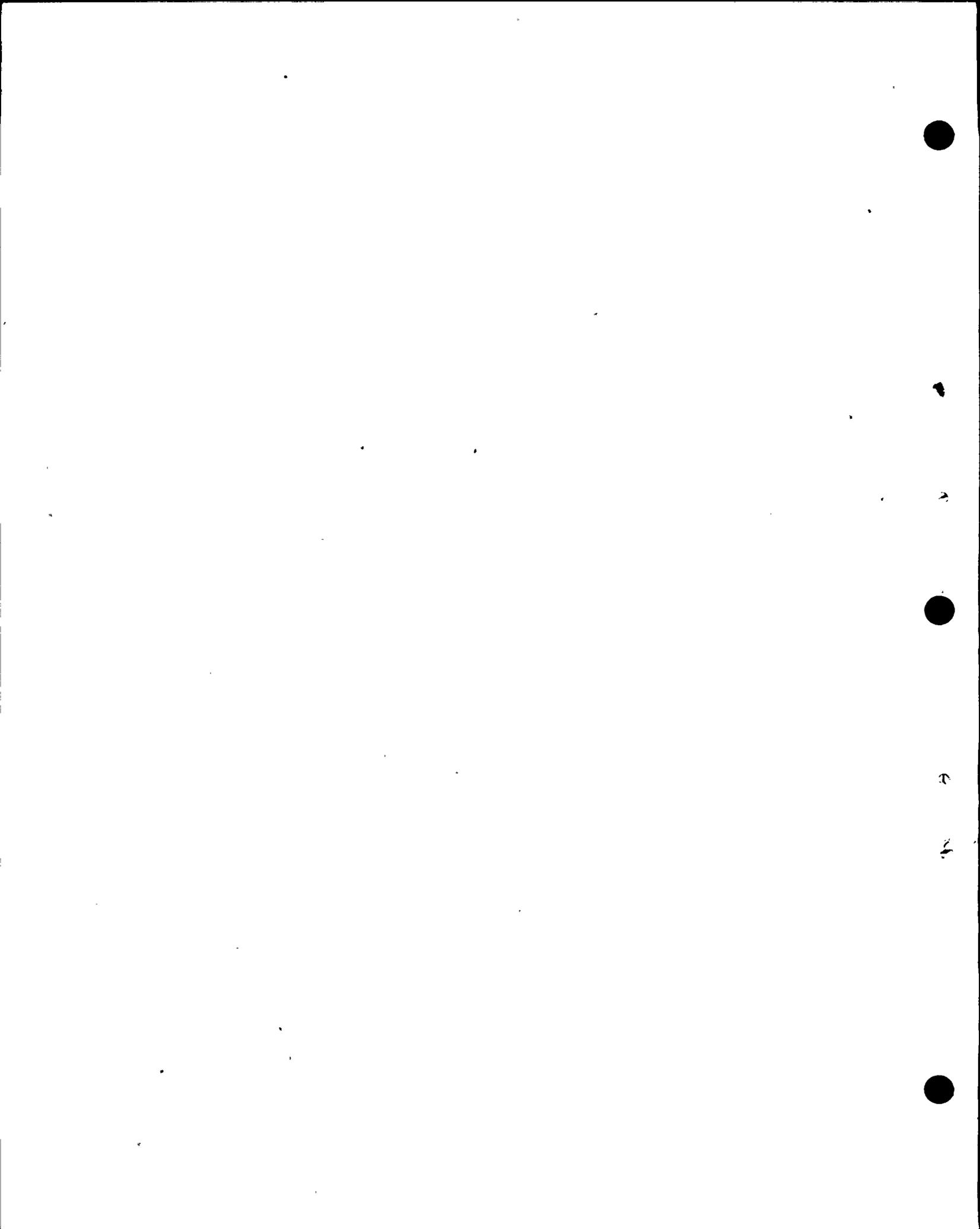
18 Q What was the distance between the accelerometers?

19 A We did several studies, and distance between the
20 accelerometers varied from 50 feet to something in excess of
21 1000 feet.

22 Q How many earthquakes did you record?

23 A Would you describe what you mean by an earthquake?
24 You mean ground shaking events?

25 Q I'm not interested in microseismicity. Earthquakes



WRB/
mpb7

1 above the magnitude of, say, four.

2 A None.

3 Q Earthquakes between the magnitude of two and four.

4 A When you're referring to magnitudes, I didn't
5 record any earthquakes.

6 Q I didn't hear your answer.

7 A You're referring to magnitudes, and I take it
8 you're using the word earthquake to mean a rupture of the
9 earth.

10 Q Correct.

11 A I didn't record any earthquakes.

12 Q I see.

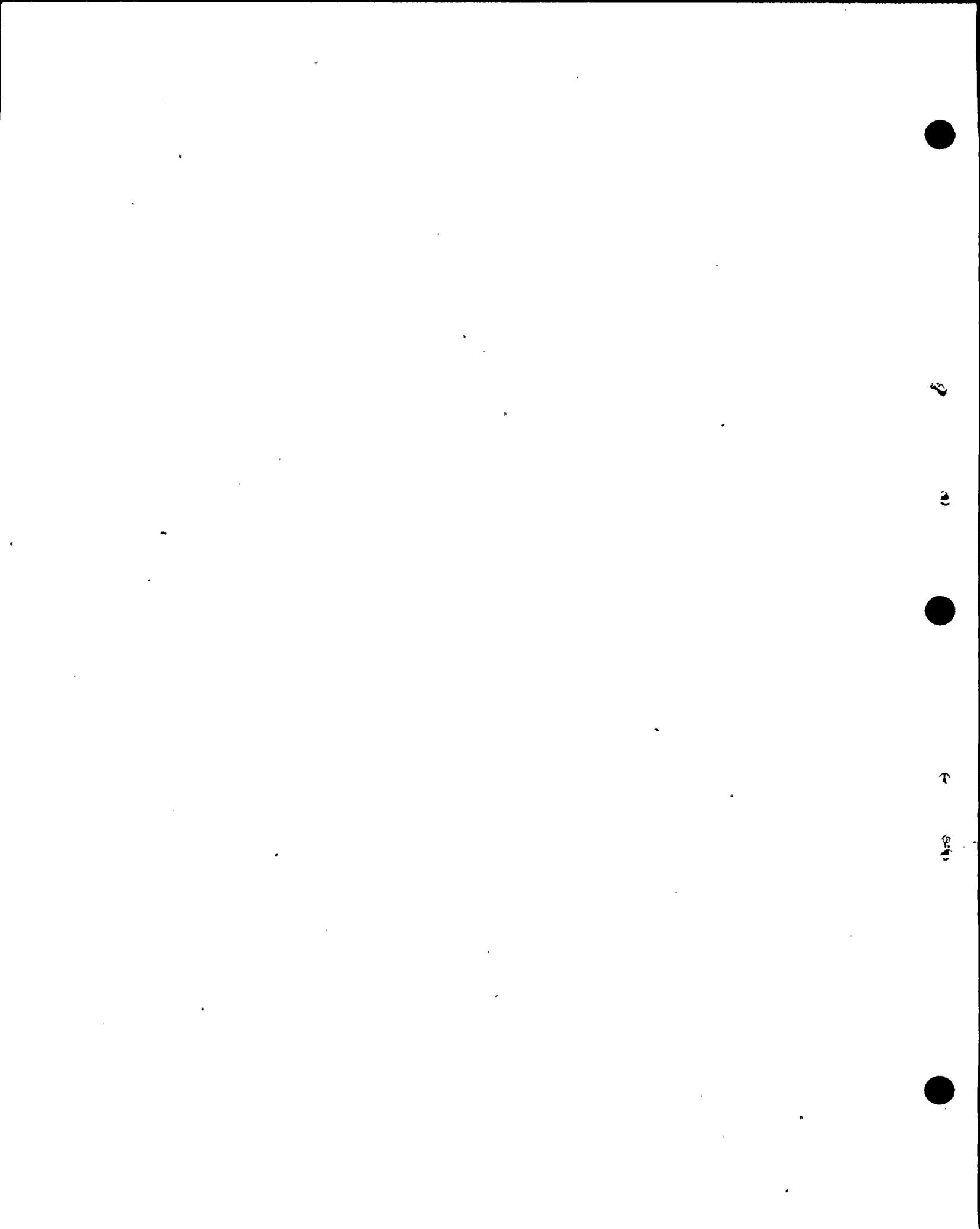
13 What did you record?

14 A Approximately eleven miles away from the Fort Peck
15 Dam the Atomic Energy Commission at that time was performing
16 cratering experiments with high energy chemical explosives.
17 And I was recording the ground motion at the dam site due
18 to those explosions.

19 And, just to give a little bit of feel for that,
20 eleven miles away, the motion was just of the type where you
21 could detect it by standing on the dam, particularly if you
22 were in a pickup truck or something, you could detect motion.

23 Q How many of those did you record?

24 A It was a long time ago. I would guess the number
25 was in excess of five.



WRB/
mpb8

1 Q In excess of five?

2 A Different events in which high energy chemical
3 explosives were detonated, and I and my colleagues and my
4 advisor from college were involved in instrumenting the dam.

5 Q Okay.

6 And how many -- does that mean between five and
7 100, or five, six, or seven?

8 A No, no, it means -- I think it was probably less
9 than ten.

10 Q What was the depth at which the charges were
11 exploded?

12 A I don't know. On the order of 100 feet.

13 MR. FLEISCHAKER: I have no further questions.

14 MRS. BOWERS: Mr. Ketchen?

15 BY MR. KETCHEN:

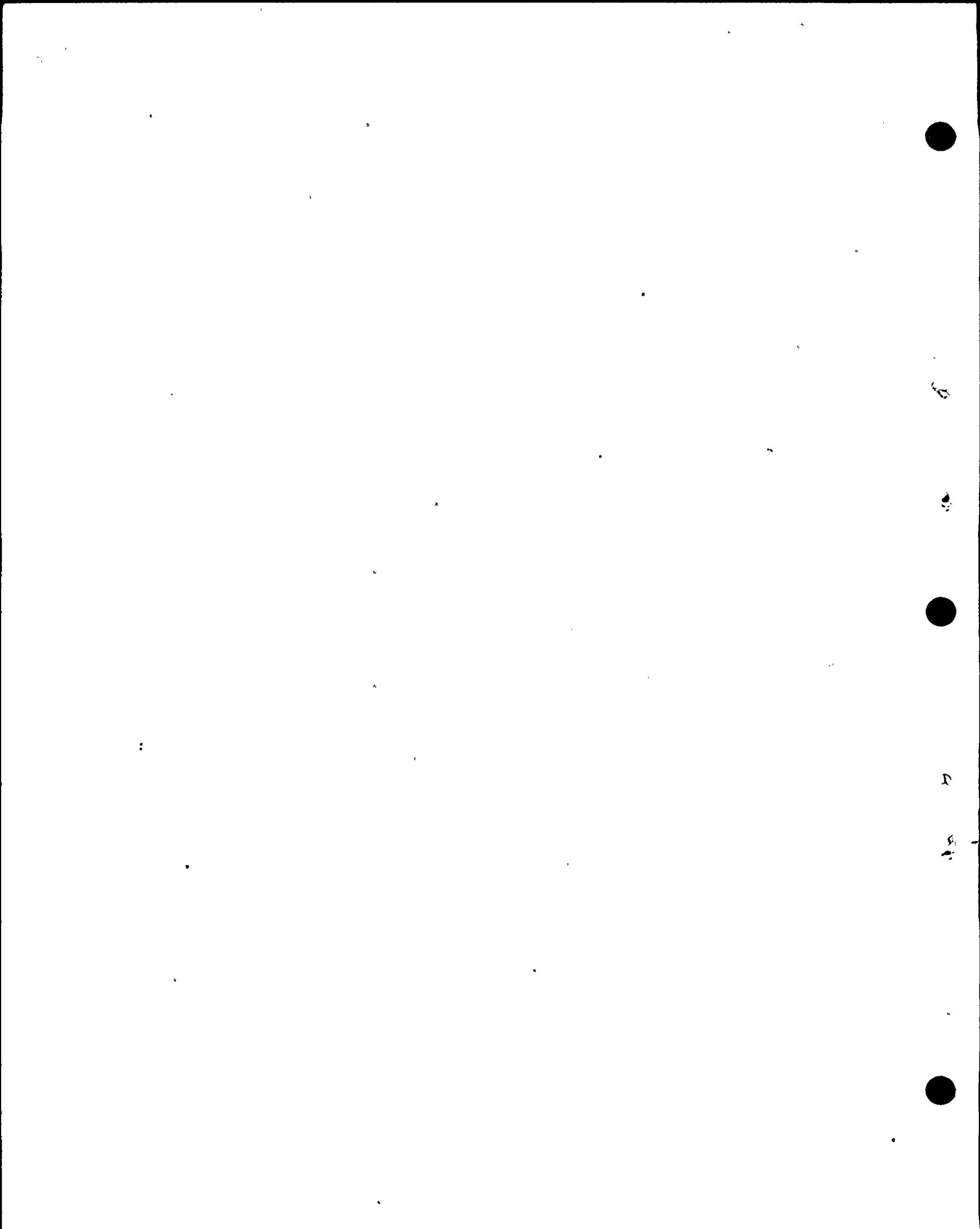
16 Q I have a question for the panel:

17 Is it your testimony -- and for the reasons
18 you state in your testimony -- that the Bartero paper is not
19 applicable to the reanalysis the Applicant conducted for the
20 Diablo Canyon facility?

21 A (Witness Malak) Yes, I agree that it's not
22 applicable.

23 Q Thank you.

24 MR. KETCHEN: Mrs. Bowers, I have no further
25 questions of this panel.



WRB/
mph9

1 MR. NORTON: Mrs. Bowers, before I forget, we
2 didn't move into evidence Applicant's Exhibit 65, which was
3 Dr. Seed's last freehand drawing, which has now been photo-
4 copied and passed out.

5 We would move that into evidence at this time.

6 MRS. BOWERS: Mr. Fleischaker, any objection?

7 MR. FLEISCHAKER: No objection.

8 MRS. BOWERS: Mr. Ketchen?

9 MR. KETCHEN: No objection.

10 MRS. BOWERS: Applicant's Exhibit number 65 is
11 admitted into evidence.

12 (Whereupon, the document
13 previously marked as
14 Applicant's Exhibit 65
15 was received in evidence.)

16 MR. NORTON: Now we also have -- and Mr.
17 Williamson is passing around -- if he can catch people as
18 they run out the door -- easy, Mr. Fleischaker, easy -- the
19 colored copy of the materials that were in color in the
20 original testimony that was submitted back in December. They
21 have now all been reproduced in color to be inserted in
22 transcripts and so on and so forth. And Mr. Williamson will
23 make sure that everybody gets the appropriate copies, includ-
24 ing the Court Reporter.

25 And I would like to take a moment to check over



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WRB/ 1
mpbl0 2

our exhibit list to make sure that everything was moved into
evidence that should have been moved into evidence, or at
least to check and make sure there is nothing that isn't in
evidence that I would like to have in evidence.

end WRB 3
Landon Flws 4

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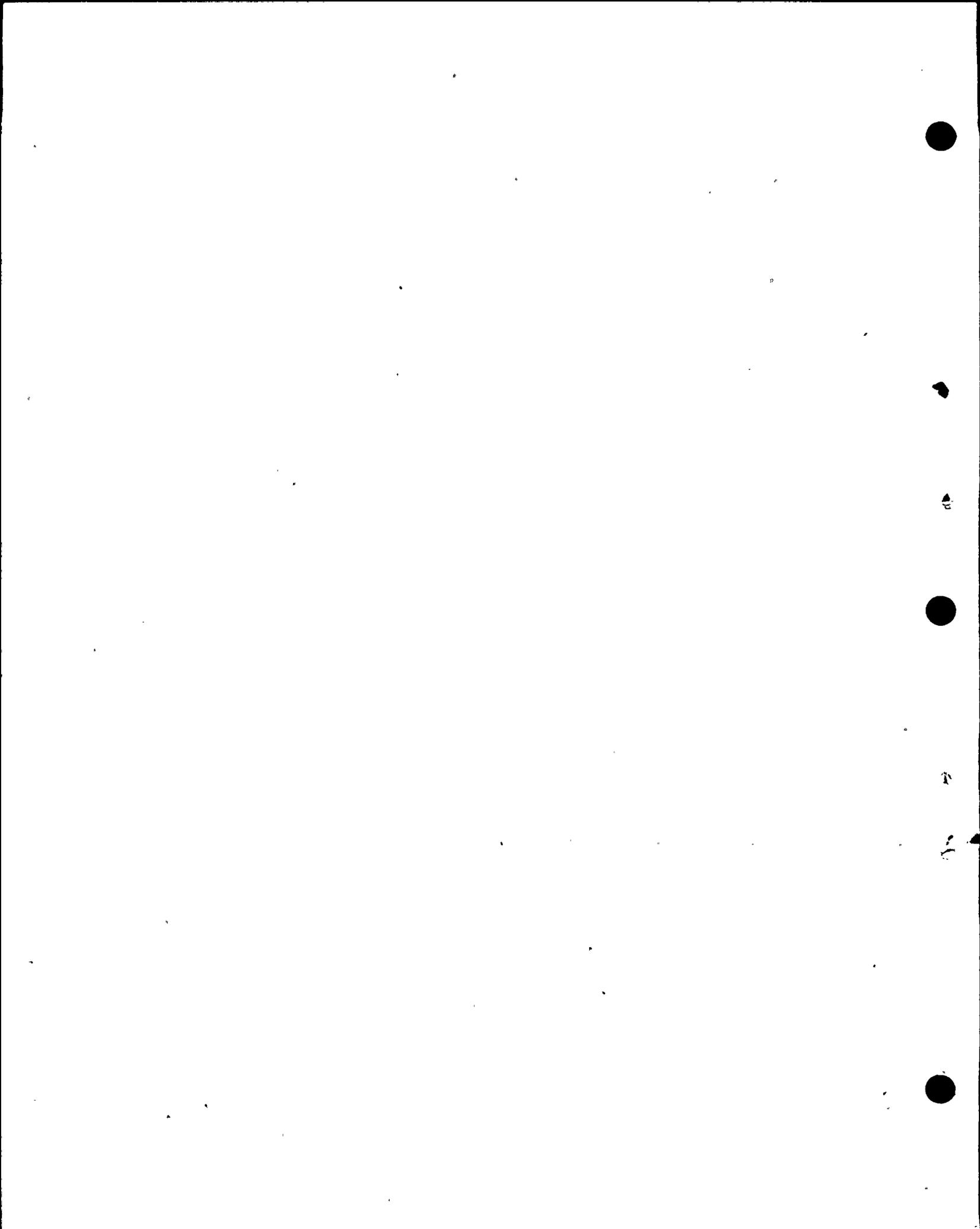
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fls WRB ?
4WEL/wel 1

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3 MR. KETCHEN: Mrs. Bowers, while he's checking
4 that list, may I take up an administrative matter, too?
5 It's a procedural matter that has to do with the record. Or
6 would you prefer me to wait?

7 MRS. BOWERS: Go ahead.

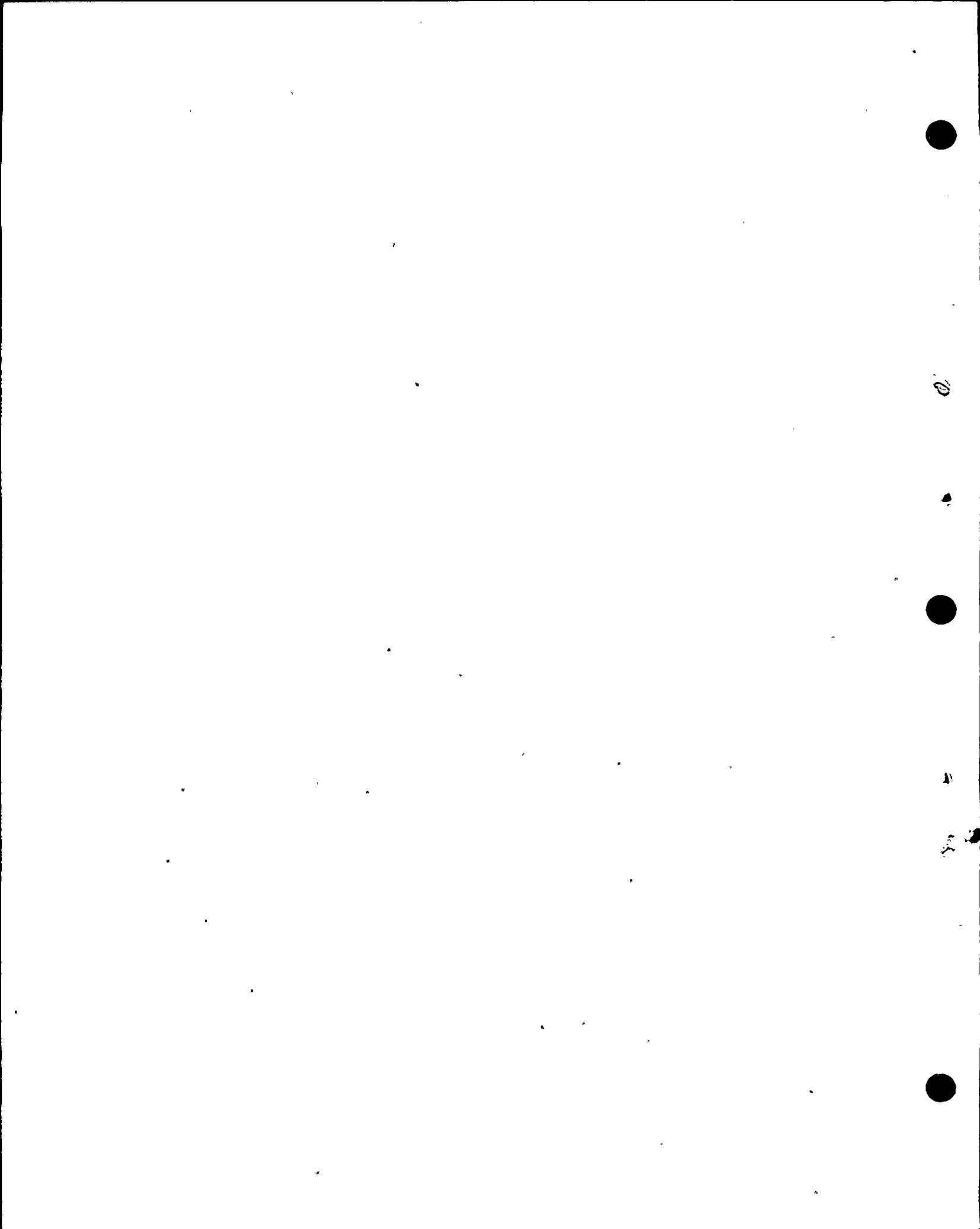
8 MR. KETCHEN: It's a procedural thing, but it
9 involves the motion that I made to move the affidavits of
10 Messrs. Aycock, Crocker and Allison into the record.

11 In view of your ruling--I had requested that the
12 affidavit itself be submitted into the record and bound
13 into the transcript as though read. Along with that, I
14 had submitted a couple of exhibits marked for identification--
15 what I would like to do is amend my motion to take the
16 affidavits, plus the professional qualifications of both
17 Messrs. Aycock and Crocker, and have them simply marked
18 for identification, so that when you rule it would be a
19 simple matter of moving them into the record as evidence,
20 and then I wouldn't have to resubmit 30 copies of the
21 affidavit, plus the professional qualifications.

22 And so with that amendment--I would like to
23 amend my motion in that respect.

24 MRS. BOWERS: You're turning all of them into
25 exhibits?

MR. KETCHEN: Yes, ma'am. I would identify the
exhibits as follows:



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1 I would mark Mr. Michael B. Aycock's professional
2 qualifications as Exhibit Number 13.

3 Mr. Lawrence P. Crocker's professional qualifica-
4 tions as Number 14 for identification.

5 The affidavit of Michael B. Aycock, Lawrence P.
6 Crocker and Dennis P. Allison relating to the status of NRC
7 Staff activities regarding generic safety issues I would
8 mark as Staff Exhibit Number 15 for identification.

9 MRS. BOWERS: Any objection, Mr. Fleischaker?

10 MR. FLEISCHAKER: No objection.

11 MRS. BOWERS: Does the Applicant have any
12 objection?

13 MR. NORTON: No objection.

14 MRS. BOWERS: The documents which you have
15 identified as Staff's Exhibits 13, 14 and 15 -- well, wait
16 a minute, you're --

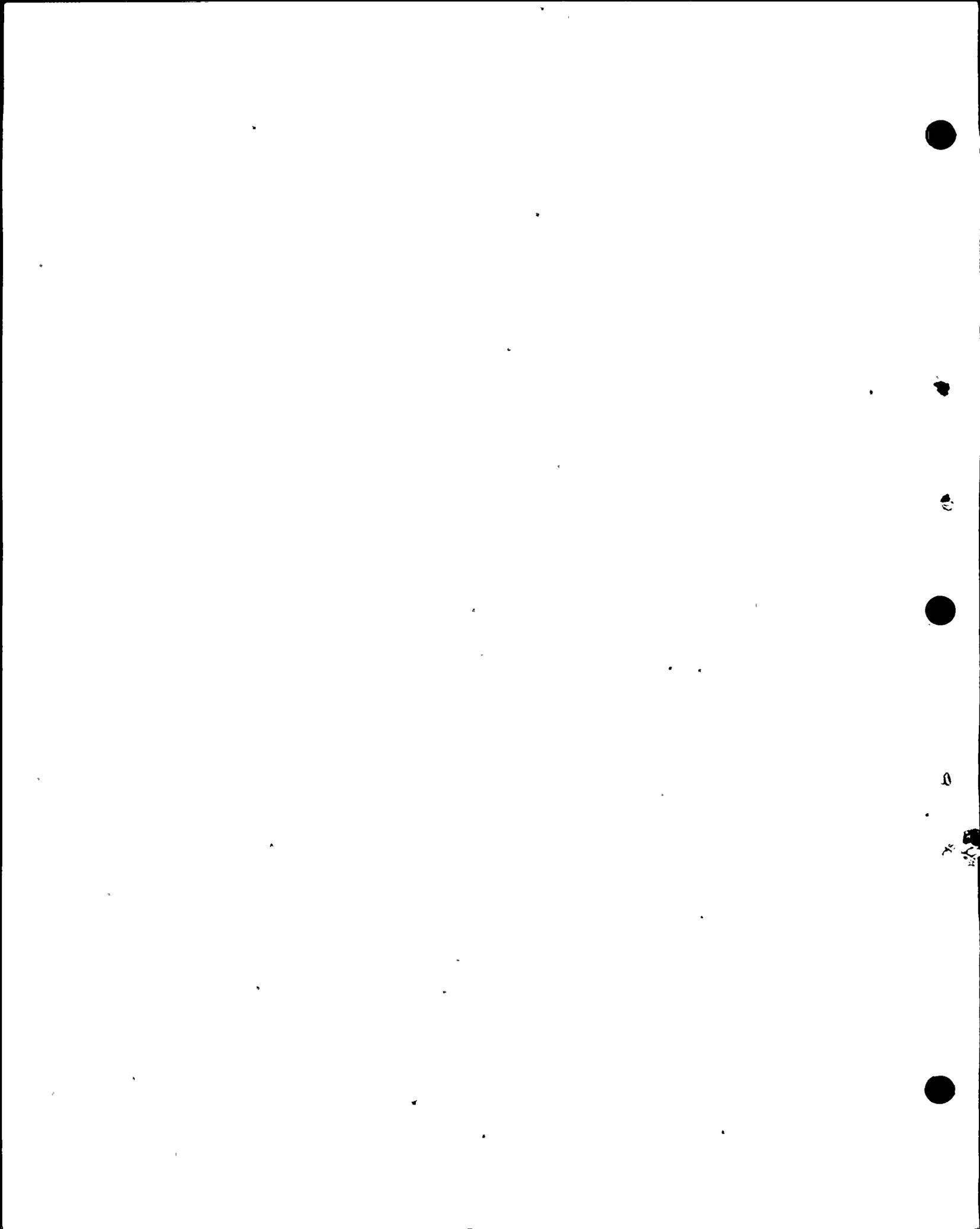
17 MR. NORTON: Can we excuse these witnesses? Some
18 of them have got planes to catch..

19 MRS. BOWERS: Any objection to the witnesses being
20 excused?

21 (No response.)

22 (Witnesses excused.)

23 Actually, you're not really offering these in
24 evidence now, you want us to know that you're changing from
25 your original planned procedure, and, depending on our ruling



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2 you would have them considered as exhibits, rather than
3 prepared testimony to be physically inserted in the record?

4 MR. KETCHEN: I think so. All I'm doing is
5 proferring them for identification, at this time.

6 MRS. BOWERS: For identification. Fine. Well,
7 they will --

8 MR. KETCHEN: The motion still stands. I haven't
9 withdrawn the motion. And as I read your ruling, it was
10 not a ruling on the motion, but a deferral of that ruling.

11 MRS. BOWERS: Well, they'll be marked for
12 identification, then, as 13, 14 and 15.

13 (The documents referred to were
14 marked for identification as
15 Staff Exhibits 13, 14 and 15.)

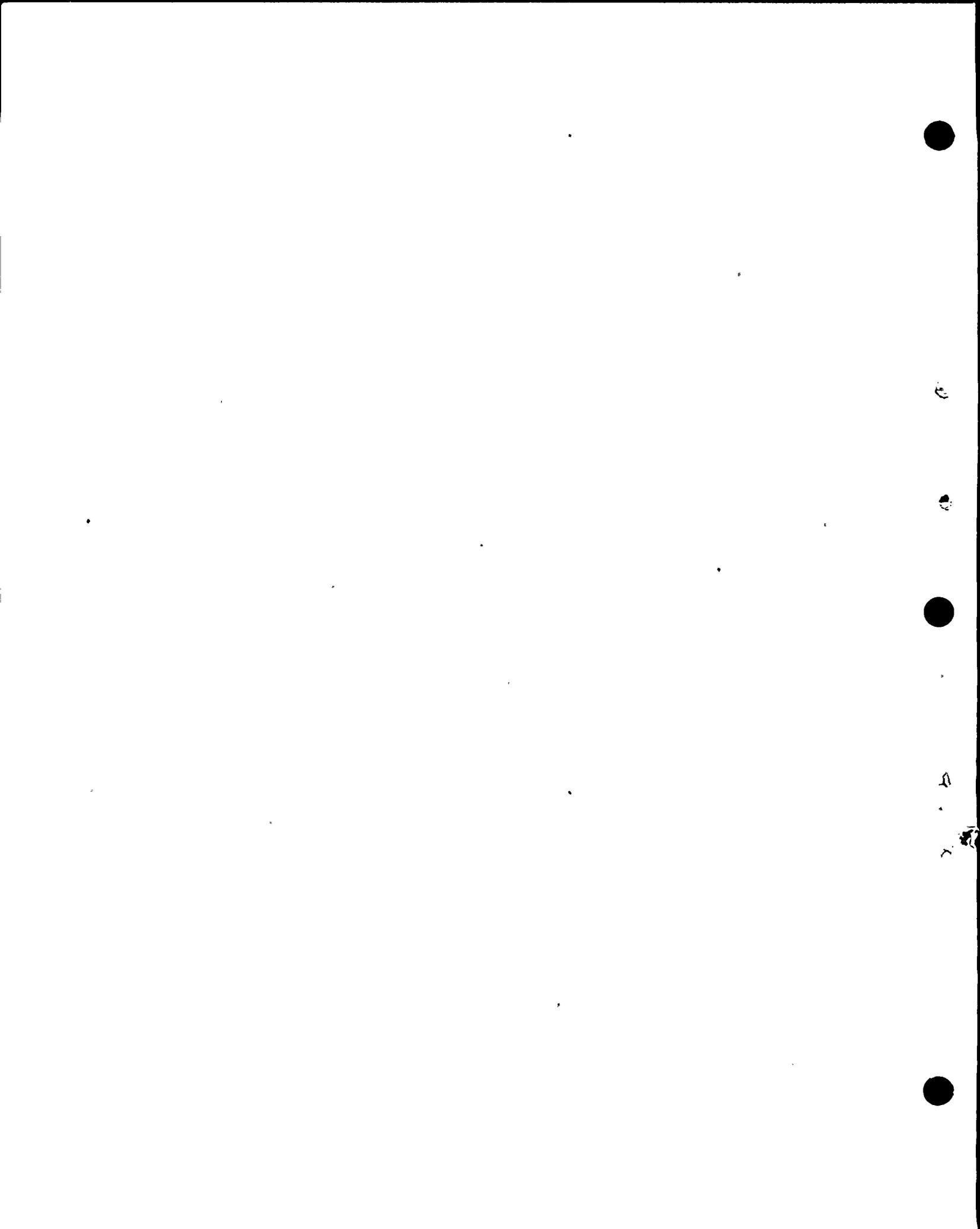
16 Now, there's another administrative matter.

17 When we were in the bench conference, the parties
18 agreed that the Applicant will submit proposed findings of
19 fact on March 13, the Joint Intervenors on March 23, and
20 the Staff on April 3.

21 Are you done with your exhibit review, Mr. Norton?

22 MR. NORTON: No, I'm not. I'm sorry. And I
23 didn't really hear what you were saying. I was looking at
24 this. I apologize.

25 MRS. BOWERS: Well, I just recited the proposed
findings of fact schedule.



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1 MR. NORTON: Yes. We were involved in that. I
2 have no objection. We get an opportunity, of course, to
3 respond under the Rules.

4 MR. FLEISCHAKER: That's correct.

5 MR. NORTON: And we'll stick with the timing
6 schedule.

7 MR. FLEISCHAKER: Correct.

8 MR. KETCHEN: That schedule is acceptable to Staff.

9 MR. FLEISCHAKER: Yes, the Board has correctly
10 stated the agreement, as I recall it.

11 MR. NORTON: We will have those couriered to Mr.
12 Fleischaker and the Staff, Mrs. Bowers. But let me ask:

13 Is it necessary to have them couriered to the
14 Board on March 13? If it's not, then we'll just simply send
15 them by regular means.

16 MRS. BOWERS: That's fine.

17 MR. NORTON: All right.

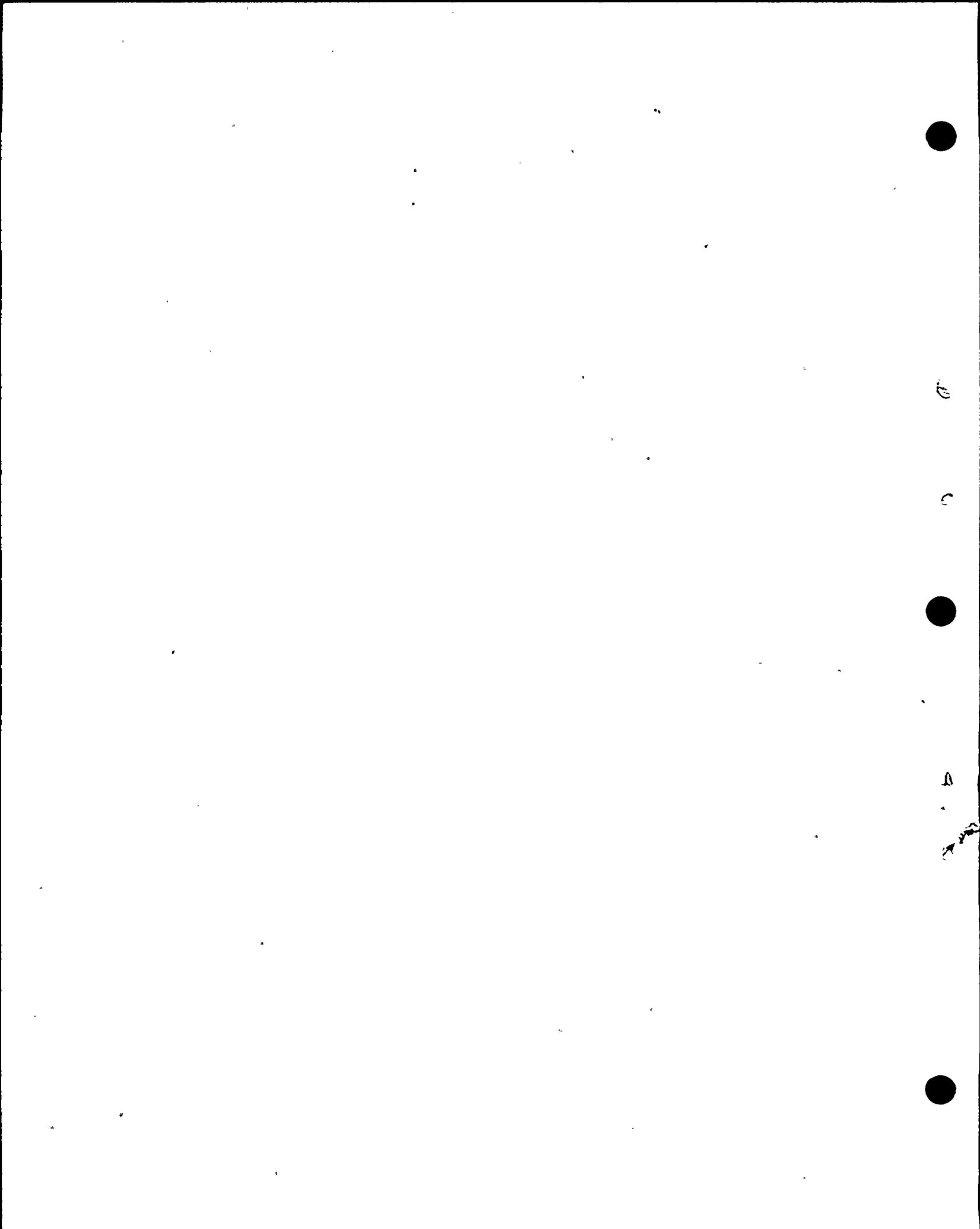
18 (Pause.)

19 I think the exhibits are okay in terms of being
20 in evidence, the ones that belong in evidence.

21 MRS. BOWERS: Well, we have one other matter.

22 The S-3 table that the Staff told us in the bench
23 conference they would -- and, Mr. Fleischaker, there's no
24 reason for you to remain, since you're not involved in this.

25 But, before you leave, we've had eight weeks that



1 have been very difficult, and, although there's been a little
2 battle scene from time to time, you really have all behaved
3 very well.

4 Of course, we've appreciated having the witnesses
5 here from all parties to hear their viewpoints.

6 So, if you want to leave, Mr. Fleischaker, the
7 one remaining piece of business is the Staff's treatment of
8 the S-3 table.

9 MR. NORTON: Well, we may bring up some other
10 things.

11 (Laughter.)

12 MR. FLEISCHAKER: Are there other things for which
13 I might want to be here?

14 (Laughter.)

15 MRS. BOWERS: Well, we're ready to close the
16 record, except for the generic safety issues and the Staff's
17 S-3 table.

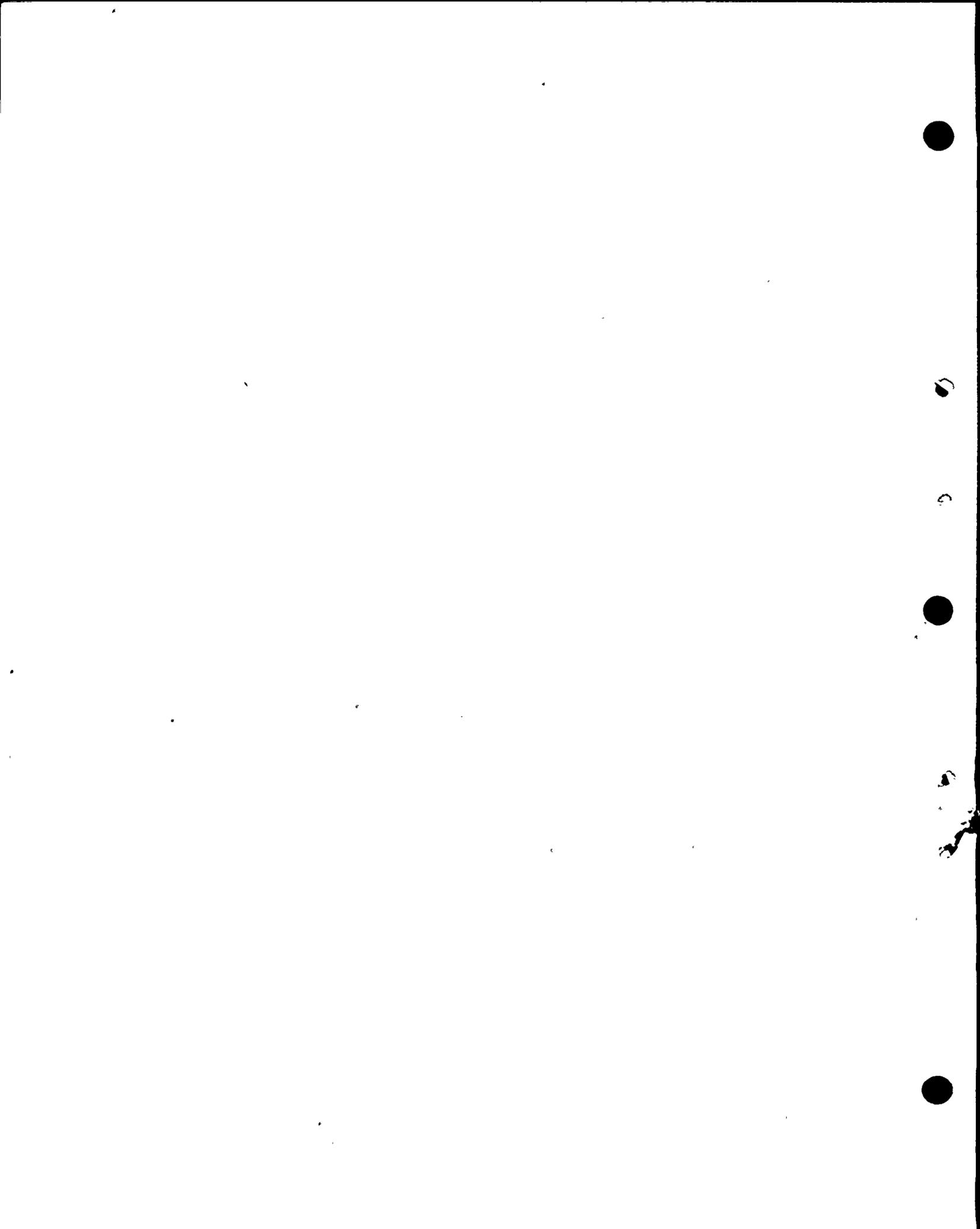
18 MR. FLEISCHAKER: Well, if I can have the Board's
19 permission, I'd like to be excused. I'm going to try to
20 catch a 5:10 plane.

21 MRS. BOWERS: Well, anyway, the record is closed,
22 except for the generic safety issues and the S-3 table.

23 MR. FLEISCHAKER: Fine. I understand that.

24 MRS. BOWERS: Have a good trip.

25 MR. FLEISCHAKER: Thank you very much. It's been



wel 6 1 interesting. I can't say I've always enjoyed it, but it has
2 been interesting, and I think, on the whole, a pleasure.

3 MRS. BOWERS: Do you want to go ahead, Mr. Ketchen?

4 MR. KETCHEN: Yes, ma'am.

5 At the bench conference I said I would tell you
6 how the Staff would handle the S-3 matter. I said I would,
7 as my first reaction.

8 But remembering yesterday's conversation with the
9 Board, I had indicated that I would provide to the Board the
10 Perkins record, and will do so next week.

11 Does the Board want anything more? The Perkins
12 record, by the way, includes, as I recall, the five affidavits
13 that we submitted in our motion of May 2, 1978, plus the
14 deposition of Dr. Kepford. And you indicated that there
15 was additional hearing testimony that was taken by the Board,
16 and we will provide that.

17 So, I'm not sure -- I'm going to provide that,
18 but I'm not sure what the Board would have me do.

19 MRS. BOWERS: Mr. Bright reminded me that all
20 panel members received a copy of the Perkins transcript. Now,
21 whether that included more than just the transcript, I'm
22 not sure.

23 This was at the time when the Appeal Board said
24 Perkins should be used.

25 MR. KETCHEN: Yes, Ma'am. This Board panel did?



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1 Yes, you're correct.

2 MRS. BOWERS: Well, you see, I have the whole
3 thing, because I'm now on Perkins.

4 MR. KETCHEN: Yes, ma'am, I know that.

5 All I can say is back last summer, as I recall,
6 Staff Counsel in all cases attempted to send the Perkins
7 record to all Boards, and that's why I was surprised
8 yesterday and caught up short when I got a message that, no,
9 it had not been submitted to this Board.

10 I asked somebody to go back and check, and they
11 couldn't find a record that it had been submitted.

12 MRS. BOWERS: Well, Mr. Bright could have gotten
13 it in some other proceeding.

14 MR. BRIGHT: Well, I don't know which proceeding
15 it was, but some little note on the back of an envelope or
16 something that says we have officially transmitted this to
17 you for the record, something like that?

18 MR. KETCHEN: We couldn't find anything in our
19 formal files that said that.

20 MR. BRIGHT: I mean will you? That's the only
21 thing I'm concerned about.

22 MR. KETCHEN: Yes, I will submit the Perkins
23 record to this Board with a motion, a proper affidavit, or
24 whatever it takes, to move its admission into this record,
25 yes, next week.



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MRS. BOWERS: And to the parties?

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MR. KETCHEN: And to the parties, yes.

3.

MRS. BOWERS: Is that satisfactory?

4

MR. BRIGHT: Yes.

5

MRS. BOWERS: Well, now, is there any other --
6 now that Mr. Fleischaker is gone, do you want a motion to
7 reopen the record or --

8

(Laughter.)

9

-- to strike Joint Intervenors' testimony?

10

(Laughter.)

11

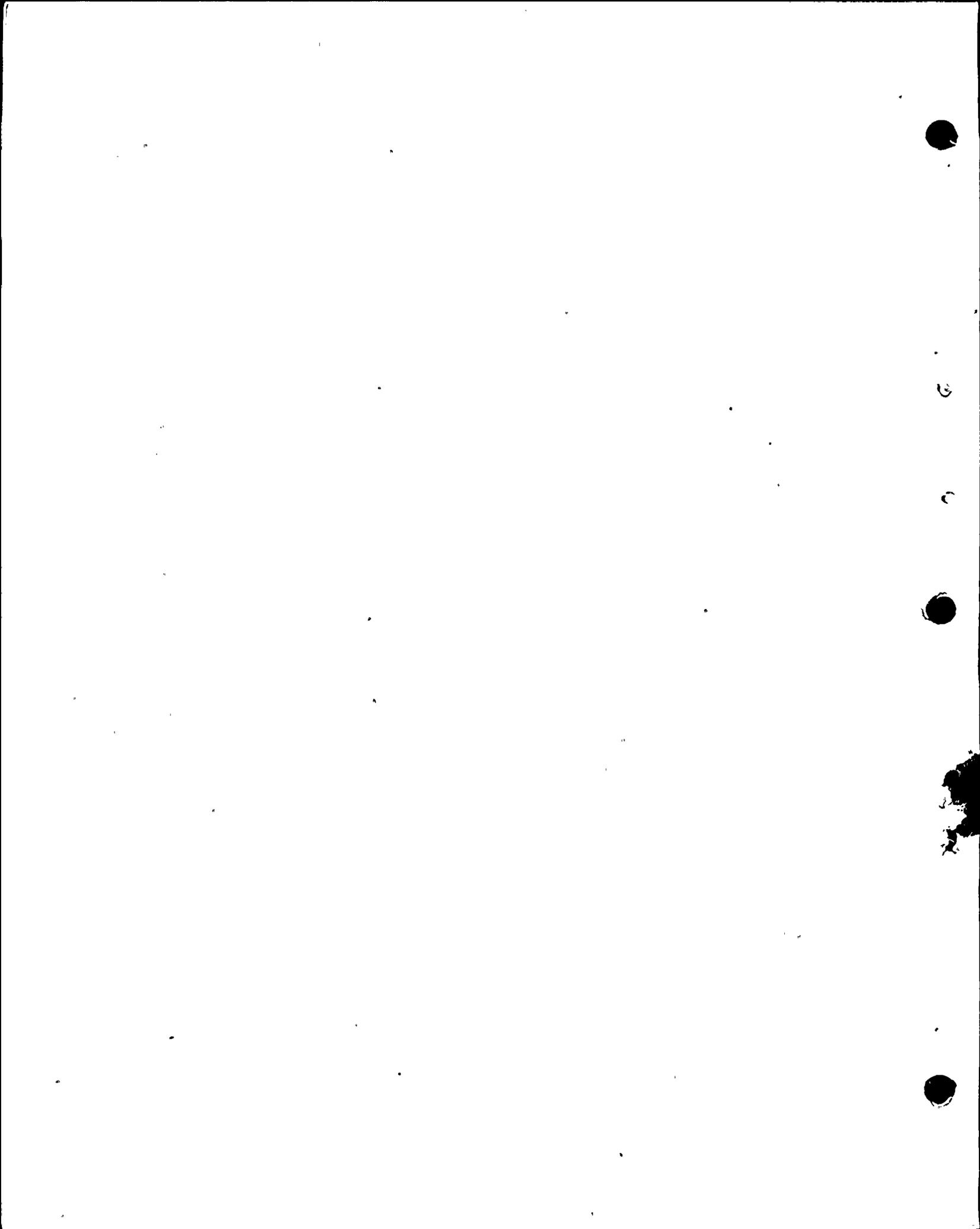
MR. KETCHEN: Mrs. Bowers, I must say that, as
12 far as Staff Counsel is concerned, I think the proceedings
13 have been interesting, educational -- to this particular
14 Staff Counsel, in any event. I commend the Board on its
15 running of the case, and it was a pleasure to be here.

16

MRS. BOWERS: Well, you know, we expressed some
17 concern at the beginning, because we were hearing vocabulary
18 that was so specialized. But as time went on, and we heard
19 about the same things over and over again from different
20 witnesses, then of course it fell into place.

21

So my concern, early on, that our record might
22 be a problem, because it was so scientific and so specialized,
23 to a reviewing authority, I think was cured as the same
24 subjects were covered time after time after time. In this
25 connection, I feel that our court reporters are to be



wel 9

1 commended for their preparation of a fine transcript of
2 proceedings in this especially difficult and technical
3 hearing.

4 Well, if there's nothing further --

5 MR. NORTON: We feel compelled, I guess, after
6 everyone else said something --

7 (Laughter.)

8 to say that we, too, shall I say, enjoyed it, and we do
9 appreciate the Board's attention. It was a very difficult
10 subject matter, as we who prepared the case over the last
11 6-8 months are well aware, and as you are now well aware.
12 And we appreciate your attention very much.

13 Thank you.

14 MR. BLOOM: We liked it, too.

15 (Laughter.)

16 MRS. BOWERS: The rich Mr. Bloom.

17 (Laughter.)

18 MRS. BOWERS: We have nothing further, so we
19 are adjourned. The record is closed. Have a safe trip
20 home.

21 (Whereupon, at 5:00 p.m., the hearing was
22 adjourned.)

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