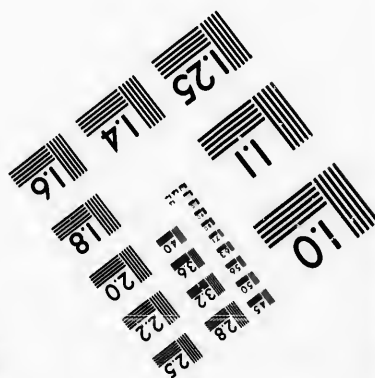
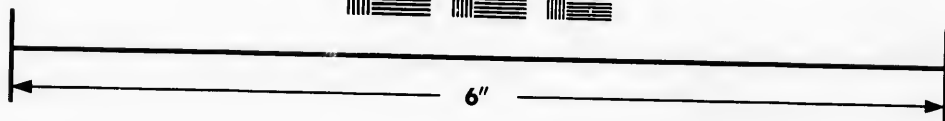
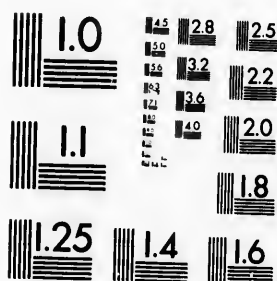


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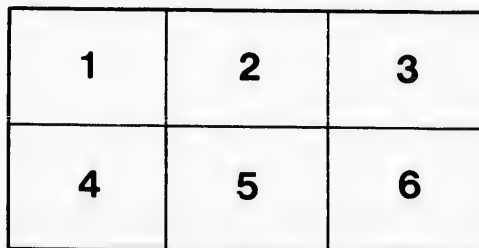
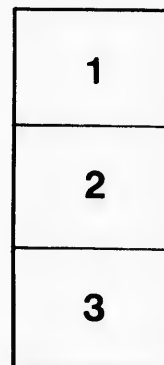
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E.C. 2 (Supreme Court)

IN THE
Supreme Court of British Columbia.

BETWEEN :

THE IRON MASK GOLD MINING COMPANY, (Foreign),
PLAINTIFFS.

AND

THE CENTRE STAR MINING AND SMELTING
COMPANY (Foreign), AND GEORGE GOODER-
HAM AND THOMAS GIBBS BLACKSTOCK,
DEFENDANTS.

EVIDENCE

OF

CLARENCE KING, WALDEMAR LINDGREN and ROSSITER W. RAYMOND,

Taken at Trial at Rossland, commencing April 17th, 1899.

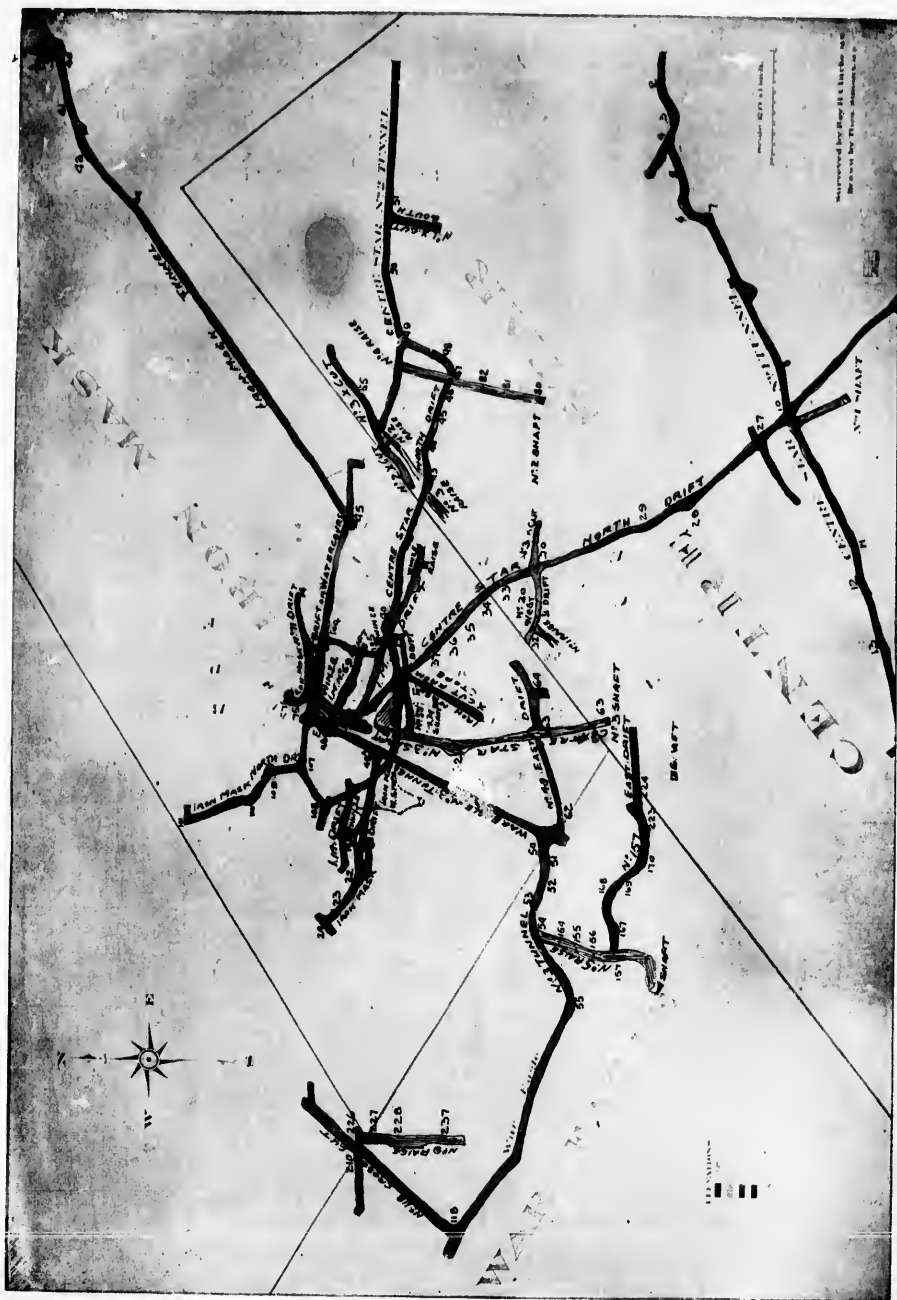
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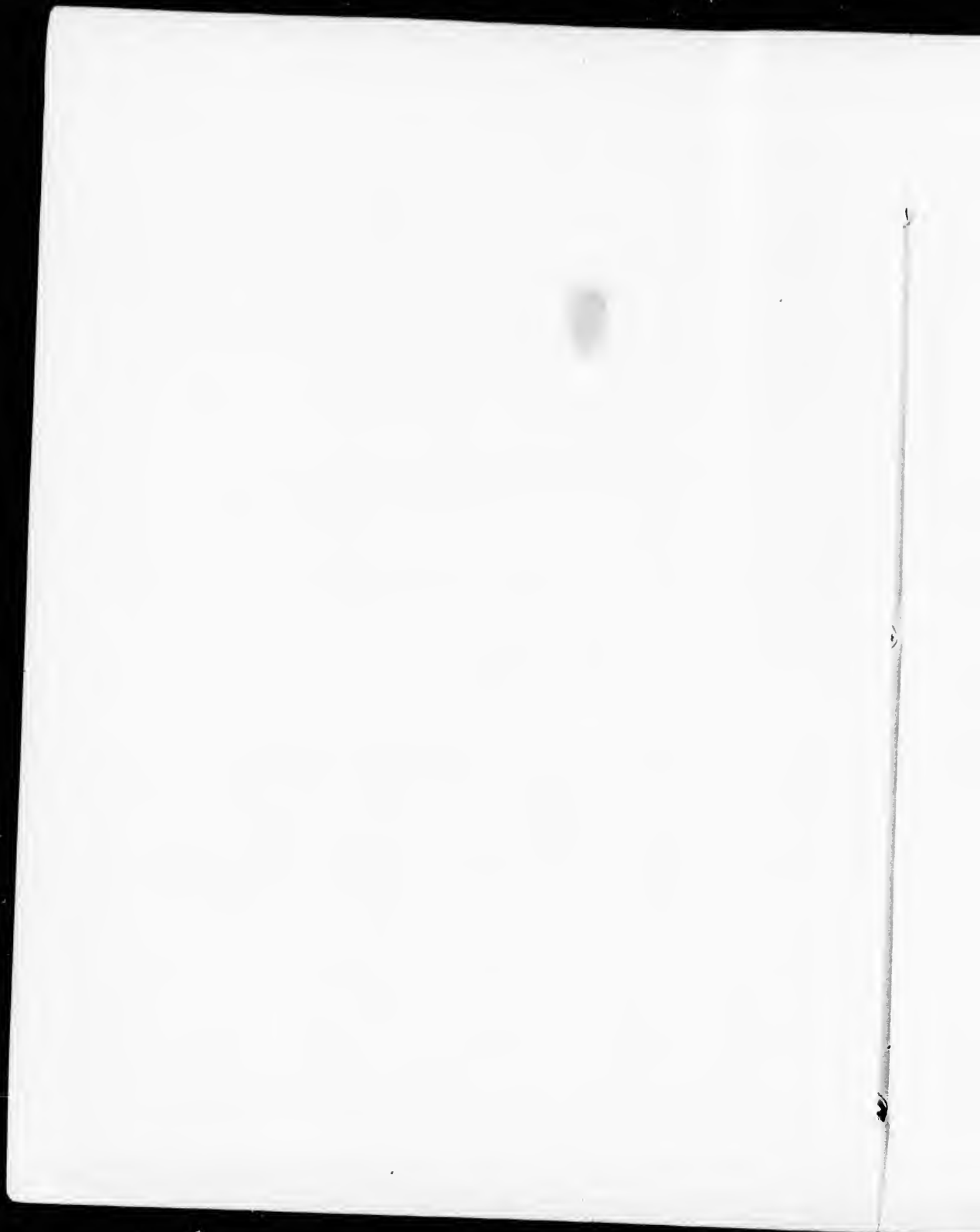
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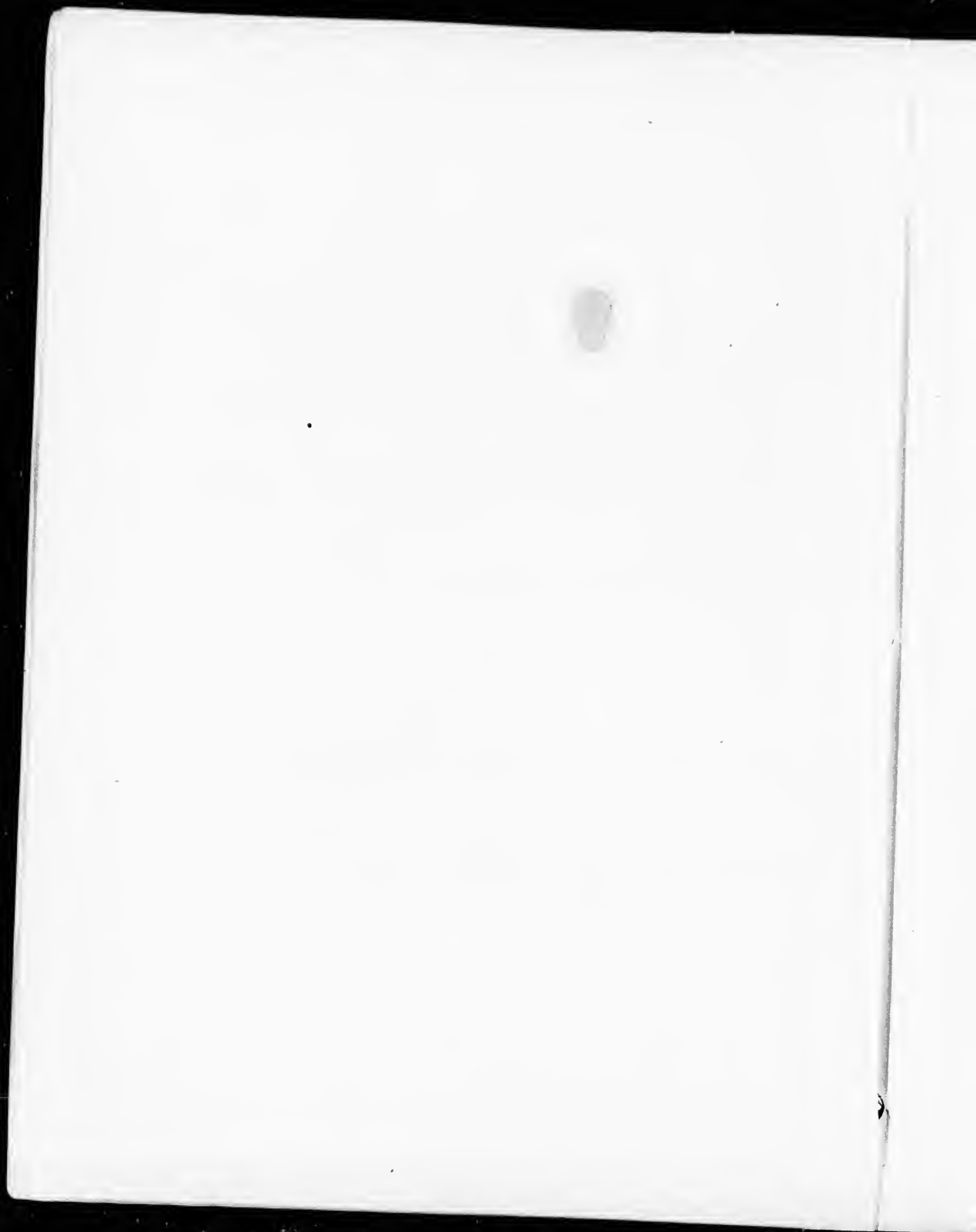
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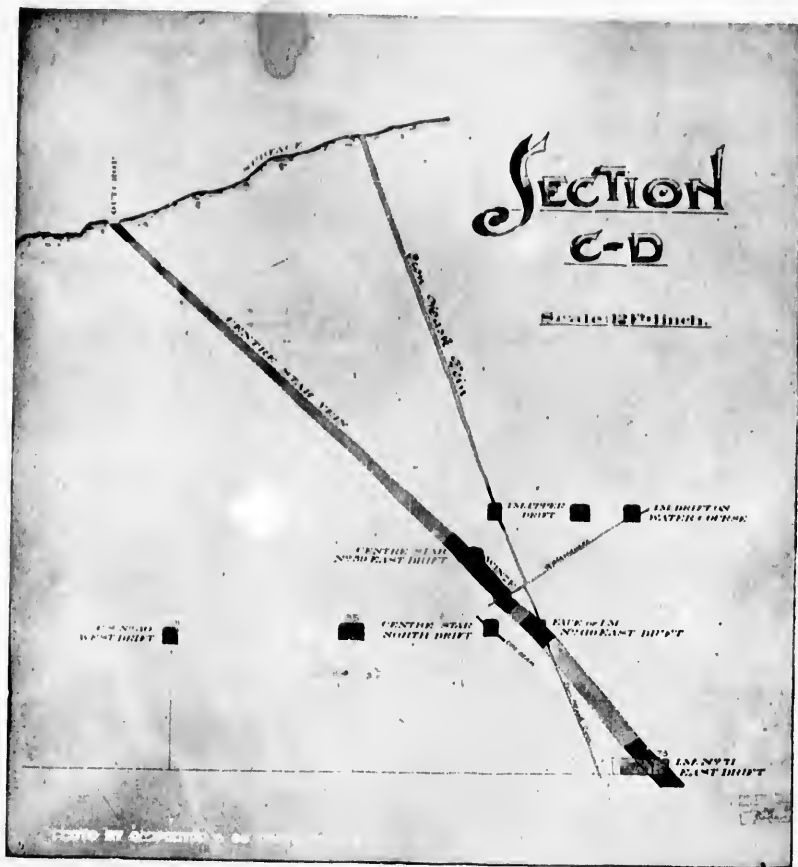




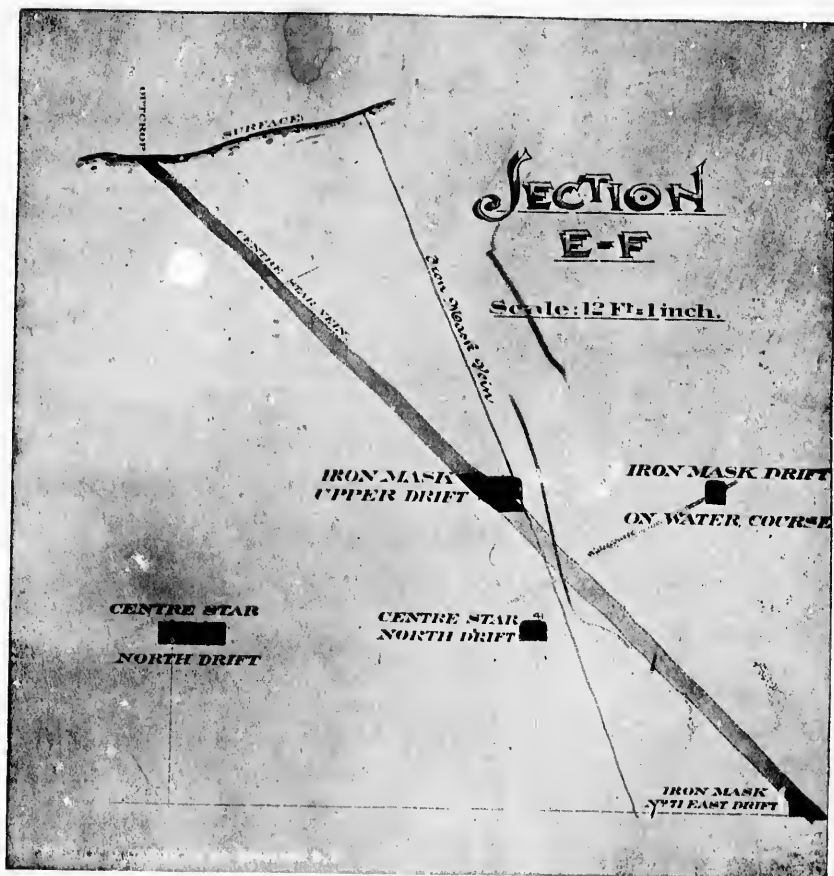


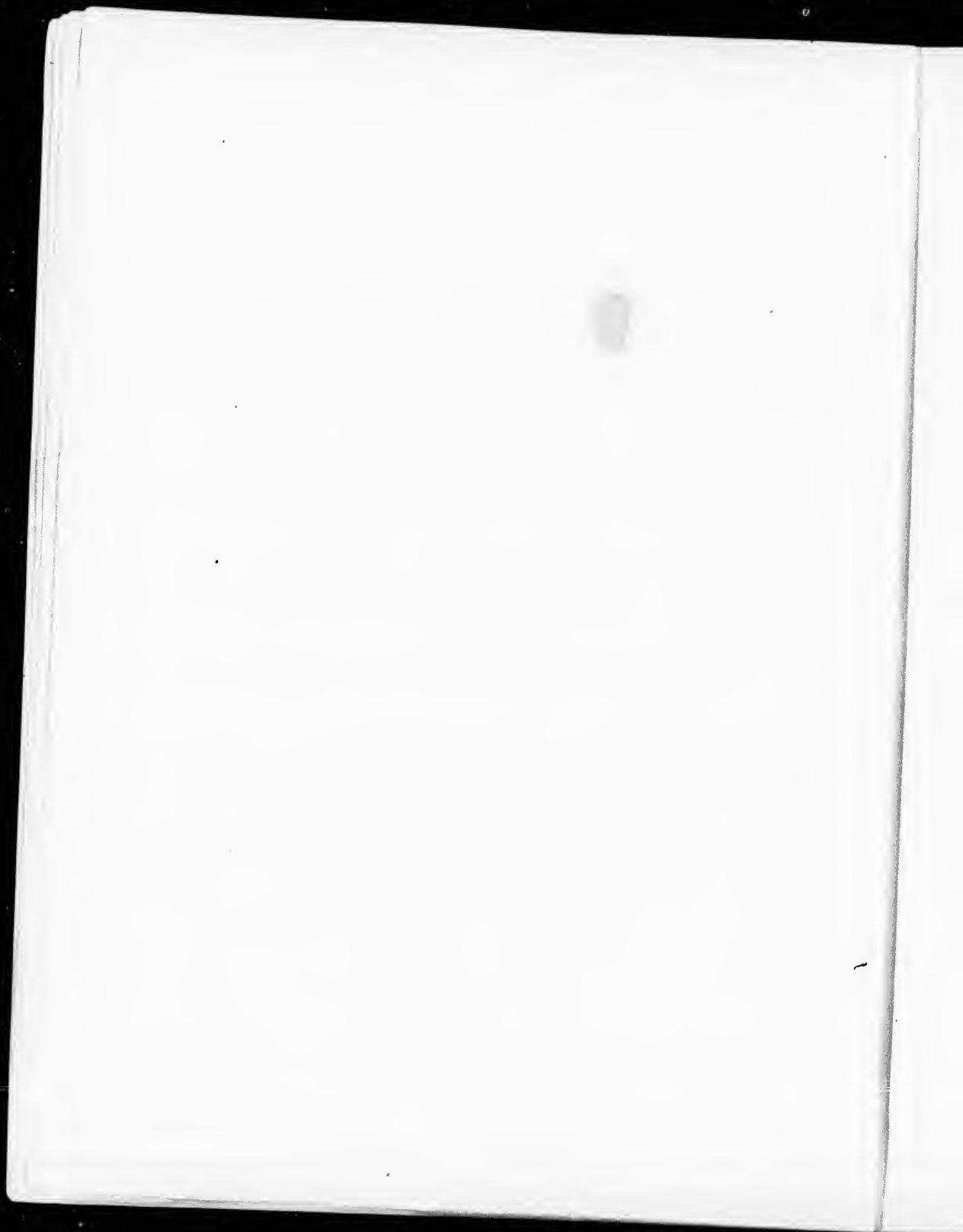
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SECTION.

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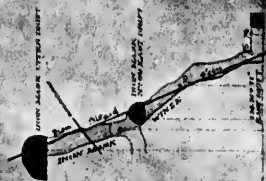
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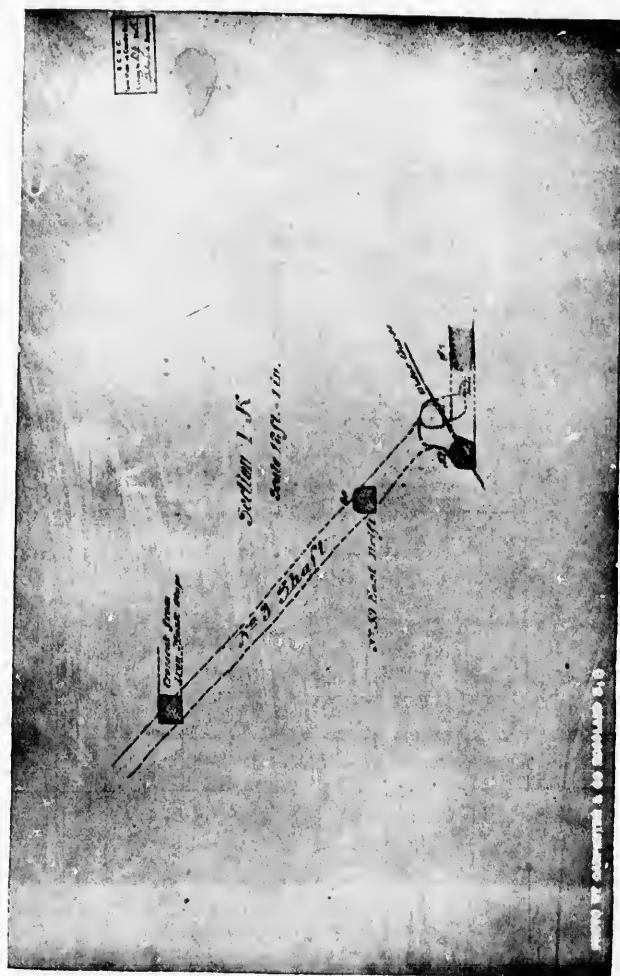


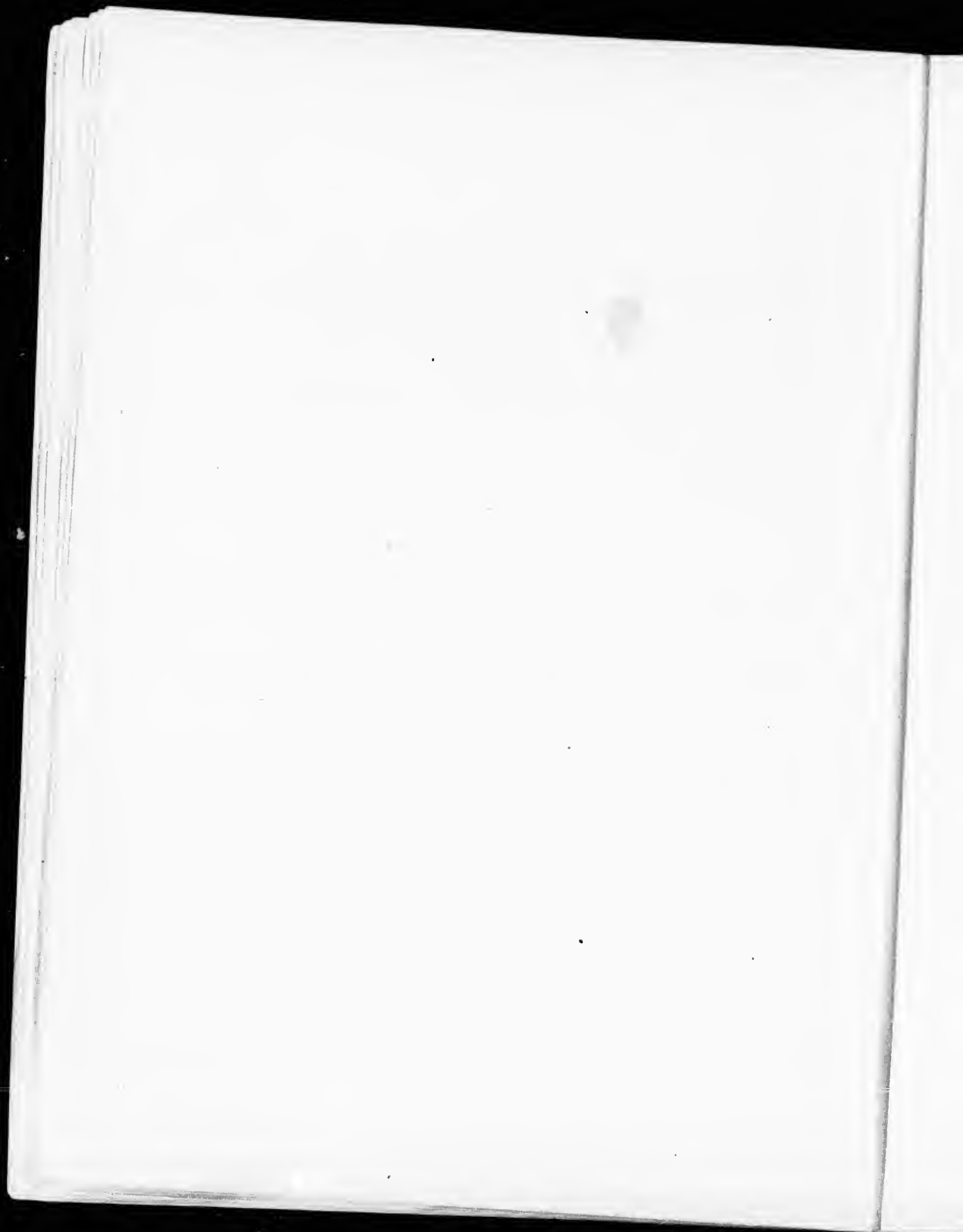
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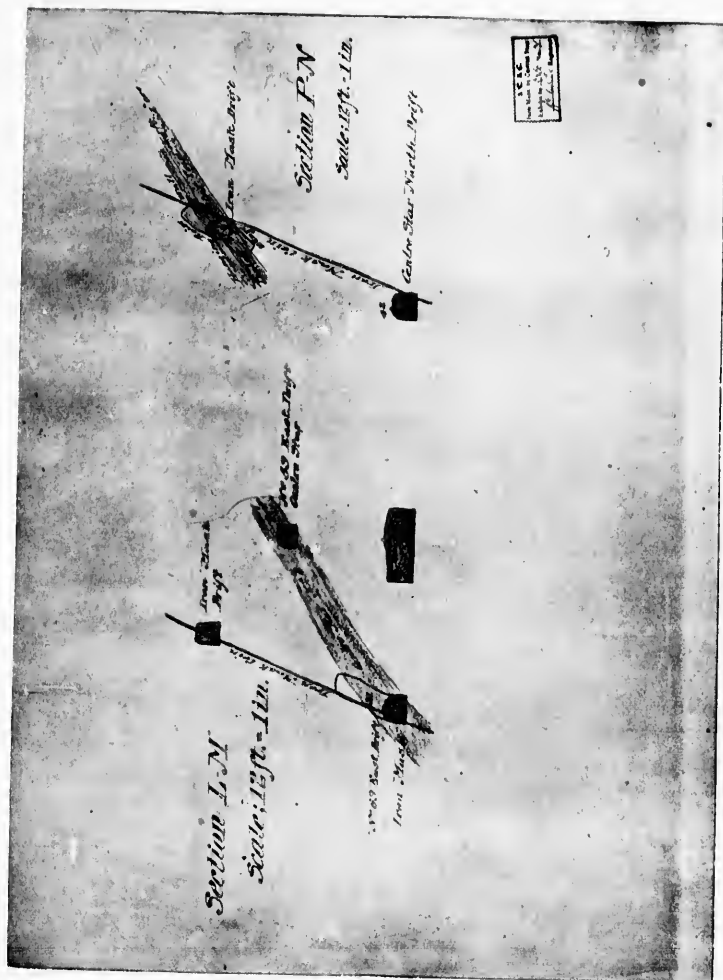
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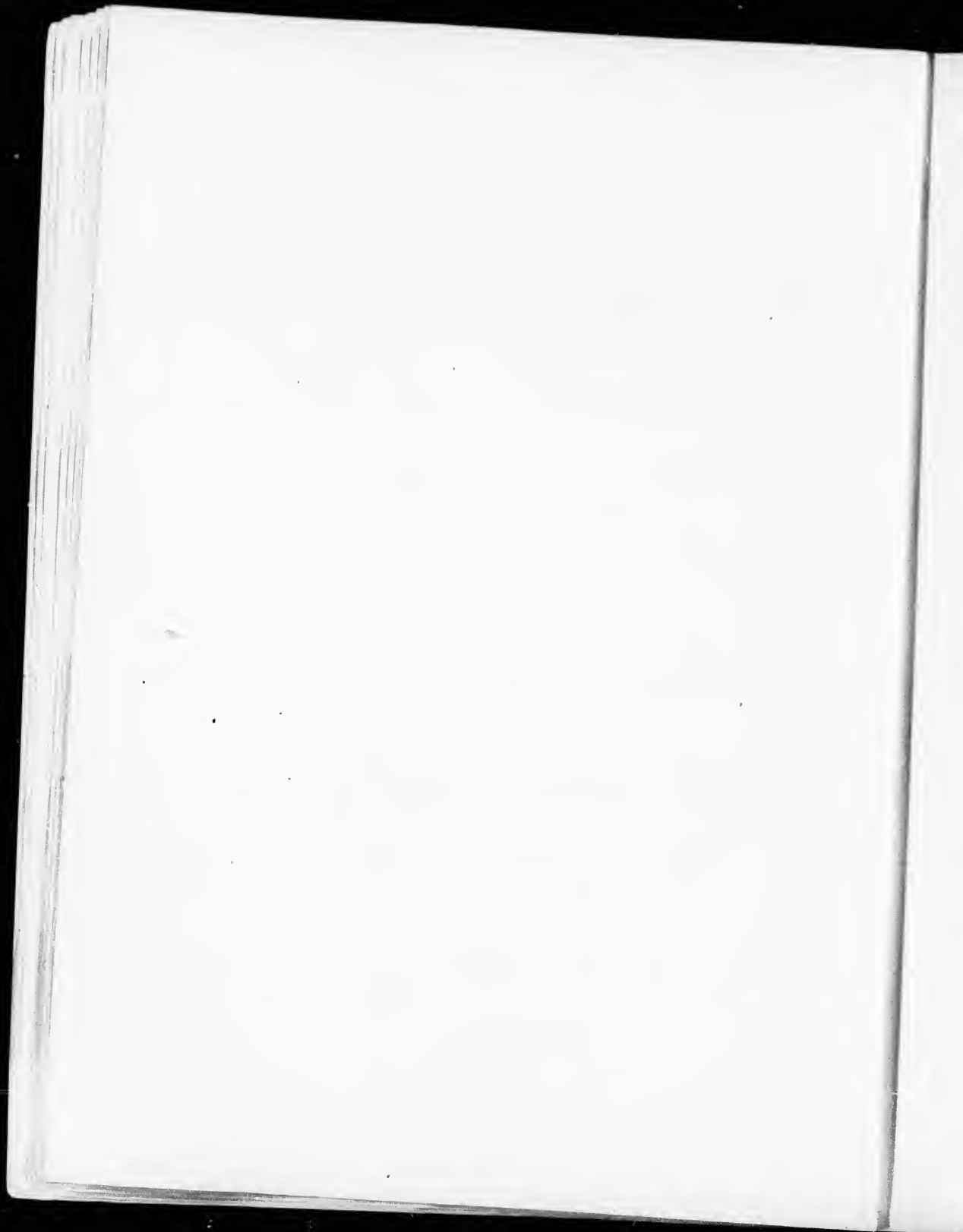
Taken at Trial at Rossland, commencing April 17th, 1899.

A. H. MACNEILL,

Solicitor for Plaintiffs.

A. C. GALT,

Solicitor for Defendants.



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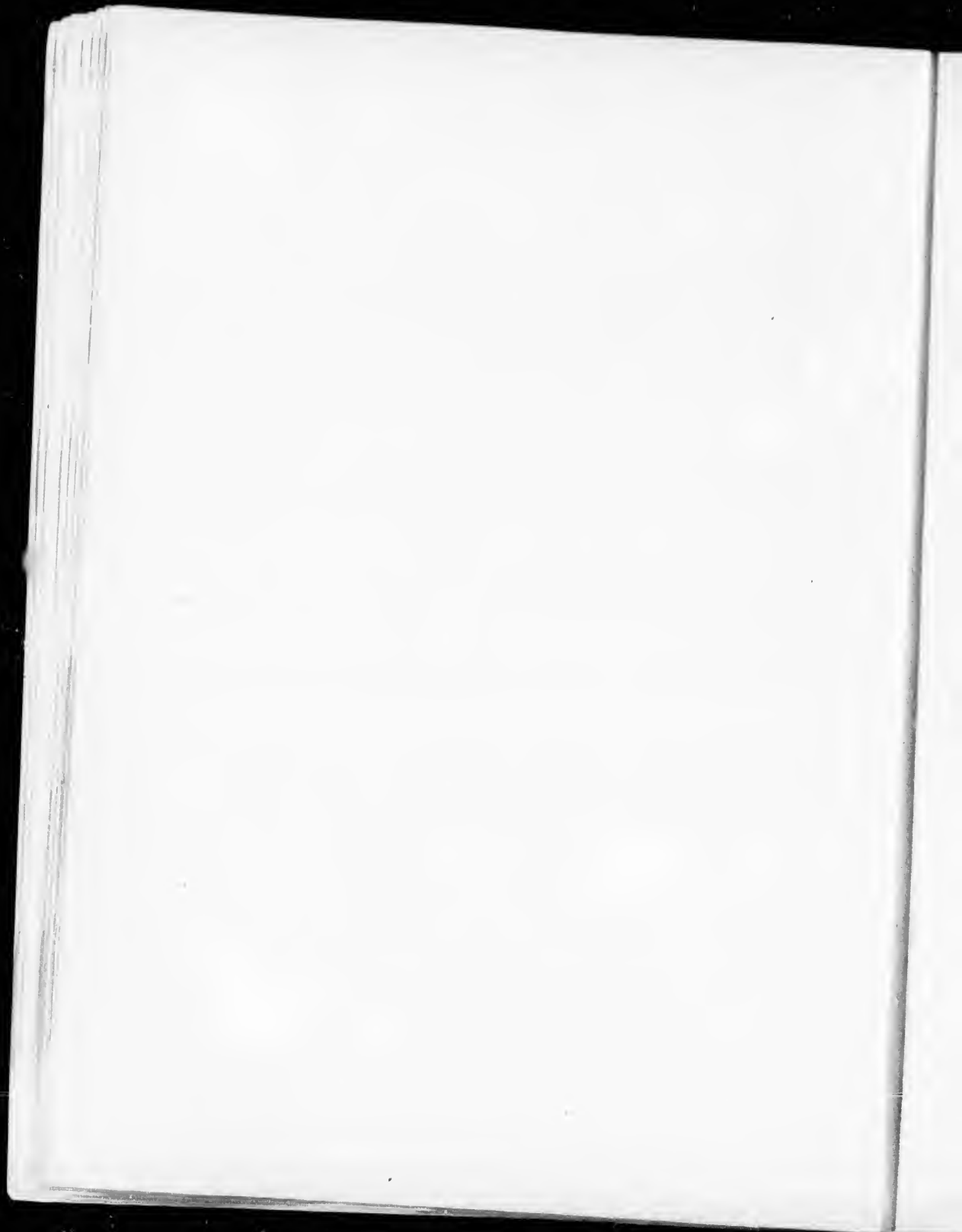
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DIRECT EXAMINATION.

By MR. DAVIS—

Q. Where do you live, Mr. King? A. New York.

Q. What is your age? A. Fifty-seven.

Q. What is your business? A. That of consulting geologist and 5
mining engineer.

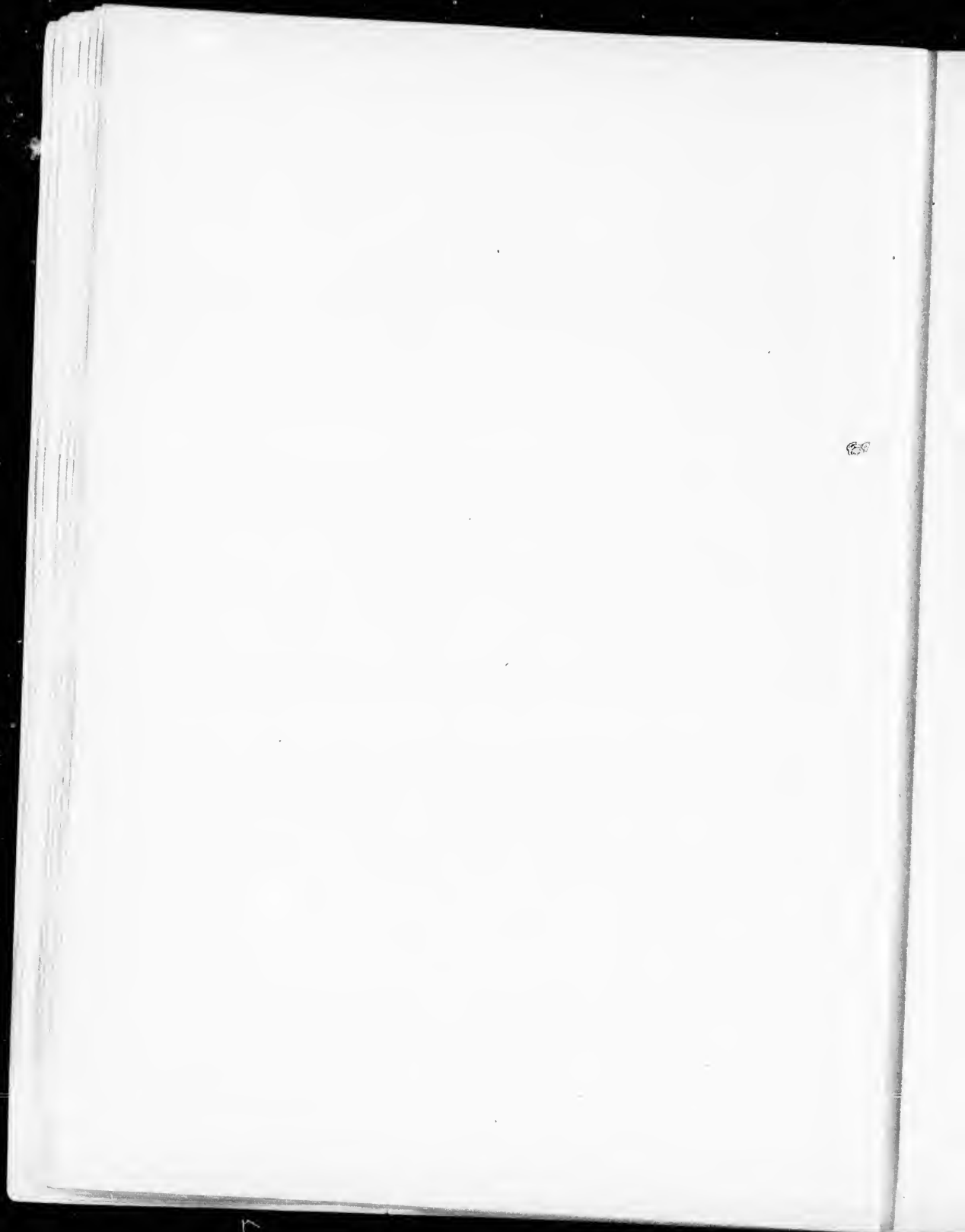
Q. You are a graduate, I believe, of Yale University? A. I am.

Q. What course did you take there? A. A scientific course, involv- 10
ing chemistry, mineralogy, physics and geology.

Q. What were you engaged in after leaving Yale? A. I graduated in
1862, and in the early spring of 1863 I crossed the continent, riding on horse-
back from St. Joe to San Francisco to join the Geological Survey of California,
which I did join in September of that year. 15

Q. How long were you with the Geological Survey of California? A.
Until the autumn of 1867, with a short interval, in which I was in the service
of the United States Engineers.

Q. Did the Geological Survey of California involve at that time any
mining questions or examinations of the country with reference to mining? 20
A. It did, but they were identical, in a measure, to the larger work.



Mr. Bodwell: Unless my friend especially wants this on the record, I am perfectly willing to admit that Mr. King is a perfectly qualified scientific man to speak on the questions involved in this case.

The Court: I do not suppose either party will be satisfied with my decision—I will pay myself that compliment—the case will go to another tribunal, and that other tribunal would like to know exactly what this gentleman is. You had better have it all down, on both sides. 5

Mr. Davis: I know it is quite repulsive to Mr. King's modesty to have all this come out, but you cannot help it. 10

The Court: No, you cannot help it. It is the same as in the case of a medical man being examined. He states, in the first place, in so many words, that he is competent, by telling you where he got his degree. 15

Q. When did you leave the Geological Survey of California, Mr. King?
A. In December, 1867.

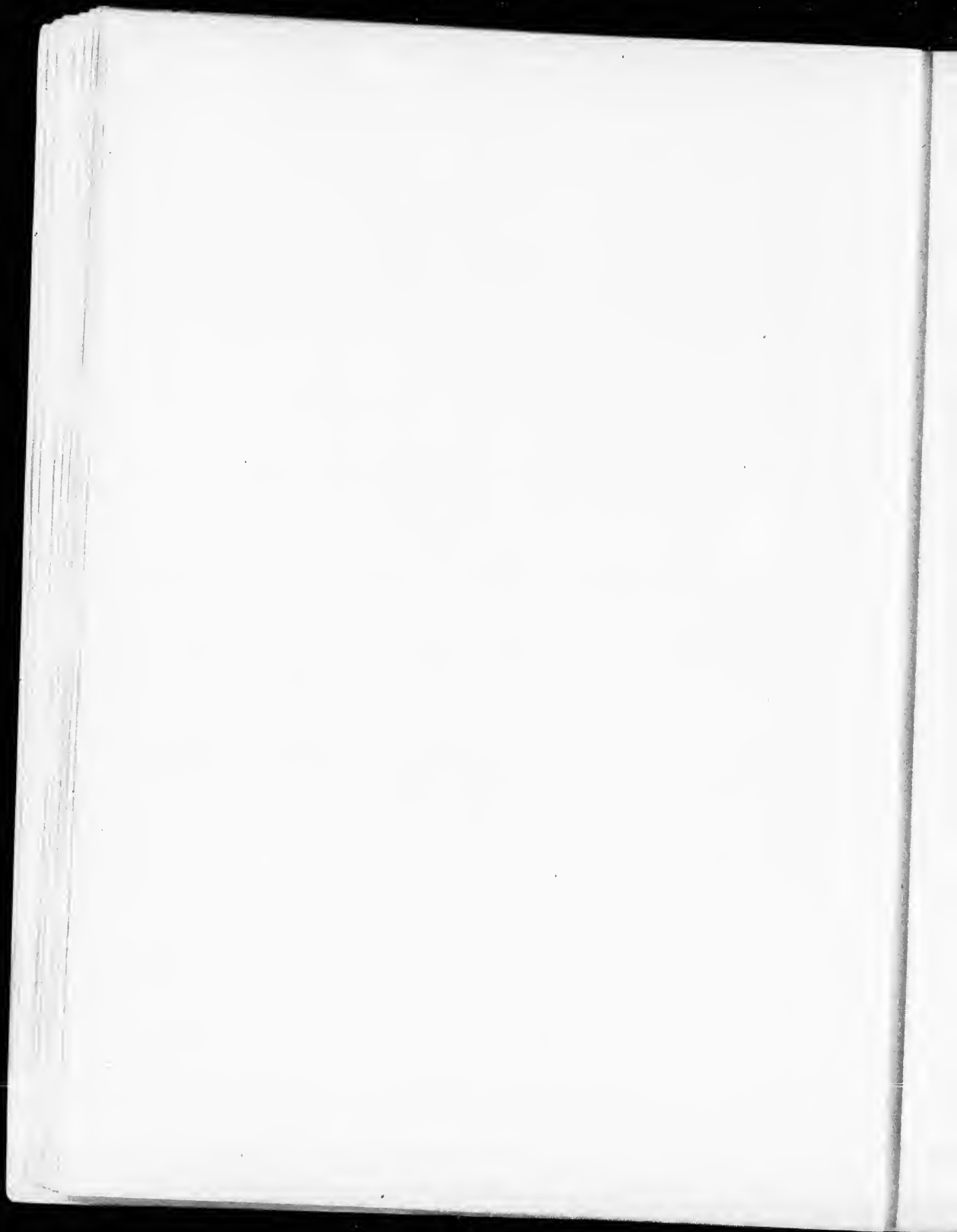
Q. What were you engaged in after that? A. In the early spring of 1868 I was placed in charge of a geological expedition called "The United States Exploration of the 40th parallel." It was under the War Department, and particularly under the Bureau of Engineers of the army under which I received my appointment. This expedition was designed to cover the country being then opened by the then building Central and Union Pacific Railroads. 25

Q. Did the examination of the mineral resources of the country form any portion of that exploration? A. It did; that was a special portion. 30

Q. Who had most to do with that particular part? A. Mr. James Hayden.

Q. Were you engaged in that branch? A. I was, particularly in investigating the Comstock Lode, the greatest lode ever discovered in the United States, and on which as a result of that examination I wrote a memoir for the United States government which was published in a portion of the report of the expedition which I made; also, other contributions to mining literature. 35

Q. When did you leave that employment, Mr. King? A. I think I concluded it in 1876 or '77; I can not quite remember. 40



Q. What were you engaged in then? A. In 1869, the government having previously confided its geological work to special chiefs who took the field under different departments of the government, concluded to unite, or rather, to discontinue expeditionary work under different departments, and instituted the United States Geological Survey, which should be a permanent bureau of the government. In that inauguration, I was placed at the head of it, and was the first director. 5

Q. That would involve, I suppose, more or less examination of the mineral resources of the country? A. It was left very much to me to decide the early policy of the Survey, and my very first efforts were directed to making a series, or to ordering and preparing for a series of exhaustive studies of the great mining districts of the United States as they should develop into prominence. That policy has been to a certain extent followed by my successor. 10 15

Q. How long did you remain at the head of the Geological Survey of the United States? A. Two years.

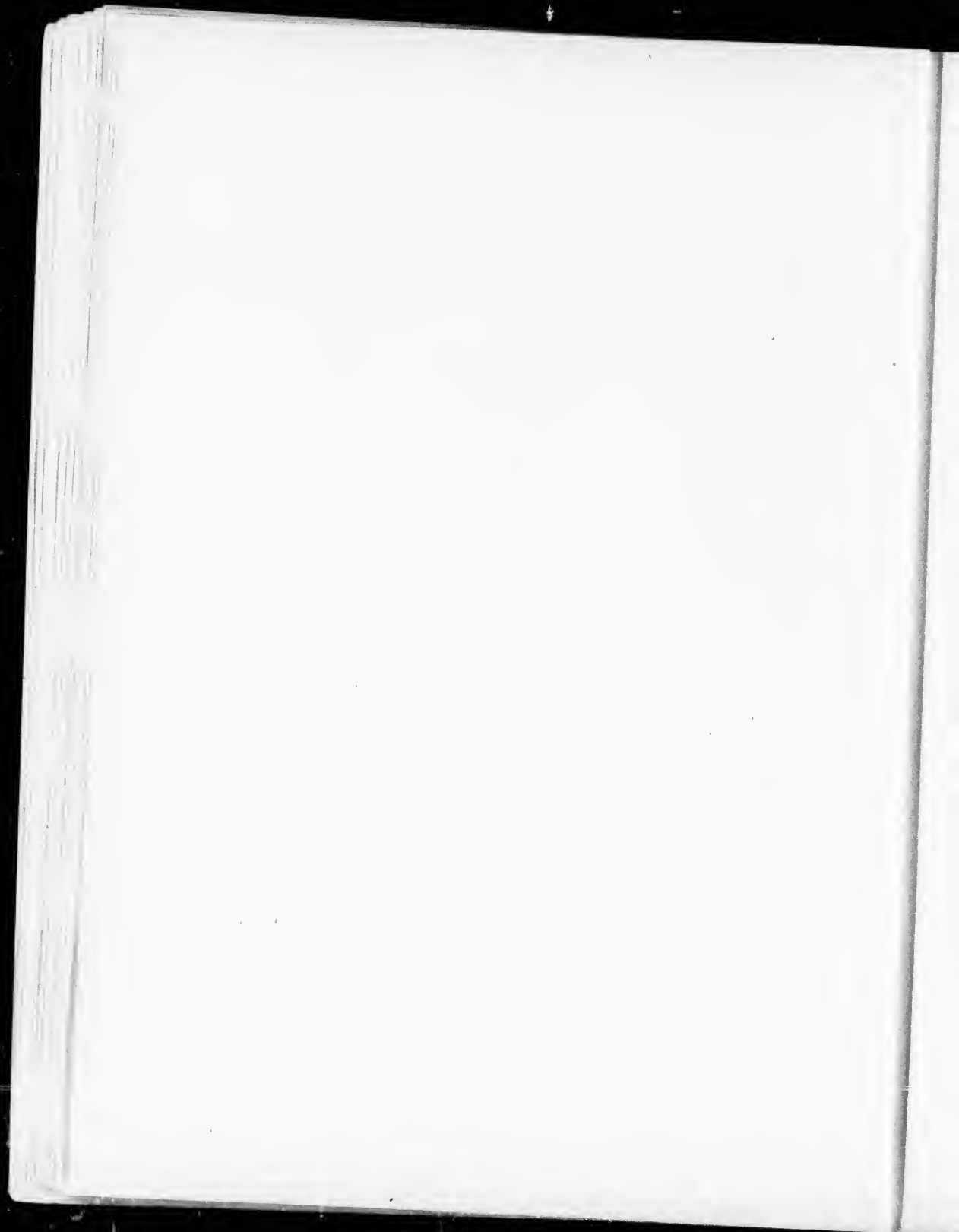
Q. Since then what have you been engaged in? A. Partly in consulting mining work, and partly in travels on my private account, in geological study and investigation. 20

Q. In what different countries and what different portions of the United States as one of those countries, have you examined the mines, or many of the mines? A. I have visited nearly all the prominent districts in the United States and made more or less of a study of them, sometimes very slightly to get a hint of their structure, sometimes more carefully, but they involve the leading districts of Nevada, like the Pecos, Virginia City, Eureka, and the leading districts of Utah,—at least most of the leading districts of Utah, Colorado and part of Dakota, parts of New Mexico, practically the whole of California and Arizona. Not absolutely the whole of any state, but most of the leading districts. 25 30

Q. And what countries outside of the United States? A. Europe and North Africa and the islands of the Pacific, parts of them all. 35

Q. And Mexico also? A. And Mexico, very freely over Mexico.

Q. What experience have you had yourself in actual mining? A. I have been both president and directing engineer of mining companies. In particular, I was the first president of three companies which opened the Las Prietas in the State of Sonora, Mexico, of the Las Yedras, in the State of Sinaloa, and Sombrete in the State of Zacatecas, Mexico. 40



Q. You have been in Rossland, I believe, before your present visit? A. Yes, calling the present visit a double one.

Q. No, I mean the one this month. A. I came here very early in February and passed a week and returned on the 6th of April. 5

Q. But prior to that time I believe you were in Rossland? A. Prior to that time in 1895, if I remember rightly, I was here, both in '95 and '96, or '94 and '95; I can not quite remember. 10

Q. At any rate—— A. In the early stages of the district.

Q. In two separate years before? A. Yes. 15

Q. At that time, did you make any examination of the mines of Rossland camp? A. I visited, but I did not make any exhaustive examination of any one; but I visited and passed many hours here, in the War Eagle, the Le Roi, I went through the Josie, through the Cliff, of the works that were then opening in the Monte Cristo, and some of the smaller claims like the Monita and No. 1, and that is about all. I took a general view of the district, not very precise or particular. 20

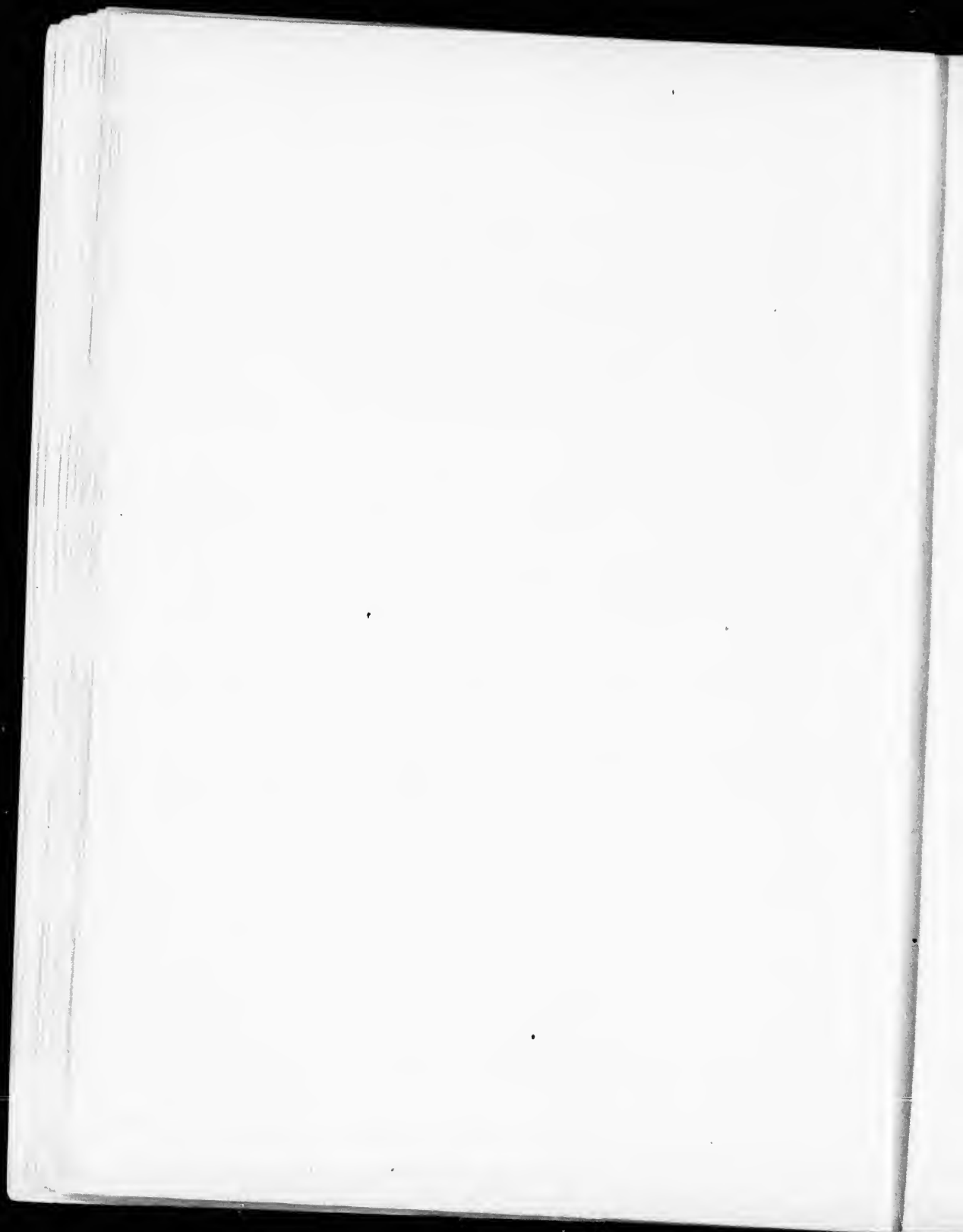
Q. And you were here in February for about a week, you say, in connection with this case? A. With this case, yes, sir. 25

Q. And you have been here in connection with this case since when, the present time? A. Since the 5th of April. 30

Q. And how much of your time have you devoted, or have you devoted it at all, to an examination of the property in dispute in this action? A. Well, I have been underground almost every day, and have devoted a good part of the rest of my time to the study of the questions involved. 35

Q. So that your examination of the ground in dispute has covered between three and four weeks? A. Yes. 40

Q. Now, perhaps as explanatory of the evidence you will give later on, Mr. King, it might be well for you to give a brief geological sketch of the conditions that you find in this camp, and the relationship they bear to the general conditions elsewhere? A. The district immediately about Rossland is, as is commonly known, a part of a very great whole, which whole is the moun-



tain system that borders the Pacific from Cape Horn to the Arctic Sea. It is a system thus covering an arc of nearly half the great circle of the globe, and has its widest expansion about the latitude of San Francisco where it is 1,200 or 1,400 miles wide. That mountain system ranks next in physical importance to that of the east and west system which traverses Asia and Europe, but unlike that system it is an empire of mines; and its geology besides having a high abstract interest, lies at the basis of the knowledge of mining for this immense area. The quantities involved in this system of the Cordilleras are great almost beyond belief. They involve the superposition of strata amounting to over 120,000 feet in actual measured thickness; they involve a history from very near the dawn of geological history—absolutely until to-day, of enormous dynamic action and effect. And this dynamic action has consisted in the upheaval, in the depression, in the crushing and folding together, and in the dislocation of enormous blocks of this great territory. The sedimentary series which I have said amount to over 100,000 feet, are derived from the older rocks in their immediate neighbourhood. So far as we have been able to see, those sediments have never travelled to very great distances. Sometimes a series of strata amounting in all to 40,000 feet have been piled up consecutively and continuously, and without break; but all these series of various episodes of sedimentation have ended in a destructive dynamic period, and they have been crushed, upheaved or depressed, and then the process of sedimentation has begun under new terms. These dynamic events which punctuate, as it were, the history of the whole of these Cordilleras, are due undoubtedly to the unbalancing of the forces of gravitation and of equilibrium. It is very well known to geology that if you load any area with a heavy mass of sediment, that area subsides; that if you unload any area, that area will rise. Consequently, whenever an area rises near an area which is stable or is sinking, there is a dynamic strain, and if that strain passes cohesion, passes the point of the elastic limit of the rocks, or the cohesive limit, they are ruptured by these tremendous strains and the action usually ends in the eruption and the readjustment of the equilibrium—and the eruption of melted matter from the subjacent area. It is in these periods of stress and strain to which the rocks and whole distances and whole enormous areas and ranges, and whole mountain ranges, have been subjected that the crushing and straining and fracturing and fissuring takes place, which is the birth of a mining district.

35

I do not mean to indicate that every crushed area, or every fissure or block of country is the birth place of a mining district, because mineral veins owe their origin to two processes; one is the fissuring of the rocks, or the solution of soluble rocks on lines of fissure, and the second process is the filling or deposition of mineral matter on, in, along and near these fissures. So that a mining district requires two periods of action; I mean a block of country requires the two classes and periods of action to bring it from an amorphous mountain mass into a mineral district. These periods of crushing have never occupied a very

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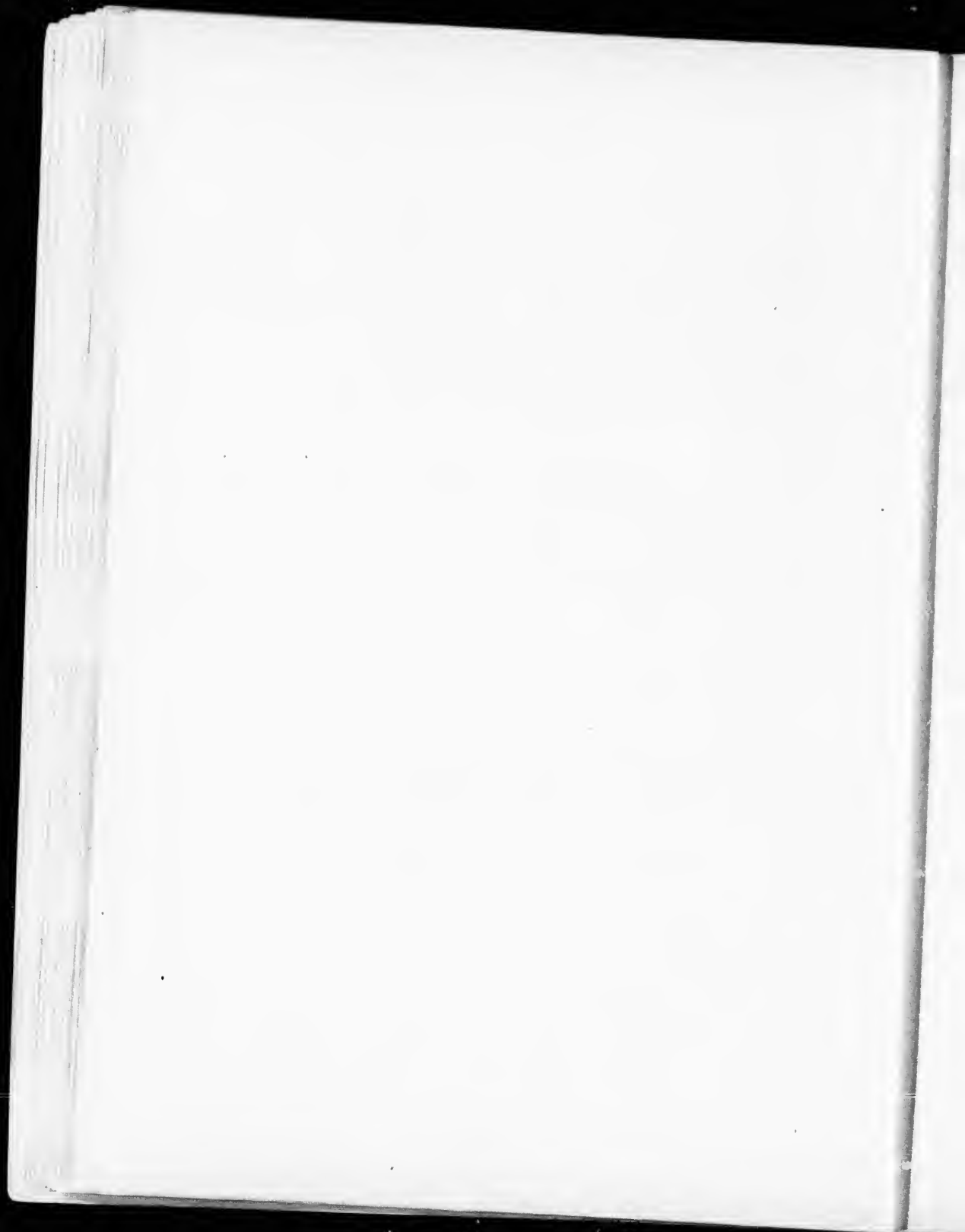


great part of the geological history; they are sudden, conclusive episodes which follow periods of accumulation of strata, periods of upheaval, and periods of depression, but short as they are, they have ended in deluging enormous tracts of this Cordilleras system with eruptive rocks, molten when they come out, and which have cooled under or upon the surface. There are fields of these eruptive rocks which cover many thousands of square miles; there are other fields which are extremely small. And, as I say, these periods began in the earliest geological ages, and have gone on practically to the present.

The study of these rocks which have been erupted in these various periods has resulted in a fine classification as to species, and in a certain measure as to origin, and also to a rougher classification in time; that is to say, the rocks which we know to be earlier than the dawn of life, which we will put at the base of the Cambrian, are of a different class from those which are erupted now from present volcanoes. They have shades of difference in texture and in composition, and in the relative proportions of their different elements; but, chiefly, their distinction is one in decomposition; that is to say, it is very rarely we get from the earliest periods any form of lava which is as fresh and as new as those which are being erupted now. They have undergone chemical decomposition more or less.

So that, in a general way, rough sort of way, the ocular examination of a district of erupted rocks usually gives rise to fairish judgment of about when that district was built.

Now, the rough examination which I have made of the geology of this immediate region when here four or five years ago leads me to compare it as fairly near—the many deposits which have come to the surface—the many outflows which have come to the surface to what is called middle geological time, say the Jura-Trias, or the beginning of the Cretaceous. They bear a certain textural resemblance to the rocks of that period. They may be later or they may be earlier; so far the data are wanting for the exact position, but for all practical purposes they may be assigned to a middle geological period. We are here, as is properly known, I believe, on the vent of an extinct volcano, one which undoubtedly reared its head high above the present surface, and one which are extremely small. And, as I say, these periods began in the earliest which went through various episodes of eruption. Those episodes are recorded here, first, in a complex mass which represents the base and center of a volcano; and, secondly, by a later and overlying eruption of fragmentary rocks which were undoubtedly associated with the extrusion and ejection of water, so that to a very large extent they shew the effects of water. They are often muds, and are all to be classed under the head of tuffs, volcanic tuffs. They surround the region in a ring; you can see them half way from here to Trail Creek; you can see them between here and where the Red Mountain Railroad descends



towards Sheep Creek; they are on the top of Red Mountain, and they are on the other side of the valley to the southwards, forming in general a ring, leaving this central axial part of a volcano an isolated mass of dark, usually fine grained rocks, having a width of about a mile or a mile and a half north and south, and, perhaps, five miles east and west. 5

The rocks of that central mass are those which enclose the veins of the district, and they are the rocks which are of interest to the miner here. They have been more or less studied by the Canadian Geological Survey, and they have been compared by Mr. Ferrier with the standard types from other localities. I have myself had the opportunity of going over with him the thin slides or thin microscopical sections of these rocks and comparing them with the Pearson types, and chips in small pieces, but enough to make comparison from a similar district to the east of here. The rocks as you walk over the surface show three easily, reasonably well-defined types: one is the rock which we see here in the cut before us. I have not examined the cut particularly, but I have seen enough to realize that the bulk of it is of a type of rock which forms the hills directly in front of us and which is the country rock of these immediate neighbouring mines. That rock has a dark, greenish-gray colour, usually of fine grain, sometimes coarser grained rock, which is very tough, breaks diffidently under the hammer, is difficult to scratch, and under the microscope, as well as in plain vision, is often seen to be pyrrhotite, and in places the original structure has been more or less obliterated by compression and subsequent chemical action. The microscope shews this rock is an augite rock, formed of augite and triclinal feldspar; and a considerable and varying proportion of monoclinic feldspar. To the east of here and in the neighbourhood of the Iron Horse claim there appears a darker, much closer grained series of rocks formed like these of augites and triclinal feldspars, but with less or none of the monoclinic feldspar, and each following very near the type known as gabbro. At the extreme west of the body where the Josie ravine comes down towards Sheep Creek and meets the road from here to the mines, there outcrops a considerable area of a third variety of eruptive rocks of the same general family, which consists of hornblende, monoclinic feldspar and orthoclase. These three types are undoubtedly local variations of the same general melted mass. Every one who has studied volcanoes, or volcanic districts, must realize—must know—that one of the peculiarities of the average volcano the world over is that it erupts at one period one type of rocks, and another at another. But on examination, these rocks are all found to possess certain family characteristics, and are, from a petrological view, so related to one another that it is seen quite clearly that they are differentiated from one great melted magma. The manner of this differentiation is somewhat of an enigma, but it is perhaps explicable on the basis of separation by specific gravity of the crystals developed in this magma. Be that as it may, here these three differentiations from one magma have come to the surface suc-



cessively and, perhaps, alternatingly, and together from this central mass which is the dark green, heavy country rock of the immediate neighbourhood.

We therefore find that there are, since other periods have overlapped to a certain extent, alternations of the three types of rock in the mass. Subsequently to this there has been a strain from north to south which has opened up nearly vertically and often a parallel system of fissures through this mass which has been filled immediately by intrusive dykes, and that is the rock which is the basis of this district.

Q. You may just explain, Mr. King, what a dyke is. A. A dyke is originally a fissure extending through the course of the rock to the deep until it intersects some pool or body of molten matter, which ascends in and fills the crack, and the filled matter in this crack consists of the dyke, is the dyke.

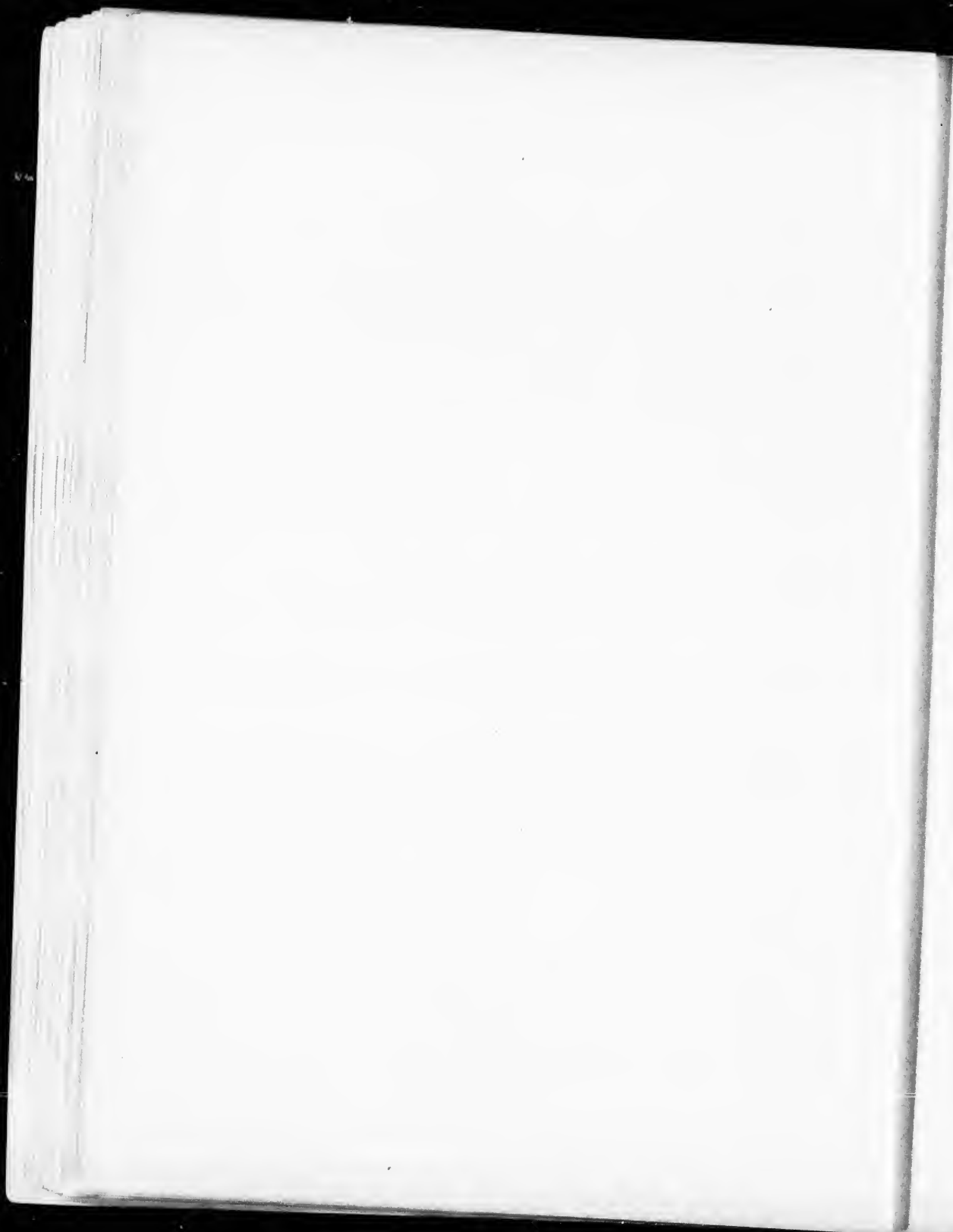
Q. The filling, then, would be foreign? A. Intrusive.

Q. Foreign to the rocks surrounding it? A. Foreign, intrusive from below.

Q. Are they limited to any particular size, or do they vary? A. They vary to a very great size.

Q. From what? A. I have seen them from an inch to 100 feet, we will say, and probably much more.

Q. From your examination of the ground in dispute of the Roseland camp, what conclusion have you come to as to the character and structure of the veins here, the causes which have produced them, and their points of resemblance and of difference from the veins you have found in other places. You might just go into that pretty fully, Mr. King. It has an important bearing here. A. I should say that all of the larger veins, at least, and perhaps the smaller ones also, belong to a single type. They are distinctly and predominantly, fissure veins. It is clear that through such a mass of rock as this, chemical solutions could not penetrate without the avenue of cracks and interstices; and, therefore, wherever any mineral foreign to the rock itself may be found, it can be easily classed, either as intrusive dyke, or as mineral matter which has come along fissures, however, large and in whatever directions. The mineral-bearing veins here are well-characterized fissure-veins; and certainly some of the larger ones, and perhaps many of them, are what are known as shear zone fissures. That type is not, perhaps, so well and so widely known as the simple fissure, but it is recognized and does exist over a very wide range of territory.



I have seen it in Mexico, I am working a mine of that type now in Colorado, I have seen it in Nevada, and I know it when I see it here. Shear zone differs from the single fissure in an important particular. While a single fissure may result from a vertical action, or even be the resultant of two horizontal compressions, through compressing forces, the shear zone is always made under very high compression,—compression which holds the rock tightly together, which prevents a wide opening of fissures, and that shear zone is always the result, or almost always the result of a disturbance of opposing couples, of what are technically called “couples” of pressure—the disturbance of that couple by a vertical complement of a vertical force; while the plain, open fissure may result from a direct upward thrust, the shear zone is always the result of a very powerful compression; and since that compression is very great, and almost equals the disturbing force, whatever it is, that produces the fissure, it is apt to break, and always does practically break, in more or less parallel seams or fissures; this making a family whose exterior boundary is always assignable, if you cross-cut or find the surface well exposed, and study the ground. Instead of being an indefinite amount of parallel fissures extending into a country an undiscoverable distance, it is always a discoverable and limitable collection or family of more or less parallel fissures. Since those forces are never mathematically adjusted to each other to be in exact opposition, the resulting fractures are not absolutely parallel. In the case, for instance, of a slight torsion of a body there might be a family arrangement of the fissures, a slight family; but in general and practically for a miner’s purpose, they are a series of parallel platings of rock. Now these platings may or may not have slipped at all; that is to say, a movement on any one plane may have been infinitesimally small, may have been less than a hundredth of an inch. When these veins are thus fissures—which is always the beginning point—if they are fissures so deep that they offer avenue for the deep-seated thermal waters, there is immediately an action of ascension and the deposition of chemicals contained in the deep solution, also a decomposition of the minerals along the lines of these minute fissures, until in some instances the whole matter between two fissures will be all eaten out and replaced by the chemical elements brought in solution by the percolating waters. It is very well known that all deep-seated springs are mineral springs. Practically none of the deeply reached water of the globe is free from mineral solution. Those solutions being hot at great depth and under pressure at great depths, have their solvent power enormously increased, and their function is indeed to dissolve and find their way up through any avenues they can, and according to their chemical nature, to dissolve or replace or deposit their load of dissolved matter. It is a peculiarity of those veins—I do not mean the veins of Rossland—but it is a peculiarity of this class of veins, that their mineral deposits within the general limits of the exterior fissures of this shattered and plated zone may be deposited on any one plane, or they may eat up all the rock between two planes and deposit another matter in its place, or they may occupy the whole zone, or they may mineralize one particular fissure and go through



a small crack into another fissure and travel upon that and so on. According to the accident of the structure and movement; they may mineralize upon one or all of the planes. These veins are of enormous extent in some places. They are well known to reach 100 or 200 feet in extent; that is, the shattered 5
 plied series. I am myself mining to-day a vein which is 150 feet thick with six or seven of these well marked divisions.

Now, the veins of this camp, so far as I have seen them—that is to say, such as I have recently studied, and I feel very sure from what I saw before 10
 that, the Le Roi is in the same category—are shear zone veins; that is to say, they occupy this plating due to parallel fissures. They are fissures veins essentially; in particular, they are shear zone veins; that the peculiar mineral combination which here forms the ore, and which is a part of these veins which occupies the greatest interest, is a mixture of pyrrhotite and chalcopyrite and 15
 copper pyrites, and it is seen over the neighbourhood of these veins and in portions of these veins, that, atom by atom the crystals which made up this original rock have been replaced by those mineral solutions; in other words, that they have made a pseudomorph, or taken a cast, you may say, or filled up the whole form and now occupy the area or bulk, the cubical contents, of what was formerly 20
 the crystalline ingredients of these rocks. Particularly near the Iron Horse you can see large diallages or large augites lying in the neighbourhood of that vein, making as it were, a kind of porphyry of which the crystals were already passed over into ore minerals, and the surrounding country was only partially transformed. It seems to be quite clear that here, as in so many other places, 25
 the process known as replacement, is the origin of the sheets and bodies of ore which occupy and which are made originally in contact with those fissures. A vein of that sort may be made along a single fissure, in which case the percolating solutions would fill the fissure and replace upon each side of it, obliterating the fissure, and all you would have would be a plate of metallic minerals, fading 30
 gradually into the country on each side, which for the distance it existed as a solid body would entirely have destroyed the plane itself which gave it birth. You see that, in a small way, all through the neighbourhood of these veins. I think that expresses about the ideas I have formed of the general origin of these 35
 veins.

Q. Where else have you seen veins which are exactly the same as we have here? A. I have never seen exactly the same, but the principle is precisely 40
 the same in a mine, for instance, that I am working to-day in Colorado, the Nellie. It is a mine like this, situated in eruptive rocks, but of a much later date, in which the shear-zone is, I say, about 140 feet wide, and in which the mineralization is distinctly by replacement, as it is here. It is a different mineralization, but the principle is exactly the same.



Q. In the veins of which you have just given a description of shear-zone veins—replacement veins,—what have you to say respecting walls? A. In a vein which may be, we will say, 140 feet wide, like the Nellie, one never knows where his ultimate wall is until he has cross-cut both ways and developed the fact that he has passed the exterior limit of the fractured zone. Anywhere within that any plane appearing is simply an anterior member of the system. 5

Q. Will the mineralization always proceed to the exterior walls? A. Very frequently not. 10

Q. Will it always proceed on the one point? A. The Nellie mine which I speak of has jumped across from plane to plane four times. In one instance the first jump it made it came up to a certain point and jumped, but its mineralization followed the original plane about 50 feet beyond, and then stopped for some probable want of access of the fluids, but it made a right angled jump of something like 40 feet to the next plane and then went on, on that. 15

Q. You have spoken of veins of this kind of very great width, 100 to 140 feet. Is it at all necessary that veins of this kind should be so broad? A. Not at all. 20

Q. That is, is it usually or necessarily the case that they are so broad? A. Not at all, not at all. These veins are fissure veins, and if they develop one fissure, that is the width of them; if they develop 40 that is the width of them. 25

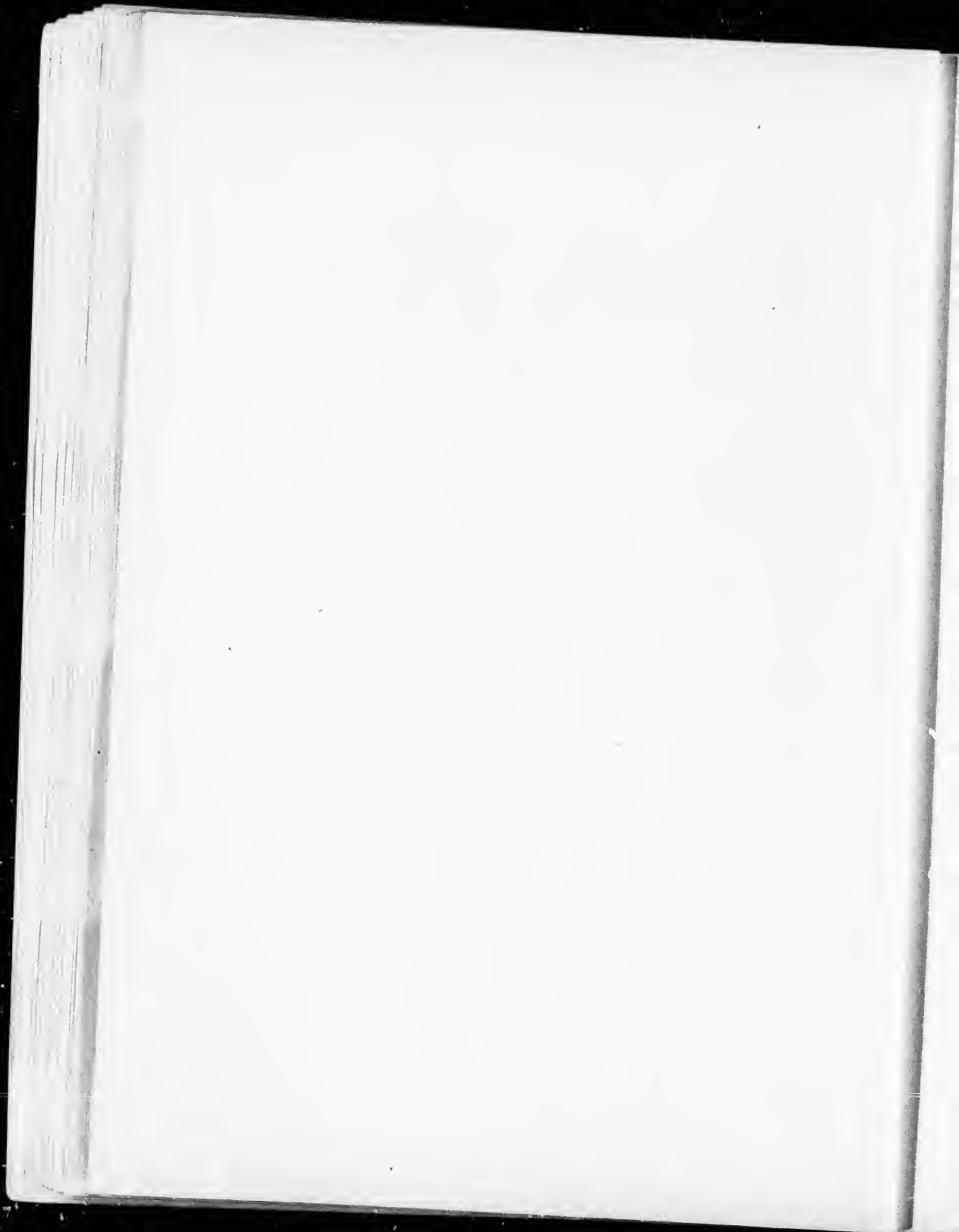
Q. And I suppose there is no law governing the width or the distance at least between the adjoining walls, parallel planes? A. No, they may be very close, or— 30

Q. Very far apart? A. Or very far apart.

Q. By the way, Mr. King, I forgot to ask you: I believe you are a member of the American National Academy of Science? A. I am. 35

Q. What is that body? A. It is a body incorporated in 1863 by the United States Government, and is self-perpetuating as to its membership, but exists for the purpose of the formation and maintenance of a body of scientific knowledge on which the government can draw at any time for any scientific problem which it desires to have solved for its own benefit. 40

Q. Is there any body in England it corresponds to? A. Not exactly; it would perhaps be nearer to the Royal Society.



Q. Is it limited in number? A. It has been practically limited to one hundred.

Q. Are there any other mining men in that body besides yourself? A. 5
There are a few; Mr. Emmons, of the Geological Survey, is a member. I do not remember any other.

Q. You have examined the point, station 66, where four carloads of ore 10
were taken away from as shewn in the evidence? A. I have.

Q. And I believe you came to the conclusion that that ore which has
been taken out properly belonged to the Iron Mask people—the Iron Mask vein? 15
A. It belongs to a vein which is at that point and has its apex in Iron Mask
ground.

The Court: What is the cause of this molten material? Is it chemical
action? A. No, sir; the earth would be fluid at a certain depth but for the
pressure of the superincumbent mass which prevents it expanding to the vol- 20
ume which fluid requires, and presses it into a solid. The relief of pressure
allows that thing to expand and become liquid, and it is already above the tem-
perature of fusion, but is unable to fuse because of pressure. When that pres-
sure is removed it expands into fusion.

The Court: It is in a liquid state, then, literally, all of it? A. The 25
interior of the earth is mostly a solid. Up to within 30 or 40 miles of the sur-
face it is undoubtedly solid. That has been proved by Lord Kelvin with very
great ability.

The Court: Let me ask, Mr. King: this has nothing to do with the case,
of course, but I have often been astonished at it. The centre of the earth is
solid, Lord Kelvin says? A. Yes; in fact, the earth is all solid except small 30
reservoirs.

The Court: There is a certain amount of liquid matter? A. Locally 35
developed.

The Court: Around the solid body? A. Not in the shape of a com- 40
plete shell, but only local pools.

The Court: Of course, of vast extent in some cases? A. Of vast ex-
tent in some cases.



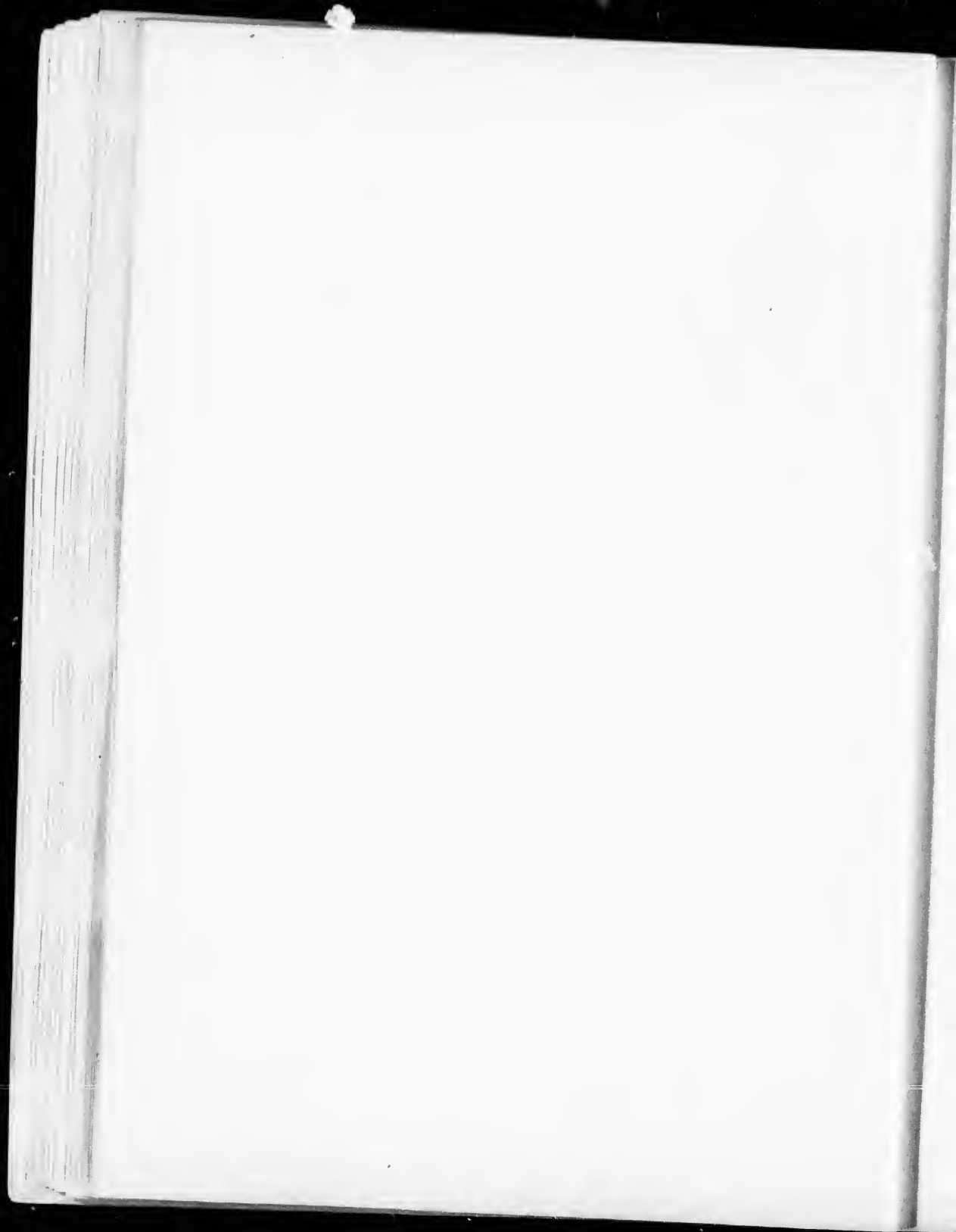
The Court: How does it become heated? A. From the initial heat of the earth. The earth was hot to begin with, and has not cooled off yet; it is very slow about it.

The Court: I know the main divisions beginning with the lowest ones, the Azoic, the Paleozoic, the Mesozoic, the Myocene and Tertiary. A. Yes, sir. 5

The Court: What caused the heated matter? A. The heat is residual heat from the original heated condition of the earth. 10

The Court: That is the explanation of a volcano? A. Entirely.

Thereupon the Court adjourned until to-morrow, April 25th, 1899, at 11 o'clock a.m. 15



CLARENCE KING—A witness for the Defendants on the stand.

DIRECT EXAMINATION RESUMED.

5

By MR. DAVIS—

Q. You know the incline shaft, No. 3 shaft, Mr. King, do you? A. I do. 10

Q. Have you made a thorough examination of that? A. I have. 15

Q. Just explain how thorough? A. I have visited the shaft and passed up and down it about a half dozen times, always looking at the ore, and on one occasion chipped the surface of the ore which defines the centre of the vein from top to bottom, and found that there were no intervals; that it was absolutely continuous ore from top to bottom. 20

The Court: You found there were no intervals? A. It was absolutely continuous ore from top to bottom with the exception of the sump. 25

Q. From top to bottom with the exception of where the mud-seam fracture is? A. There is in the bottom of the shaft an opening which is in the nature of a sump on the bottom of that chamber, which I exclude from that general statement. 30

Q. That is, that 8 or 10 feet at the bottom? A. Yes, sir.



Q. So we will take it down to that sump at the present time. Do you find any vein in that shaft? A. I find a clear fissure vein from the top to the point indicated at the head of the tunnel.

Q. You say you found continuous ore. What was the nature of that ore, what kind of ore was it? A. That ore, the bulk of it, was pyrrhotite, but throughout, almost every hand-specimen taken, chalcopyrite and iron copper sulphide could be seen.

Q. You may say just what chalcopyrite is and what pyrrhotite is and what iron pyrites is? A. Pyrrhotite is a very basic sulphide of iron; chalcopyrite is a double sulphide of copper and iron, of which the normal proportions are 30 per cent. iron, 30 per cent. silver and 30 per cent. copper, but it is an extremely varying mineral in its copper percentage, and has often been, and in fact, is generally, considered to be a more or less mechanical mixture of the two crystals of pyrite and chalcopyrite, for its composition varies from 30 copper down to only 3 or 4 copper, and even a trace of copper.

Q. And what is iron pyrites? A. Iron pyrites is the bi-sulphide of iron.

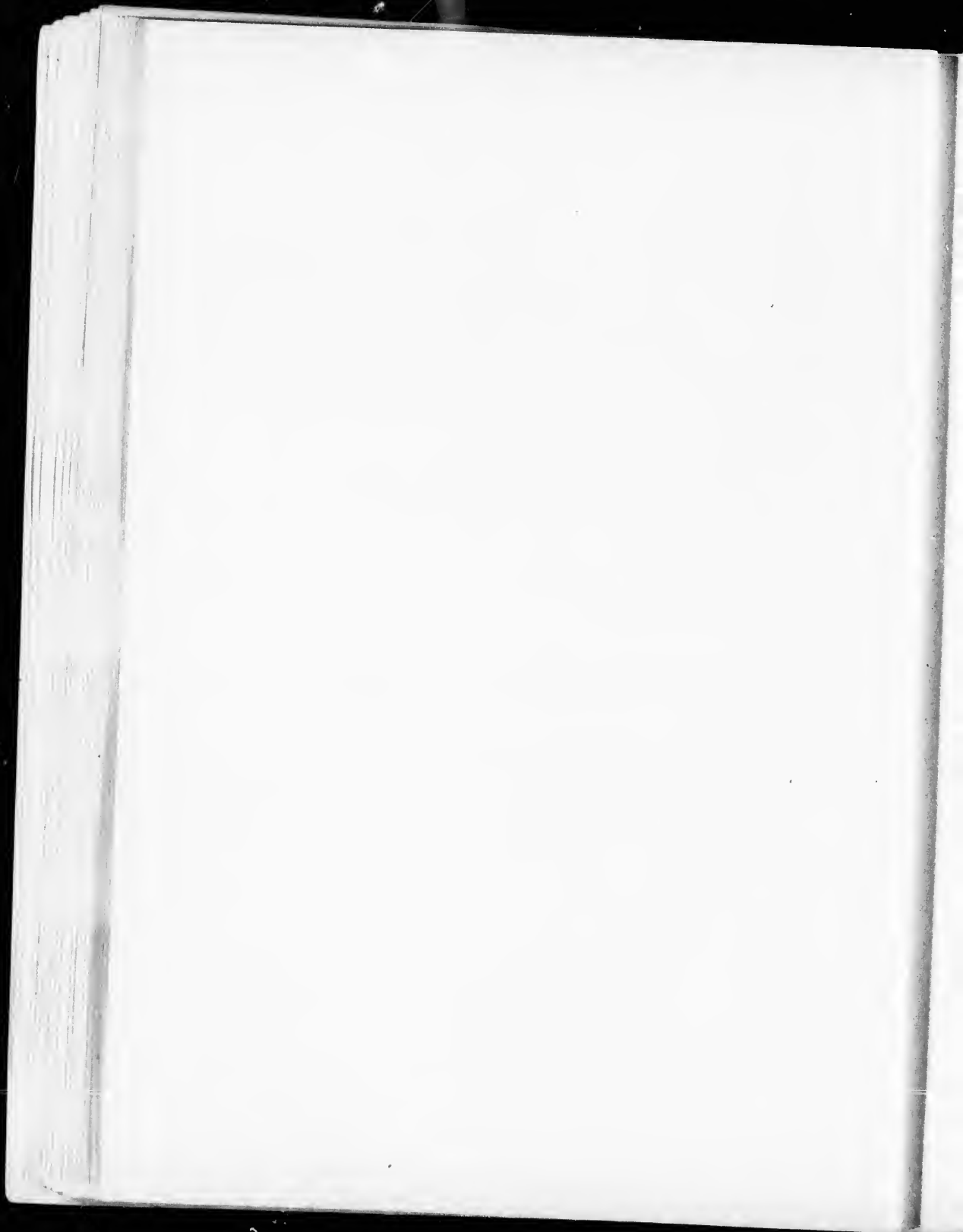
Q. You say this was a fissure vein you found in the No. 3 shaft. What particular kind of a fissure vein would you call it? A. Taken alone and without relating it to other parts of what I believe to be the Centre Star vein, I should say it was a fissure vein with accompanying exterior walls; that there was a main fissure which defined the limits of the ore above and below, or two main fissures, as the case may be, and over it a supplementary, parallel and correlative fissure which constitutes an upper wall about 2 feet above the upper limit of the ore.

Q. You find then, walls in that shaft, do you? A. I find walls continuous, enclosing the ore.

Q. Enclosing the ore? A. And I find the correlative wall about two feet above and lying parallel.

Q. What about below? Below where, sir?

Q. Below the ore? A. The workings do not go into the foot country enough to define any walls, other than the one which is the downward limit of the ore; that is to say, there are no cross-cuts back into the foot country by which you can see correlative walls.



Q. Did I understand you to say you found any fissures there? A. The ore is enclosed by fissure walls.

Q. And is it difficult to trace these fissures you have just referred to, the fissure walls? A. The upper limiting fissure of the ore is very easy to trace; the lower one is sometimes obscured and sometimes visible by the distance at which the cut enters the foot wall, or ends at the edge of the ore, and that plane is more chemically destroyed than the upper one. The upper one is a very well-marked fissure, but the other one is sufficiently in view to be sure of it from place to place.

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Q. By the way, speaking generally of the veins in which disputed ground, is it easy or difficult to follow the line of ore and the line of country rock, or whatever you may call it? A. In some places it is easy, and in some places it is difficult. Not always easy, not always difficult, often very simple.

15

Q. What is the colour of the country rock? A. A dark greenish-gray.

Q. What is the nature of the vein filling, as you term it? A. The vein filling is of two kinds. Do you mean as regards shaft No. 3?

20

Q. Well, in the Centre Star vein, we will say first, where it appears in different places? A. Within what I believe to be the limiting planes, that is, the extreme walls of the Centre Star vein, there is a mineralization which, to a certain extent, defines the whole zone, included from the exterior country; but the influences which have changed the inside have, to a certain extent, and to a limited extent, changed the outside. Usually it is not impossible and not difficult to define the limits by inspection, and it would certainly always be possible by analysis.

25
30

Q. (By the Court). That is to say, the walls have disappeared in some cases? A. Not quite disappeared, sir, but the chemical influences of the solutions which have come by exterior cracks have not only mineralized that which was within, to a certain extent, but to a lesser extent, that which is without.

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Q. What do the vein fillings in that vein chiefly consist of?

Mr. Bodwell: What vein do you refer to?

40

Q. Centre Star No. 2 vein. A. It is largely of this altered country rock, very largely of altered country rock, and in places it consists of plates and



bands and some irregular patches of metallic minerals, that is to say, of pyrrhotite or chalcopyrite and iron pyrites; the main mineral of the metallic passages of the vein is pyrrhotite; the chalcopyrite in the vein is always in much less quantities, and the pyrite is more evenly distributed, and does not seem to me to be an essential, although it is usually present. 5

Q. Do you find any special difference between the constituents of the Iron Mask vein and the Centre Star No. 2 vein, both as to ore, I mean, and also as to vein matter apart from ore? A. Where I have seen the Iron Mask vein its fissures were never very far apart, and the vein filling which I have seen 10 has been always of ore, except a little country material towards the edges of their body. Whereas, the Centre Star vein, in my belief, is a much wider vein enclosed within shear planes, which are not less than at the extreme of 20 feet, and the bulk of the vein included between those is country rock, as I have said before, more or less altered. That constitutes the difference, as I have seen, 15 between the two veins.

The Court: You say the walls are about 20 feet apart? A. I should say about that, the ultimate walls. And probably in some places are much less, as I will afterwards show. 20

The Court: I understand.

Q. Which vein are you speaking of now? A. Centre Star No. 2. 25

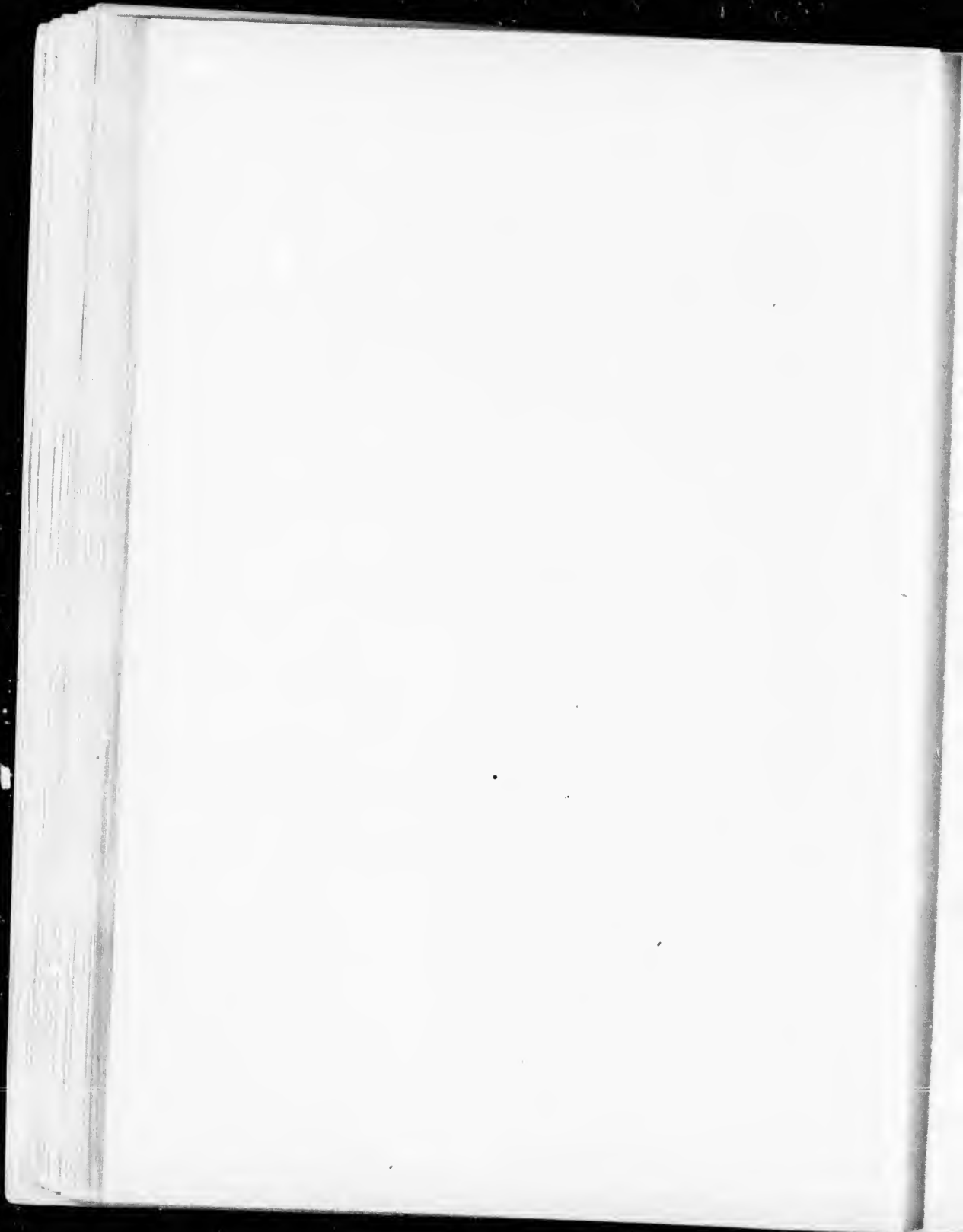
Q. Now, that you are speaking of the width of the Centre Star No. 2 vein, will you tell me, Mr. King, if the width of the veins is a uniform thing at all? A. Not at all. I have spent a great deal of time in the study of one vein that was over 500 feet,—in the Comstock.

Q. And did it remain of a uniform width? A. It was a closed fissure, a mere crack for thousands of feet. 30

Q. And how did you find the veins in this camp in that respect? A. As to their uniform width? 35

Q. As to their uniform width or the opposite? A. I have seen in the Le Roi not less than 40 feet of solid vein matter. That was at a time when the development had not proceeded very far, and as to the later widths, which I am told is very much greater, I am not able to testify personally. 40

Q. Well, was the width in the Le Roi vein uniform? You say you saw 40 feet of a width. Was it any narrower at other places? A. It certainly narrowed westward as far as the workings went, rather rapidly, but I am not familiar with the later developments at all.



Q. Well, speaking of the veins in the camp that you are familiar with, are they as a rule of uniform width, or do they vary in width, and if so, give us an approximate idea? A. They vary very widely in width, and each vein is apt to vary in width.

5

Q. I am speaking, Mr. King, not altogether of the comparative width of the different veins, but I am speaking of the uniformity or non-uniformity of any particular individual vein. A. I am about to illustrate that. There may be some geological question as to whether the stopes upon the Iron Mask, east and west, are upon the same vein. In my belief they are upon the same vein, and the eastern edge of the western stope, where it comes in very close to the dyke, which will perhaps later be described, which cuts through this country to the north and south, is perhaps 6 or 7 feet wide; at other places I have seen it down to a mere fissure. So that that vein itself varies from an extremely narrow seam to 6 or 7 feet.

15

Q. What is the dip of the Centre Star No. 2 vein in the incline shaft? Take it first the average dip, we will say, from the top to the point you mentioned before? A. About 45 degrees.

20

Q. Does the dip of that vein vary? A. Very little. It has a slight variation, but very little.

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Q. That is, in the shaft? A. In the shaft it is steeper at the top, perhaps 6 or 8 degrees.

Q. Now, do veins as a rule maintain a uniform dip, or do they vary? A. They vary enormously. I have seen veins in their dip describe a curve that amounted to almost a right angle. The ore bearing part of the Comstock, which is a very constant example among miners, the eastern walls dip west for a considerable distance, finally swing into the perpendicular and then dip east. Another very well known vein is the Tomboy, which is now a very important mine belonging to the Rothschild Syndicate, in Telluride, Colorado. It started with one dip, made a curve and assumed another. It is not an uncommon thing that their dip or strike should be seriously changed.

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Q. About what is the strike of the Centre Star No. 2 vein at the incline shaft? A. It is a little east, a little north of east, about north 86 east.

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The Court: You mean as between these two shafts?



The Witness: No, I mean right at this point, in this region here. (Indicating on model.) As between the two, that has not been asked me. I can figure that out.

Q. Yes, you might give it to us, Mr. King.

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The Court: I think I misunderstood your question probably.

Mr. Davis: The question was as to the strike of the vein in the incline shaft.

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The Witness: The strike of the whole vein between No. 2 and No. 3 closely approximates to east and west, at this level (indicating), the level indicated.

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Q. At which level? A. The level indicated, about 100 feet above the bottom of the shaft.

The Court: The strike, as I understand (of course, subject to correction), the strike ordinarily, for instance, of that incline, would be taken on the top of it if you did not know there was another shaft here? A. Yes, sir; if you had no other guide to go by it would be.

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The Court: That is the reason I asked you if it was between the two shafts. A. I was asked that and was answering as to one shaft only.

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The Court: And you say north 86 degrees east. A. Yes, sir, at this point. But taking the wider range of the vein it would be about east and west, and the course of the outcrop, which defines the vein upon the surface, would be quite different, because this is lower than that, and the true strike would be from the top of this to that produced at an equal level.

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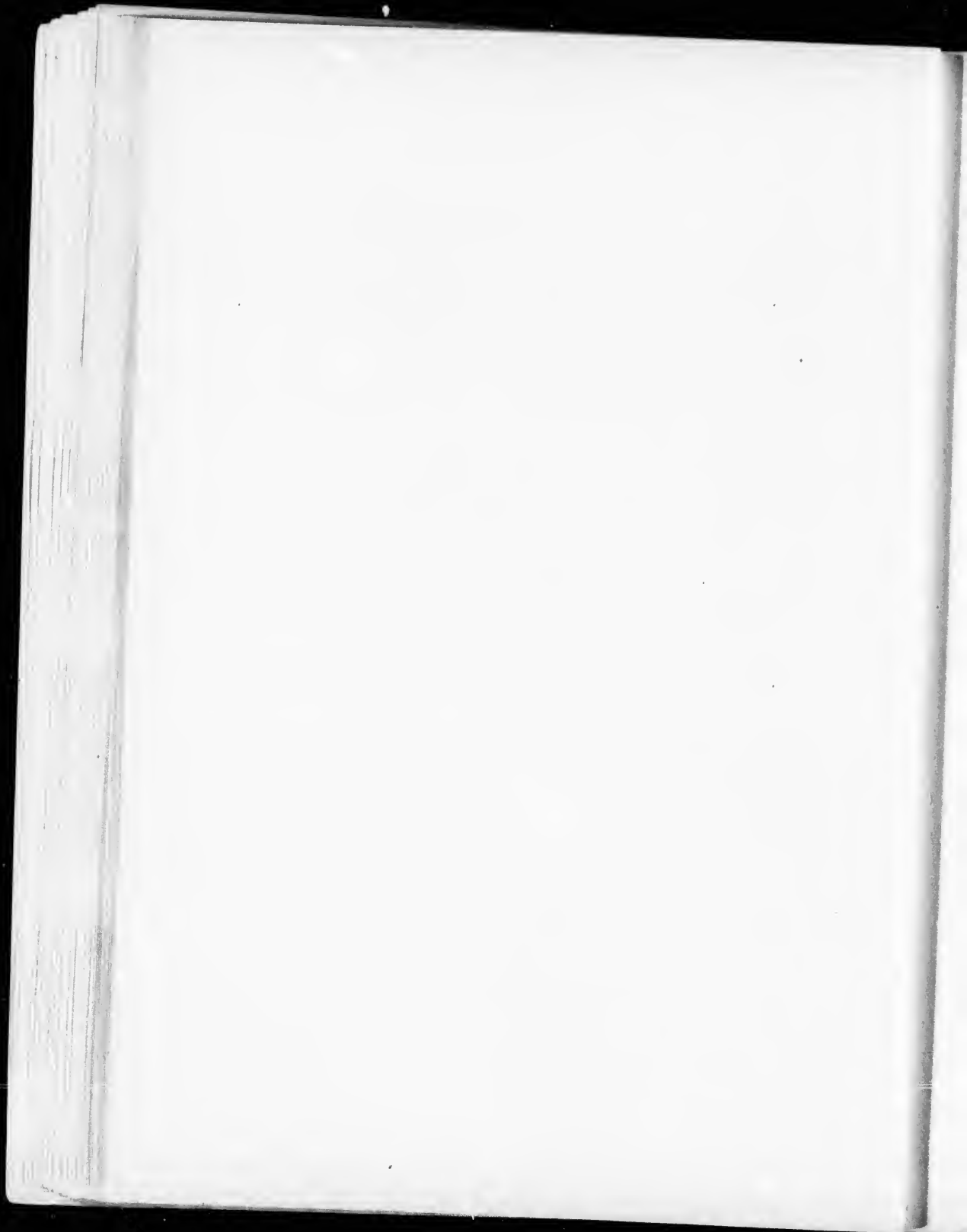
Q. Do you find the vein in the No. 3 shaft narrower or wide or of the same width that the shaft itself is? A. The ore bearing part of the vein is narrower than the shaft. It lies near the foot of the shaft and there was over it from 2 to 4 feet according to the breaking of the shaft—

35

Q. Can you tell— A. May I finish this answer? Will you kindly read that to me again? (Last question and answer read).

40

A. (Continued). Before reaching the last seen hanging wall, which hanging wall is not continuous, but is sometimes broken into by the mining operations and for considerable spaces obliterated.



Q. Can you tell from an examination of No. 3 shaft, as it is at present, what is the width of the vein at that place? A. I cannot. I simply see that a little above, 2 or 3 feet above, the upper boundary plane of the ore is another parallel plane, which is undoubtedly in my mind, a part of the shearing system of the whole. But no works give me access to planes; if they exist, below the lower level of the ore; and I do not believe that I saw the upper planes of the veins; the ultimate plane of the vein, anywhere in this shaft. My reason for that is, that a few feet to the east of it, at the east end of this brown drift, which is the south drift from the Iron Mask stope, what I believe to be, from its position and character, an eastward projection of the ore body of this shaft. 5 10

Q. That is No. 3 shaft? A. No. 3 shaft—is accompanied by two superior parallel walls, at distances of from 4 to 5 feet in actual cross section. The lower one of these I believe to be the one which exactly geometrically fits it and which is the one which is the wall I have spoken of as overlying the ore of this shaft, but we have never cut high enough in No. 3 to get at the upper of those walls, and we have never cut below to get at the lower walls. 15

Q. From the explanation you have given, I understand this is what you described yesterday as the shear zone vein? A. Yes, sir, the shear zone vein. 20

Q. Now, you spoke a moment ago of the hanging wall disappearing. What hanging wall were you referring to? A. The lowest plane seen above in the No. 3 shaft. 25

Q. And what is the cause, if you know it, of its disappearing? A. I explained that, that it was due to cutting in by the miners, but they had never broken accurately to the plane; that they had sometimes left some material below it, and for large distance they cut into it. 30

Q. And had not gone far enough back to cut the wall? A. Any correlative planes that might be there.

Q. In the case of a vein that you have described, what would be the only possible way of accurately and mathematically demonstrating where the two ultimate walls of the vein were? A. By a thorough cross-cutting into the hanging and foot walls. 35

The Court: In the present shaft? A. In any case; in this case exactly the same cut. 40

The Court: And cutting out any particular place? A. Yes, sir.



Mr. Davis: I may be a little long over this No. 3 shaft, but that is the shaft so much fight is about.

The Court: I want all the information possible.

Q. Now, Mr. King, will you kindly come around here and point the ore in this Exhibit No. 90 out to the Judge and explain the different ores as you find them. This is a sample from near the top of No. 3 shaft. I suppose that will explain the oxidation? A. Yes.

Mr. Davis: All of this evidence is being given with reference to the pieces of ore in Exhibit 90.

The Witness (Proceeding to illustrate to the court from Exhibit No. 90): This is the type of the metallic mineral of the No. 3 shaft and of the vein at large. It is taken from near the surface, and this dull bronze lustre is a characteristic of the ore and of the copper—which is much more easily decomposed than the pyrrhotite, more soluble, appears only scattered. There (illustrating), for instance, is a little yellowish spot, which is the copper. Here is a sample which contains but little of the pyrrhotite or the metallic mineral, and is chiefly of country rock. The sample, therefore, is composed of a mixture of what I should probably consider the country rock and of the metallic mineral such as you would get in a breaking into a more or less decomposed and not always perfectly defined outcrop. Here, for instance, is a piece of the siliceous, and the quartzose part of the vein which is found, but not an absolutely constant accompaniment, which contains a good deal of the copper mineral chalcopyrite. Quite often, as near the surface, some of the copper has been oxidized, and has left a green stain of itself, which indicates its former presence. That is the characteristic of this pan full of ore. It is made up of a mixture of broken country and ore material, with more or less silica.

Mr. Bodwell: I will put those in a piece of paper which Mr. King referred to.

The Witness: I picked that out on purpose to shew the mixture.

Mr. Davis: This is more for the purpose of shewing your Lordship the ore itself and having Mr. King point out the different minerals, than anything else.

Q. From what you said, Mr. King, you apparently find country rock more or less altered, and perhaps not altered at all in the vein. Is that correct? A. In parts of the vein.



Q. Here is Exhibit 91. This is the second one down in the shaft. A. (Illustrating). I take the two top specimens, as illustrating precisely the same phases that I spoke of before. This sample is chiefly pyrrhotite, but contains a little copper mineral; this is chiefly country rock, containing a good deal of chalcopyrite and some calcite.

5

Q. As to Exhibit 92, first of all, Mr. King, what ore do you find in that, speaking generally? A. You mean what ore minerals?

Q. Yes. A. Pyrrhotite and chalcopyrite, with the calcite which I mentioned as accessory.

Q. You found both of those? A. If you will allow me to look at the very first specimen again. (Referring to Exhibit 90.) It has perhaps a little lime, but it is largely quartz.

The Court: Is that term "shear zone" that you mentioned yesterday and this morning a geological term? A. Yes, sir.

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The Court: A very well known one? A. Yes, in modern times; it has not been very well recognized until very recent years. It appears in geological literature in a prominent way in recent times.

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The Court: Owing to the new theory by compression. A. Owing to new observations chiefly. This (referring to Exhibit 92) is again a mixture of country rock; and when I say country rock, I do not mean in this case to limit it to the country rock exterior to the vein, but to the material of the country rock; and as to whether it is altered by vein influence and is within the bounding planes or exterior to it I could not say without close examination, which is impossible to make here. Outside that, the bulk of the exhibit is of pyrrhotite, with a good deal of chalcopyrite—that is in the specimen of the chalcopyrite. Here is also a considerable amount, a noticeable amount, of calcite. I should like also to say that in the first specimen (Exhibit No. 90) there is calcite.

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Q. I hand you Exhibit 93. A. Can I make what I said about country rock apply to all of the specimens later?

Q. Certainly, you can if it does. A. There appears to be three types here, a country rock with very slight impregnation by metallic mineral, a pretty solid pyrrhotite ore with a little copper and the same mixture type in which there is considerable calcite, with pyrrhotite and chalcopyrite.

40



Q. When you speak of the country rock being altered in the veins, what is the alteration which you refer to? You might just describe it as simply as possible. A. It is a varying decomposition of the included country rock, which results prominently in the degradation of the feldspar, and in the uralization of the augites, and the development of the secondary biotite. The two former cases also proceed into the country rock, but in less degree, and the third case, that of the secondary biotite, is, so far as my examination has gone, characteristic of the included country rock, which I call vein matter. 5

Q. In Exhibit 94 what do you find? A. An exhaustive examination of this would take hours, of course, and perhaps days. I am only giving it in a cursory manner. This is the same mixture of country rock, containing disseminated pyrrhotite and chalcopyrite, more or less charged with calcite and solid masses of pyrrhotite. I will qualify those at the end by what my limitations are. 10

Q. What about Exhibit 95? A. This is a similar mixture, in which, however, the proportion of country rock is much less and the pyrrhotite and chalcopyrite much greater than in the previous sample. 15

Mr. Bodwell: That applies generally to the whole sample? A. That applies generally to the whole sample. That contains the two chief ore bearing minerals and shews the country rock, (referring to one of the specimens.) 20

Q. What do you say about 96? A. This has more country rock in it. This is a similar mixture of country rock containing more or less calcite and carrying the ore minerals pyrrhotite and chalcopyrite. 25

Q. And what else? You said it is a mixture of country rock carrying so and so. A. Carrying the ore minerals pyrrhotite and chalcopyrite, together with solid masses of pyrrhotite and chalcopyrite, the latter always in less proportion. Do you want me to particularize, or can I say this is similar to the previous? 30

Q. I want you to say whether or not it contains pyrrhotite and chalcopyrite. A. Yes. 35

Q. Say that definitely, and then you can generalize as much as you like. A. This is a similar mixture of country rock, impregnated with the metallic minerals and of solid masses of pyrrhotite and chalcopyrite. 40

Q. What do you say about 98? A. A similar mixture of country rock, more or less impregnated with metallic minerals, the impregnation amounting in places to a solid mass of the two metallic minerals.



Q. That is pyrrhotite and chalcopyrite? A. Pyrrhotite and chalcopyrite.

Q. What do you say about Exhibit 99? That is taken from 102 and 107 feet down? A. It is a similar mixture of country rock, pyrrhotite and chalcopyrite and iron sulphide. 5

Q. That is iron pyrites? A. No, which is probably iron pyrites mixed with a little chalcopyrite. 10

Q. What do you say about Exhibit 100, taken 112 and 117 feet down? A. It is a similar mixture of country rock, pyrrhotite and chalcopyrite, and is in part more silicified—apparently more silicified. It contains calcite as well.

Q. What do you say about Exhibit 101, taken at 123 and 127 feet down? A. It is a similar mixture of country rock, pyrrhotite and chalcopyrite. 15

Q. Is it possible to form any reliable opinion from looking at those samples which is the richer in value? A. I should suppose that the higher percentage of chalcopyrite would indicate a slightly greater contents of precious metal, but so far as the bulk of the ore mineral goes, which is pyrrhotite, there can be no determination made of relative values by looking at them. 20

Q. By merely an examination; that is what I want to get at? A. No. Since part of the values of the ore are in copper, the higher visible proportion of chalcopyrite means a higher value; but that pyrrhotite offers no guide. 25

Q. Now, are the values in veins, as a rule, uniform? A. Not at all. 30

Q. Just describe how values are frequently or usually found in that respect? A. The distribution of the valuable minerals within the material of a vein is most capricious and most irregular, and follows a very great number of types. Sometimes the values are all in certain layers of a banded structure; sometimes they are thinly distributed through a gangue stone; sometimes they are highly concentrated in the mud-seam of ore bodies, and sometimes one will carry more value than another. Sometimes in a mine whose vein consists of a vein stone of metallic minerals and of an impregnated companion zone exterior to the gangue stone, the plain exterior zone which may be due to silicification or even the presence of calcite, the exterior zone may carry a higher proportion of the precious minerals than the visible metallic minerals would shew. In the case of veins of replacement the values may, and usually do, depend on the perfection of the pseudomorphism or replacement by the mineral 40



as well as the original matter of the vein, and as that is a most capricious process, both values and the carrying mineral matter may cease at any time and re-appear in the most eccentric manner, and practically not until a great vein should be entirely worked out would it be possible to map the distinction of accompanying minerals or essential minerals.

5

Q. So that if, in following down a vein, you come to a place where the mineral rock constituting the vein, the filling, carried only a trace, what would you say of the precious metals; would you attach any importance to that? A. Only a commercial importance.

10

Q. But I mean as to the vein itself, or as to what might ultimately result in that vein? A. No, not at all.

Q. What do you say as to Exhibit 102, taken at a depth of 132 and 137 feet? A. That it was a similar mixture of country rock, pyrrhotite, chalcopyrite and a white quartzose matter, which possibly includes feldspar; that the chalcopyrite is accompanied by tarnishes which indicate local decomposition.

15

Q. What do you say about Exhibit No. 103, taken at a depth of 142 and 147 feet? A. A similar mixture of country rock, pyrrhotite and chalcopyrite.

20

Q. What do you say about 104, taken at a depth of 152 and 157 feet? A. Similar mixture of country rock, pyrrhotite and chalcopyrite.

25

Q. What do you say as to Exhibit No. 105, taken at a depth of 162 and 167 feet below? A. A similar mixture of country rock, pyrrhotite and chalcopyrite in which the metallic minerals are in larger proportion than in most of the preceding samples.

30

Q. Did you break one of those and see the chalcopyrite and pyrrhotite when it was fresh? A. (Witness breaks the rock.) This shows it pretty well, the bright, brassy yellow is chalcopyrite, and this dull metal coloured bronze is the pyrrhotite.

35

The Court: There are no sulphurets? A. No, they are copper-bearing sulphurets.

40

Q. What do you say as to Exhibit 106, taken at a depth of 172 and 177 feet? A. I should say that it was a similar mixture of country rock, pyrrhotite and chalcopyrite. To save multiplicity, of that sample, I have got both.



Q. What do you say as to Exhibit 107, taken at a depth of 182 and 187 feet? A. It is a similar mixture of country rock, with pyrrhotite and chalcopyrite.

Q. What do you say as to Exhibit 108, taken at a depth of 192 and 197 feet? A. The same mixture of country rock, pyrrhotite and chalcopyrite. 5

Q. What do you say as to Exhibit 109, taken at a depth of 202 and 207 feet? A. A similar mixture of country rock, pyrrhotite and chalcopyrite.

Q. What do you say as to Exhibit 110, taken at a depth of 212 and 217 feet? A. Similar mixture of country rock, pyrrhotite and chalcopyrite. 10

Q. Now, Mr. King, looking at 109 and 110, which from appearance would seem to be the richer sample; which seems to shew more mineral? A. 15
(After examining.) This one (Exhibit 109).

Mr. Davis: The assayer's returns shew that 110 is the richer by one-half.

The witness: It is a question of the interior of the rock, as well as the exterior. 20

Mr. Davis: That is what I wanted to bring out, that you can't tell by looking at the outside their values. 25

The Witness: What I judged by was the visible breaks, there seemed to be more chalcopyrite.

Q. What do you say as to 111? A. Mixture of country rock, pyrrhotite and chalcopyrite. 30

Q. What do you say as to 112, taken at a depth of 232 and 237 feet? A. This consists of a mixture of country rock, pyrrhotite, and what I take to be a mixture of pyrite with a little chalcopyrite, but that could only be determined by closer examination. 35

Q. What do you say as to Exhibit 113, taken at a depth of 242 and 247 feet? A. It contains country rock, pyrrhotite and pyrite, the latter apparently euphriferous. 40

Q. That is, copper-bearing, is it not, Mr. King? A. Yes, copper-bearing; perhaps I had better put it in "copper-bearing."



Q. What do you say as to Exhibit 114, taken at a depth of 252 and 257 feet? A. Mixture of country rock, pyrrhotite, some pyrite and chalcopyrite.

Q. How would you say that particular sample compares in value with the ordinary run of them, the last few you have been having, for instance? A. I don't like to answer that. 5

Q. I suppose what you mean is, that on a cursory examination such as this, you could not tell very much about the difference? A. I could not tell without a very close examination; I should say it was low in value. 10

Mr. Davis: That is the assay which runs the highest in value. The assayer's return is \$45.60.

The Court: Very few of them ran over \$20. 15

Mr. Davis: Very few indeed.

The Witness: I had previously stated it could not be done by the eye. 20

Mr. Davis: I just wished to accentuate that. That is the very object of it.

Q. Exhibit No. 115, taken at a depth of 262 and 267 feet? A. Country rock, pyrrhotite and chalcopyrite and pyrites. 25

Q. What would you say as to Exhibit 116, depth 272 and 277 feet? A. Similar mixture of country rock, pyrrhotite and chalcopyrite. 30

Q. What do you say as to Exhibit 117, depth 282 and 287 feet? A. Mixture of country rock, pyrrhotite, chalcopyrite and a little pyrite.

Q. What do you say as to 118, taken at a depth of 292 and 297 feet? A. Country rock, pyrite and pyrrhotite. 35

Q. Now, the point where you stopped in the shaft, Mr. King, that is at the bottom of this sump, is coincident, I think, with the place where the so-called flat fault goes through, is it not? A. It is. 40

Q. Now, Mr. King, is there anything you want to add to what you have said individually as to these specimens? Because we have finished all the speci-



mens in the No. 3 shaft down to the mud-seam? A. I should like to make a qualification, yes. In regard to these determinations, they were intended to cover essentially the obvious facts of the samples. They do not propose to determine obscure or difficultly visible accessory minerals. I have not always mentioned that calcite was present when it was present in some of the samples. 5 I may say generally that there is a little calcite through the whole suite, not in every piece, but in a great number of them. That the mention of pyrite has been chiefly confined to specimens in which the mineral appears with sufficiently crystalline facets to offer easy determination. The pyrite is probably present in a very large number of cases where I have not mentioned it, and 10 where it could not be easily differentiated from chalcopyrite.

Q. Mr. King, looking at these samples which you have examined, which came, as the evidence shews, from trenches cut across the full width of the ore every five feet down in No. 3 shaft, is it a physical possibility that there should be no vein in that shaft, in your opinion? A. In my opinion it is not. I will qualify that. From what I know of veins in general, and of the Rosslund district in particular, it would be impossible to trace continuous ore upon any plane or line unless you were following a vein. 15

Q. You have examined, I believe, the Centre Star east drift, that is, the green drift which runs from the No. 3 shaft? A. I have. 20

Q. Have you made a careful examination of that? A. I have. 25

Q. Do you find any vein there? A. I find precisely the same vein, which I followed from the collar of No. 3 shaft where it outcrops down to the mouth of the 59 east drift, and all through that drift I continued to follow that vein to the head of the winze. Its ore is continuous, its structure unmistakable. 30

Q. So that there is a lateral extent of the vein in No. 3 shaft of at least 100 feet? A. There is.

Q. You spoke of the structure of the vein in 59 east drift. Please describe that structure you found there, and why from that point of view you say there is a vein in the 59 east drift? A. Primarily because the ore lies upon the south and north sides of the drift, corresponding in position to the inclination which the ore has followed from the surface; therefore it is a part of a 40 plane, which plane has been defined upon one side by No. 3 and upon the other side by the east drift. Also by the presence of a plane visible, frequently tapping the ore and defining it from the immediate country rock, which plane is the trace of a fissure. 35



Q. What about the ore? A. I should like to qualify that answer a little more, and say that that plane is not a mathematical plane in the sense of it fitting co-ordinates with absolute exactness, but is a pure geological fissure vein.

Q. What do you say as to the ore in 59 east drift? A. It is the same mixture of predominant pyrrhotite and a little chalcopyrite. 5

Q. As to its continuity, what do you say? A. Absolutely continuous from the point of its divergence from shaft No. 3 to the head of the winze; and the face in that direction shews ore forthgoing. 10

Q. Now, I wish to have this point clear, Mr. King. When you speak of the ore being absolutely continuous, you are speaking literally. A. I am speaking in the case of No. 3 and this drift literally. 15

Q. You have made such an examination as enables you to say that? A. Yes, sir; it is literally continuous. 20

Q. What do you say as to the width of the ore and the width of the vein, if you know the width in 59 east drift? A. It varies from— 25

Q. Which? You see, I asked you as to the width of ore and also of vein. A. As to the width of ore, it varies from perhaps 18 inches to about four feet on the plane of exposure. It would indicate a little less on an absolute perpendicular to the plane of the vein. As to the vein itself, I got no further light—I did not get so much light as to the general structure or rather as to the presence of of overlying parallel walls as I do in the shaft itself. 30

Q. That is, you cannot tell the width of the vein in the 59 east drift? A. No, I am only able to follow a distinct line of unbroken continuous ore, which was a part of the sheet which I had followed down which I traced inwardly to the head of the winze. 35

Q. What do you say as to the walls there? A. I repeat that the only wall, clearly visible is a somewhat disturbed wall covering and limiting the ore, which wall I will describe later. 40

Q. Perhaps it would be as well to describe that wall now, since we are on it? A. Well, if you ask me about the winze I will do it then. It appears better in the winze.



Q. All right. I don't know whether I asked you when examining you on the No. 3 shaft about what the width of ore was in that shaft. I do not think I did. A. From about a foot to three feet and a-half in one place, I think. It is a substantially continuous zone shot of ore.

Q. Before I ask you about the individual samples, I will ask you whether you find any similarity or any difference between the ore in the No. 3 shaft and the ore in 59 east drift? A. I see none whatever.

Q. No which? A. No difference.

Q. What do you say as to Exhibit 72, which is from 7 and 12 feet east station 59? A. It contains country rock, pyrrhotite, pyrite, and chalcopyrite.

Q. What do you say as to Exhibit 73, which is from 17 and 22 feet east of the shaft? A. They contain country rock, pyrrhotite and pyrite.

Q. What do you say as to Exhibit 74, which is from 27 and 32 feet east? A. They contain country rock, pyrrhotite and chalcopyrite.

Q. What do you say as to Exhibit 75, which is from 37 and 42 feet east? A. They contain the same country rock, chalcopyrite and pyrite.

Q. Any pyrrhotite in that? A. I meant pyrrhotite, not pyrite.

Q. Chalcopyrite and pyrrhotite? A. Yes.

Mr. Davis: I will ask your Lordship to look at these samples in Exhibit 75. This piece, which to me, at any rate, looks rather "rocky," is the highest sample in the drift.

The Court: For silver? A. For gold. There is a silicification of these ores. In answering the question as to this sample I was not aware of the value of the sample at all, which is shewn to be \$18.80; and I now suspect that it owes that value largely to gold accompanying a secondary silicification, which is a prominent feature in certain parts of the Rosslund mines.

Q. What do you say as to Exhibit 76, which is 47 and 52 feet east of No. 3 shaft. A. That contains country rock, chalcopyrite and pyrrhotite.



Q. What do you say as to Exhibit 77, at 57 and 62 feet east of the shaft?

A. I should say that it was country rock, pyrrhotite, a little chalcopyrite and pyrite.

Q. What would you say as to Exhibit 78? A. Pyrrhotite, chalcopyrite and country rock. 5

Mr. Davis: I will ask your Lordship to look at this one specially.

Q. Would you mind pointing out to his Lordship those different pieces 10
showing the pyrrhotite and chalcopyrite? A. That yellow going through
there is chalcopyrite, a sort of brassy yellow. The bronze mineral is pyrrhotite.
And that piece is a mixture of both, with some country rock.

Q. What is that which you see there in that piece? A. Pyrrhotite. 15

Q. What do you see there (showing another piece to the witness)? A.
Pyrrhotite with a tarnish that may contain a trace of copper. 20

Q. What do you see there? A. Pyrrhotite.

Q. And what do you see there? A. A little chalcopyrite.

Q. What do you see in that piece? A. Pyrrhotite. 25

Q. What do you see there? A. Pyrrhotite, with a little chalcopyrite.
There you can see the association; there is the pyrrhotite and there is the brassy
chalcopyrite. 30

Q. There is not a piece in this sample, is there, in which you cannot find
pyrrhotite and chalcopyrite? A. It would take a long time to determine it. 35

Mr. Davis: Now, that, my Lord, although it looks so nice, is one of the
poorest assays, only \$2.40.

Q. What do you say as to Exhibit 79? A. Country rock, pyrrhotite
and chalcopyrite. 40

Q. What do you say as to Exhibit 80, 87 and 92 feet from No. 3 shaft?
A. Country rock, pyrrhotite and chalcopyrite.



Q. What do you say as to Exhibit S1, which is 97 and 102 feet east of No. 3 shaft? A. It is country rock, pyrrhotite and chalcopyrite.

Q. So that the chief ores in this vein that we are considering are clearly chalcopyrite and pyrrhotite A. With accessory pyrite. 5

Q. What are the chief ores which you find in the Iron Mask vein? A. Chiefly pyrite, with mixtures of chalcopyrite.

Q. Chiefly pyrite? A. No, pyrrhotite, with a mixture of chalcopyrite. 10

The Court: That is, they are the same? A. Practically the same, yes.

Q. Now, Mr. King, have you anything further to say as a whole with reference to the ore in that drift? A. Only to repeat its absolute continuity, and like the vein in No. 3 shaft, so far as its metallic contents are concerned, it consists predominantly of pyrrhotite with a little chalcopyrite and occasional masses of pyrite, which seem to me to be secondary and accessory. 15

Thereupon the Court adjourned until 2:30 p.m. 20



AFTERNOON SESSION.

Trial resumed at 2:30 p.m.

CLARENCE KING.

DIRECT EXAMINATION RESUMED.

By MR. DAVIS—

Q. You know the winze from the end of the Centre Star drift, do you, 5
Mr. King? A. I do.

Q. Known as the Centre Star winze. Have you examined that? A.
I have. 10

Q. Have you examined it carefully? A. I have.

Q. Do you find any vein in that winze? A. I do.

Q. What vein is it? A. The same vein which I followed from the 15
collar of No. 3 shaft to the mouth of this east drift and through the drift and
to the head of the winze; I continued upon and followed uninterruptedly down
the winze to its bottom. I say uninterruptedly; I mean to say as to continuity
of ore. 20

Q. You mean there is continuous ore in that winze; is that it? A.
Yes, there is.



Q. When you say "continuous ore" do you mean continuous literally?

A. Literally.

Q. From the top of the winze to the bottom? A. Yes, sir, from the top of the shaft to the mouth of the drift through the drift and down the winze, 5 continuously.

Q. What is the nature of the ore in the winze? A. Similar to that in the shaft, in the drift.

10

Q. About what width is it in the winze? A. Twelve to sixteen inches, until you get nearly to the sump of the winze—the pit of the bottom of the winze.

Q. By the way, have you notes of the width of the ore at different points we will say down that incline shaft? A. No, only that a minimum would be somewhere near eight inches and the maximum somewhere near three feet. 15

Q. You could not from your notes check the width of the ore as given by Edwards? A. No, I could not. 20

Q. Where he speaks of the width of ore? A. I could not.

Q. Can you tell by looking at the samples whether he has gone beyond the ore or not? A. He undoubtedly has. He has included a percentage of country rock which is not characteristic of the pure metallic part of the vein. 25

Q. What about walls in the Centre Star winze? A. There is a very well defined wall which is the upper limiting plane of the ore, and two to two and a-half feet above that a superior correlative plane, which I took to be the same seen in the shaft at intervals, about the same distance above the bounding ore plane. 30

Q. Can you tell the width of the vein in the winze? A. I should say that it would average certainly a foot down to nearly— 35

Q. That is the body of ore, you mean? A. The body of ore.

Q. Well, go on with that, then Mr. King? A. And at the head of the pit or just above the head of the pit, which is the bottom of the winze, there is a rather sudden expansion of ore both upward and downward which continues unbrokenly until cut by a fissure known as the flat fault. 40



Q. Can you tell what the width of the vein is in the winze; that is, can you tell whether or not you have got to the ultimate walls? A. I cannot in either case.

Q. Outside the mud-seam, do you find any other fracture in that winze— rock fracture? A. I find a small basic dyke cutting from north to south, with its fissures, if that is— 5

Q. Yes, that is what — n, Mr. King. About what is the dip and strike of that dyke in the winze? A. It is approximately north and south with a very slight easterly dip. 10

Q. About what is the thickness of it? A. It varies from 8 or 9 inches to a little over a foot. 15

Q. Was that later or earlier than the Centre Star vein? A. It is later.

Q. How do you know? A. By the fact that it produces a solution of continuity where it crosses it; in other words, it cuts through it. 20

Q. It cuts through the Centre Star vein? A. Yes, sir, both at the head of the winze and at the east side of the bottom of the winze.

The Court: You are talking of this basic dyke? A. I am, sir. 25

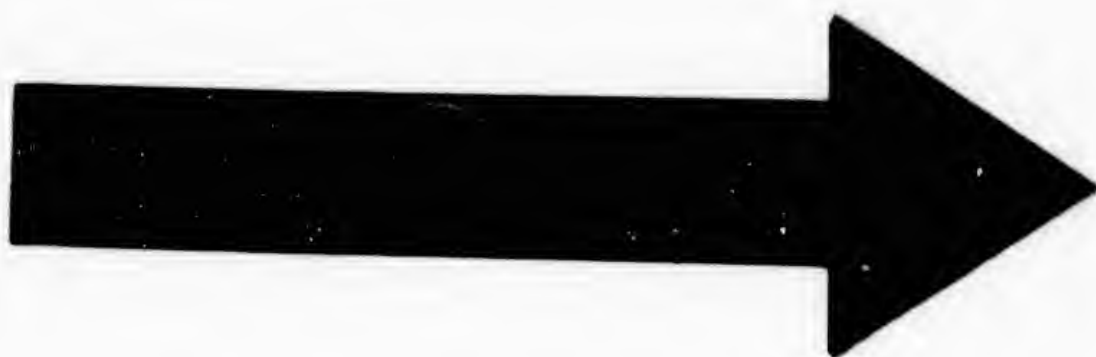
Q. Just at this point I might ask you what is the relative age, then, of the so-called mud-seam. A. The mud-seam is later than the dyke. 30

Q. What about the vein? A. The vein is earlier than either.

Q. Then the order in which they come is: No. 1 the vein, No. 2 the dyke, No. 3 the mud-seam? A. That is the order. 35

Q. Does the dyke dislocate the vein in any way? A. It does not.

Q. How do you know that? A. Because on the course of the vein the vein reaches the dyke in the body of the winze upon the west side of the dyke, and there it is cut sharply off by the matter of the dyke itself, but the excavation both at the top of the winze and at the bottom of the winze passes to the east of that dyke, and in each case the ore vein is found in the position that it would be if continuous. 40



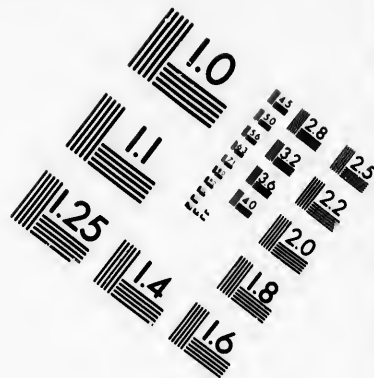
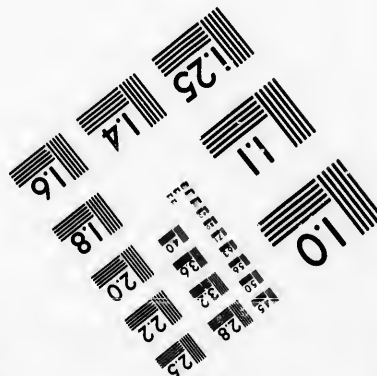
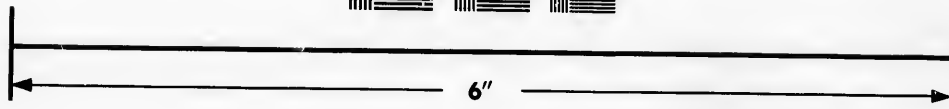
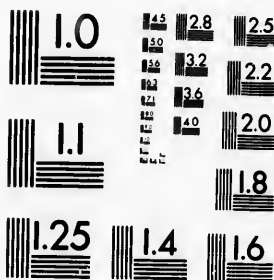


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Q. This dyke you speak of is a dyke in accordance with your definition of a dyke given yesterday, is it? A. Yes.

Q. That is, it has foreign matter which has been intruded from below?
A. It is a fissure filled by injected melted volcanic matter. 5

Q. The filling of that dyke differs from the country rock, then? A. Entirely.

Q. What kind of a dyke would you call that particular one? A. It 10
would come under the general head of lamphrophyre.

Q. Entirely distinct from the country rock? A. Entirely distinct
from the country rock. 15

Q. I believe you found a number of dykes through this territory which is in dispute? A. I found a half a dozen which I identified myself and of whose continuity I satisfied myself at various points. 20

Q. What do you say of sample Exhibit No. 83, taken 4 and 10 feet below the top of the winze? A. It is composed of country rock, pyrrhotite, chalcopyrite and pyrite. 25

Q. What would you say as to sample Exhibit No. 84, taken from 10 and 16 feet below the top of the winze? A. It is composed of country rock, pyrrhotite and chalcopyrite. 30

Q. What do you say as to sample Exhibit No. 85, from 24 feet below the top of the winze? A. It is country rock, pyrrhotite, pyrite and chalcopyrite. 35

Q. Have you been up in this brown drift, being the Iron Mask cross-cut south from the Iron Mask east stope? A. I have. 40

Q. About what is the length of that cross-cut, roughly? A. About 80 or 90 feet. I can scale it if you wish.

Q. Well, perhaps you might as well. A. (After scaling it.) It is about 55 feet. 45

Q. Did you find anything in the face of that cross-cut? A. A large body of pyrrhotite.



Q. Is that scale correct, Mr. King? Mr. Ferrier tells me he thinks the scale you used is not the right one for that map, which is 20 feet to the inch.

A. The scale was placed here with it. Have you a 20-foot scale?

Q. There does not appear to be one here now. A. Well, I can give it approximately from this one. (After scaling again.) It is about 110 feet; 108 feet perhaps. 5

Q. You say you found a body of pyrrhotite in the face of that cross-cut. Is that in a vein? A. That is in a vein. It passes diagonally through the face of the winze, across the face of the winze. 10

Q. Across the cross-cut, you mean? A. Across the cross-cut; cutting it diagonally on the strike of its vein which is here, approximately. 15

Q. I was just going to ask you: what vein is it that it strikes? A. Undoubtedly the vein shewn in Centre Star shaft 3. And the reason I say "undoubtedly" is— 20

Q. When you are pointing to the model, Mr. King, in order that the stenographers may get the exact points on the notes, mention what you are pointing to. A. (Continuing.) Because the strike as shewn in the south face of this brown cross-cut is exactly the strike shewn, only 35 feet off, in the neighbouring Cer. re Star No. 3 shaft. 25

Q. It is only 35 feet? A. Only 35 or 40 feet at the farthest, and on the east side of that shaft— 30

Q. That is shaft No. 3? A. No. 3 shaft; the ore is seen extending eastward, and on the west side of that cross-cut place it is seen passing westward.

The Court: Did you say the strike or dip? A. The strike there, because they are on the same level. 35

The Court: I know, but I understood that probably that was due—using a phrase of mine—to a beveling off. A. Yes, exactly; it is beveled off, that precisely expresses it. 40

The Court: That shews the dip and the strike to be the same? A. It shews the dip to be the same; the dip and the strike are alike.



Q. How much of a shewing of ore do you find in the face of that cross-cut?

A. About 3 feet thickness of pyrrhotite and one foot directly underlying that of silicified vein material; highly silicified; 10 inches to one foot of the silicified vein material.

Q. Has the face of the cross-cut been carried through the vein or does it still remain in ore? A. It remains in the silicified vein country matter, which is frequently charged with valuable metals, but in that case I have not had it assayed.

Q. Did you find in that brown cross-cut the ultimate wall of the vein which you have spoken of as you have described it before? A. Upon the hanging wall side I found two correlative planes coinciding in dip and strike with the geometrical position of the planes of the Centre Star No. 3 vein.

The Court: The No. 3 shaft? A. The vein in the No. 3 shaft, yes.

Q. How far would those planes be from the body of pyrrhotite? A. On a line of the cross-cut about seven and a-half feet—the first one from the pyrrhotite; and the second one another seven and a-half feet, making it at its true right angle to the strike, something like 14 feet from the three bodies, the pyrrhotite and the two plates of country rock including the inside of the exterior boundary.

Q. Would you expect to find similar veins on the opposite side of the body of pyrrhotite in case the cross-cut had been carried through? A. May very well be. We have there the evidence of three parallel plates—there may be more on the other side—but we appear to have reached the ultimate hanging wall at that point.

Q. To have reached the ultimate hanging wall? A. Yes, at that point.

Q. Yes, at that point. As to the ultimate foot wall you have no—
A. We have no knowledge whatever, as the cross-cut was stopped in ore.

Q. I think there were some samples taken from that point.

The Court: While you are getting your samples I want to ask a question. Do I understand from you, Mr. King, that after that drift was run—because, of course, it was a drift—it came to what you say is, or suppose is, the Centre Star vein? A. Yes, sir.



The Court: In shaft No. 3? A. Yes, sir.

The Court: This superior wall, as you call it, in the first place, is the first outside wall, you mean? A. The first outside wall.

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The Court: Then, what do you call the inside wall where they are divided up into compartments, as it were? You have first your outside superior wall. A. Yes, sir.

The Court: What is the next? A. The next is the inner wall.

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The Court: Just the inner wall? A. Yes, sir.

The Court: This superior wall—I only want to know for my own information, because I do not understand it otherwise—this superior wall you meet there might be the hanging wall. A. Yes.

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The Court: Because you meet another wall beyond. A. Meet another wall beyond.

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The Court: And no other reason? A. That is the only reason.

The Court: There is no peculiarity about it? A. No peculiarity about it.

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The Court: Is there any foreign matter here, what they call selvage—or— A. No, only very slight; it is a mere fissure seam; but upon a brief examination of the country rock intruded between that exterior seam and the ore I saw a decided difference as compared with the country rock exterior to that superior wall.

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The Court: That is, of a mineral character? A. Yes, sir.

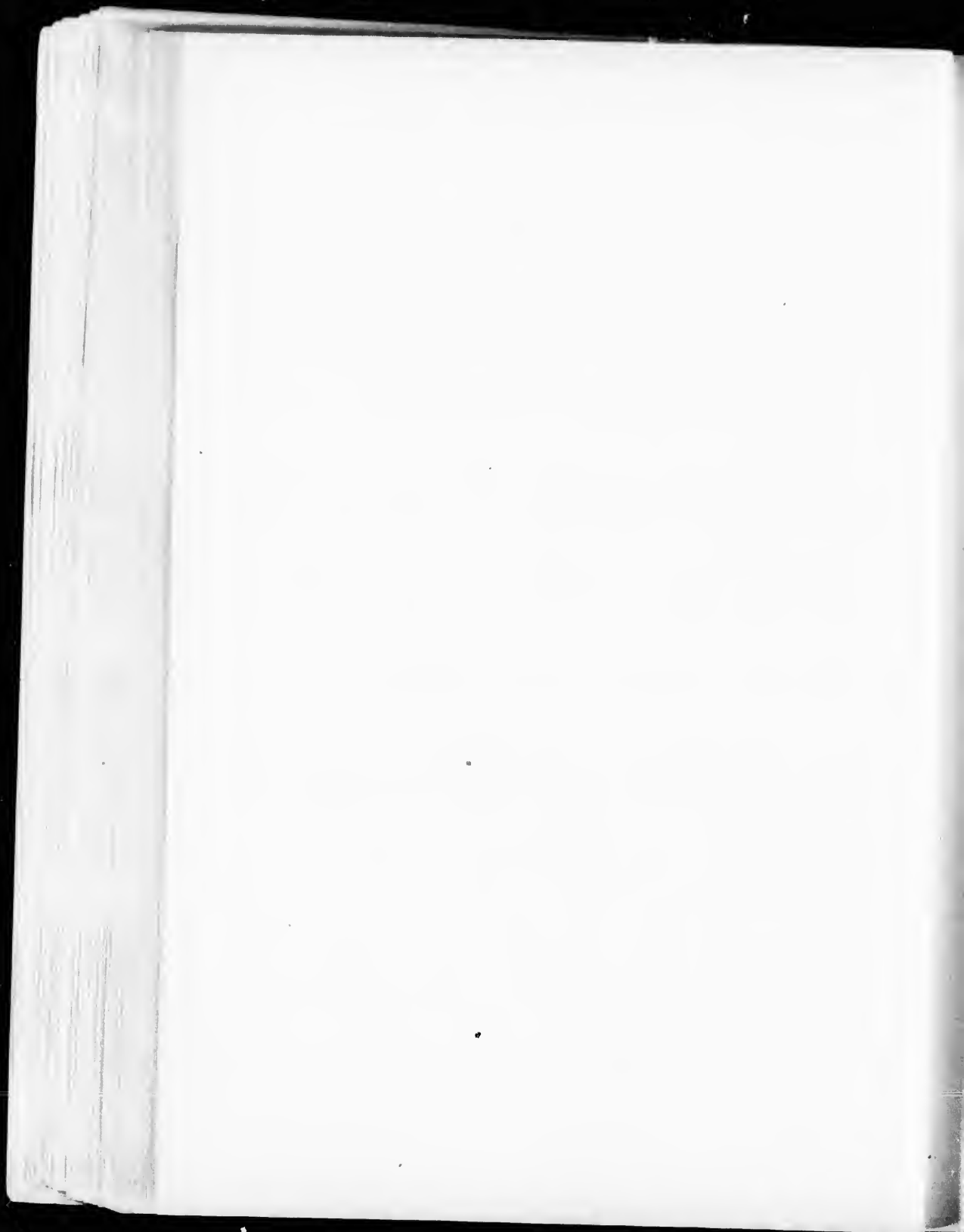
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The Court: That is all, thank you.

Q. Exhibit 134 is a sample taken from the face of this south cross-cut in the Iron Mask stop. What do you say as to Exhibit No. 134? A. It consists of country rock, pyrrhotite and chalcopyrite.

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Q. How does it compare with the samples which you have already examined from the Centre Star No. 2 vein? A. Practically identical.



Q. Now examine Exhibit 135. What do you say as to that? That is taken 10 feet north of the last sample. A. That is what I would call somewhat altered country rock irregularly impregnated with metallic mineral.

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Q. There is no sample selected from it, is there? A. I might enumerate those minerals, that it is chiefly pyrrhotite.

Q. Have you examined the outcrop? A. I have.

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Q. Between what points? A. I examined it about 28 feet west of the west side of the collar of No. 3 Centre Star shaft, and thence to the collar of the No. 2 shaft and a few feet beyond.

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Q. Producing the line of outcrop as you found it, where would it pass out of the Centre Star mineral claim boundaries, that is, through what line? A. Do you mean on a line of the outcrop calculated only by the line of outcrop?

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Q. Only by the line of the outcrop, I am taking first. A. It would pass about there (indicating on the model).

Q. That is, it would pass through the easterly end line? A. Through the easterly end line on the third line south of the corner post.

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Q. Now, taking the general course of the vein as disclosed in the workings below, where would it pass out of the Centre Star boundaries to the eastward? A. In the neighbourhood of where the end line passes off the paper.

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Q. That would still be on the easterly end line? A. Would still be on the easterly end line, yes.

Q. And the exact angle at which it cuts the centre line would simply be 35 a matter of calculation from the model itself? A. Yes.

The Court: You mean the Centre Star centre line cuts the Iron Mask line?

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Mr. Davis: No, the Centre Star centre line. The angle at which the vein would cut the Centre Star centre line.

The Court: That could be easily ascertained, I suppose, because the centre line is parallel to this?



Mr. Davis: Yes.

The Court: That would be the angle where it cuts it, would it?

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Mr. Davis: It would depend on whether or not it occurred. Would that give it as it stands there, Mr. King? A. Roughly.

Q. And you mean at what angle does it meet this line?

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Q. No, the centre line parallel to this. A. At about 35 degrees.

Q. Now, if you take the angle made by the outcrop with the centre line of the Centre Star, what angle would it be? You have taken the general course of the vein there as disclosed in the workings below. A. I have taken the course of the vein as—

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Q. (Interrupting.) Now, taking the outcrop, what angle would it give? A. (After measuring on the large map.) Roughly 20; 18 to 20.

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Q. Now, taking the outcrop west of the No. 3 shaft, what sort of an outcrop did you find there? A. Chiefly an oxidized outcrop showing a width of from 6 to 8 feet—5 to 8 feet—largely characterized by the usual oxidation of the iron sulphides into brown oxides; but by picking into the brown oxides which constitute a considerable portion of the actual surface of the outcrop, I have been able in every instance to obtain the sulphides of the vein.

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Q. What do you mean by the "sulphides" of the vein? A. Pyrite, 30 pyrrhotite and chalcopyrite, of which the latter remains in a less altered condition, the pyrrhotite frequently being partly decomposed, being a more unstable compound.

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Q. Can that outcrop be properly called an iron-cap? A. Not properly so.

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Q. What is the distinction? A. The usual iron-cap is much more deeply oxidized, and the amount of the top of the vein which is rendered by oxidation entirely different—chemically different—from the portion below is usually in the case of iron-caps much more deep and the alteration much more perfect. A great many iron-caps have absolutely no traces; for instance, an iron-cap of a copper mine may have absolutely no trace of copper in the outcrop. The more leachable metals, I mean, have been washed out.

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Q. As a rule do you find outcrops of veins well marked in country rock of this kind? A. The general rule as to outcrops is that where the enclosing country is softer than the material of the vein, that wears away much more rapidly than the vein and the vein stands out in relief.

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Q. A well marked outcrop? A. A well marked outcrop. I have seen them over 100 feet high, and over 100 feet wide and long continuous. But where the country rock is harder than—as here—the vein proper, since even the country material which is within the vein has been more or less decomposed and the ore itself is more decomposable and softer than the country rock, the outcrop would necessarily be in a measure covered and enclosed.

Q. To what point did you follow that outcrop from the point you speak of, 28 or 29 feet west of No. 3 shaft? A. Continuously to the collar of No. 2 shaft, and there was at the time of my examination there, one pit beyond that which seemed to line up with this, which contained a similar outcrop, but the connection between the two had not been dug out or there had not been any attempt to dig it out.

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Q. Have you seen any better or more continuous outcrop in this camp than what you saw there? A. I have not, but I have not made any recent examination of outcrops.

Q. What would you say of that outcrop as an outcrop? A. That it was a thoroughly characteristic and absolutely continuous outcrop.

Q. Is there any question as to its being the outcrop of a vein? A. None whatever.

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Q. Of what vein is it an outcrop? A. It is the outcrop of the vein which is in Centre Star No. 3 shaft and in Centre Star No. 2 shaft.

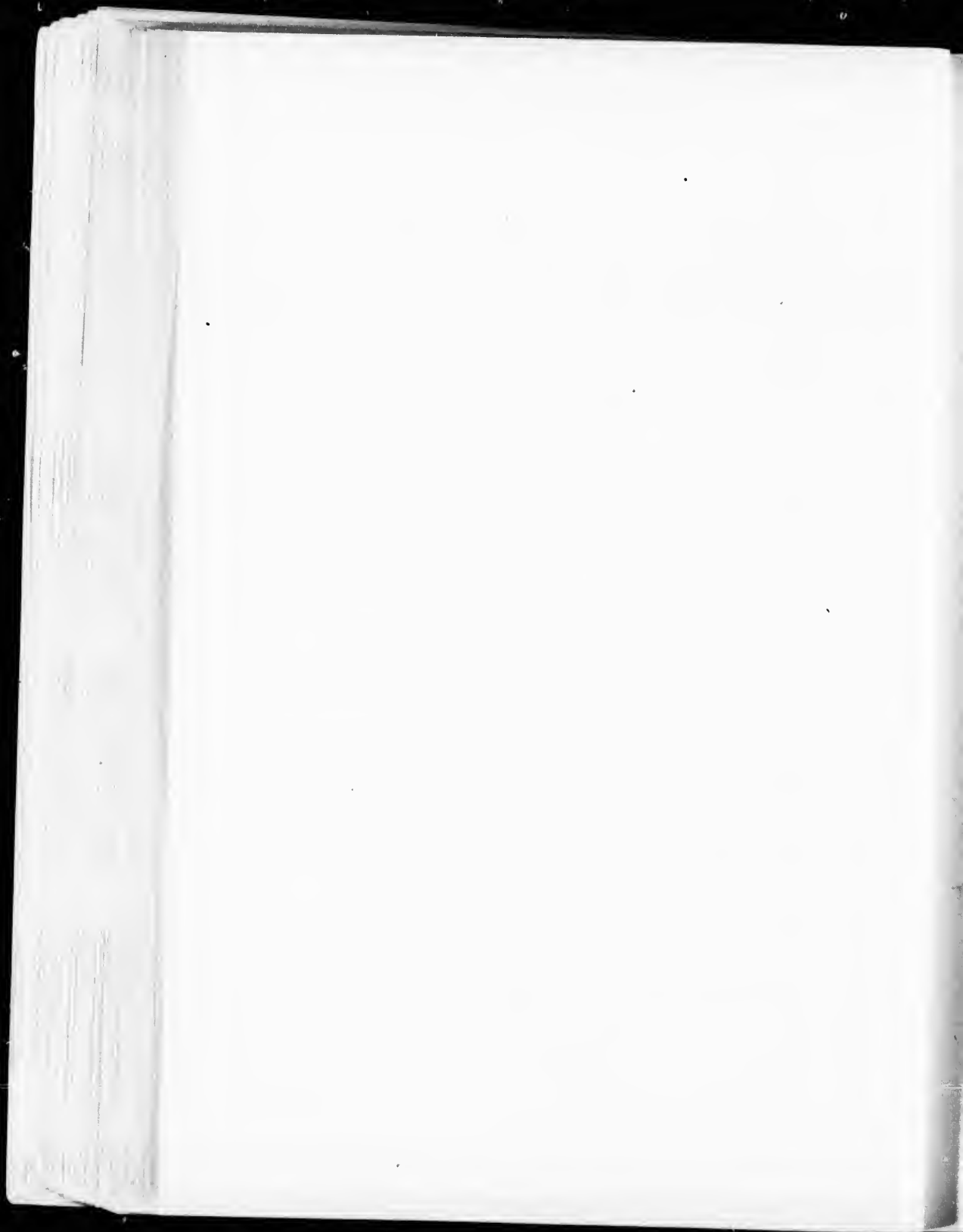
Q. It crosses the railroad track in its course, I believe? A. It crosses the railroad track in its course. In answer to your former question, I should say that it is the outcrop of the vein which is seen here and which is seen there, both, (referring to the model).

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Q. What is "here" and "there"? A. At the collar of No. 3 and the collar of No. 2; not only by the consecutive connection on the surface of the ground, but from the fact that the outcrop in each case is identified as being the same vein which passes down the shafts.

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Q. As you go down the shaft itself? A. As you go down the shafts.



Q. Will you look at this Exhibit 43, Mr. King. This was taken from points 15 and 19 feet southwest from the collar of No. 3 shaft? A. I find very much oxidized country rock containing pyrrhotite and pyrite and shewing very clearly the oxidation of the iron minerals in it, iron oxide to a brown iron oxide. Whether there are any copper minerals or not I do not feel sure, but there appears to be in this piece a little chalcopyrite. 5

Q. What would you expect to find at the outcrop of the vein so far as values are concerned? A. That depends entirely upon the character of the ores which fill the vein. 10

Q. Taking ores of this kind, what would you expect to find? A. I should expect to find on the whole, I think, a little less values. 15

The Court: A little what? A. A little less value. In some respects there would be concentration, in some there would be solution. What the exact resulting balance would be I can not say without a careful analysis of the ore itself. 20

Q. I will only shew you two or three more of the specimens of the outcrop of the vein. Look at Exhibit 47, taken from 52 and 59 feet west of No. 3 shaft. What do you say as to Exhibit No. 47? A. It contains pyrrhotite, chalcopyrite and the usual decomposition oxides, a good deal of quartz and some more or less altered country rock. 25

Q. Look at Exhibit 54, coming from a point 187 feet east of No. 3 shaft. What would you say as to this sample? A. It contains, so far as I can see from a hasty examination, no pyrrhotite, but does contain chalcopyrite, iron oxide, some quartz and country rock. 30

Q. Look at Exhibit 62, which comes from a point 282 feet east from No. 3 shaft. What would you say to that sample? A. Like the former, it consists of country rock, of chalcopyrite, iron oxide, but I do not see any distinctly preserved pyrrhotite. 35

Q. Look now at Exhibit 65 which comes from a point 318 feet east of No. 3 shaft. What would you say as to this sample, Mr. King? A. Chalcopyrite, iron oxide and country rock. 40

Q. About what is the width, average width, of that outcrop, so far as it is disclosed? A. It varies from a few inches to eight feet.



Q. About what would the average width be, or have you approximated it at all? A. I could not approximate it exactly.

Q. Can you tell from any stripping that has been done what the width of the vein itself is at the outcrop? A. Just where the outcrop comes down to the railroad embankment and passes into the cut of the railroad embankment the correlative planes show about eleven feet—ten to eleven feet, and to the west of the shaft the outcrop itself is certainly nine or ten feet thick. 5

Q. Have you examined No. 2 raise? A. I have.

Q. Do you find any vein in No. 2 raise? A. I do. 10

Q. What vein, in your opinion, is that? A. I take it to be the vein seen in Centre Star No. 2 shaft at top and bottom.

Q. And what vein is that? A. The same which is shewn throughout the outcrop, and the same which is shewn from top to bottom of No. 3 shaft. 15

Q. What are your reasons for saying that the vein in the No. 2 shaft is the Centre Star No. 2 vein? A. Because in the first place, of the continuity of exposure of vein and wall from the foot of No. 2 shaft to the upraise; and the rising of that ore in No. 2 upraise. 20

Q. What do you mean by the rising of the ore in No. 2 upraise? A. The tracing of the ore which forms the body of the vein in the drift, on the north face of the drift, from No. 2 shaft to No. 2 raise; it then ascends that raise, or the raise, in other words, follows that ore. 25

Q. Is there a continuous vein in the No. 2 raise? A. There is a continuous body of mineralized rock, which I take to be a vein. 30

Q. What is the dip and strike of the vein there, as nearly as you can see it? A. The dip starts at about 60 degrees and bends over to about 48 degrees, and the strike and the lower part and in connection, pretty close connection, with the vein which extends from the No. 2 shaft to here (indicating on model). 35

Q. Where is "here"? A. I will answer that question again, please. 40

Q. Yes, start that answer over again, please. A. You asked me, I believe, for the dip and strike of the vein.



Q. Yes, what is the dip and strike of the vein there? A. The strike in the lower part of that vein is the same as the strike in the bottom of No. 2 shaft to bottom of No. 2 winze, which is the direction as shewn upon the drift here.

Q. When you say "winze" there, you mean raise? A. Raise, yes, sir. 5

The Court: You meant upraise, did you not?

The Witness: This raise here. (Indicating on model). 10

A. (Continued). It is approximately north 80 degrees west.

Q. And what about the dip of the vein in the No. 2 raise? A. No. 2 raise, or No. 2 shaft? 15

Q. No. 2 raise? A. So far as I can follow the ore, the upraise itself is not in absolute coincidence with the current of ore as I see it. It is about 56 to 60 degrees, in the first part of the upraise up to the bend, and from there it approximates closely to 46. 20

Q. That is, the vein in that winze flattens out at the top? A. Flattens out for the upper 60 per cent. of its length.

Q. Bends over? A. Bends over. 25

Q. Now, you say that there is a vein between the No. 2 raise and No. 2 shaft? A. Yes, sir.

Q. That is in the yellow Centre Star drift as it is called, the yellow level? 30
A. Yes, sir, in the yellow level.

Q. The yellow level? A. Yes, sir.

Q. How did you find the ore in that vein between those points? A. 35
Continuous and consisting of the same metallic sulphides which characterize the same vein elsewhere.

Q. You have already said it is a part of the Centre Star No. 2 vein. A. 40
A part of the Centre Star No. 2 vein, which I identify not only by the continuity of ore on that strike, but also by the position of the wall, which is continuous



from opposite No. 2 shaft until cut off by the mining over near the base of No. 2 upraise; and thence is seen passing into the country rock in a westerly direction. That wall, which directly overlies the ore, has a dip of about 56 degrees, which is characteristic of the lower part of the vein further on.

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Q. Now, do you find any vein in No. 2 shaft? A. I do.

Q. What vein is that? A. The same vein in which the outcrop was traced from the top of No. 3 shaft to No. 2 shaft. It enters that shaft and descends, or at least, the shaft descends along it.

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Q. Now, please describe what you find, so far as vein formation is concerned, in No. 2 shaft, Mr. King? A. Well, entering the shaft there is a plane, which is at an angle to the shaft standing at about 70 degrees, the angle is about 18 degrees of departure westward from the strike of the Centre Star vein. Its dip is about 70 degrees and it passes out of the shaft and is not seen any more until at the depth of about 12 to 15 feet, and on the foot wall side of the shaft. But at the actual collar, and on the north side of the shaft and on the east and west sides of the shaft, but mostly on the west side, is the outcrop of that vein which has been followed to that point, which is the Centre Star vein, in my opinion. That vein is there wide enough to fill the whole width of the shaft. It is characterized by a good deal of quartz, and the presence of the metallic sulphides—the typical sulphides.

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Q. That is pyrrhotite, chalcopyrite and iron sulphides? A. Pyrrhotite and chalcopyrite. In descending, that vein narrows continually and grows poorer continually, until from filling the whole shaft it disappears to a thin edge. That point is about—I will calculate in a minute—about midway the depth of the shaft.

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Q. How many feet from the bottom, about? A. About 120 feet.

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Q. The shaft itself is about 200 feet long? A. Well, that is a little over 100 feet long. Perhaps it is 25 feet below station 81; I did not take any measurement, but I can give it to you from the one station. Well, it is between station 81 and station 82, nearer station 82; station 82 is now obliterated in the shaft and we cannot fix it exactly without re-measuring. We will say about 81 in the shaft.

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Q. Do you want any of these sections in this, Mr. King? A. It is not necessary.



Q. What do you find from that point on? A. The vein which has been followed to that point, which is a distinct vein, separated from country rock by fissures, has tapered there to a point just below—

The Court: Where is this?

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The Witness: Near station 82 in that shaft, something like 40 per cent. down the shaft. I cannot give you the exact figures because 82 is now chipped out or washed off or disappeared, and I could not re-locate it. Beneath that point the ore lessens to a very, very scant sprinkling of mineral sulphides, from some little distance, perhaps 12, 14 or 15 feet, and below that comes in the heavy body of pyrrhotite, which extends to a point about 60 feet above the bottom of the shaft; that body of pyrrhotite turns and gives out against the foot wall of the shaft and is immediately succeeded by a very coarse, heavy basic rock.

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Q. Do you mean a different kind of rock from the country rock in that shaft generally? A. Different entirely from the material in the vein down to the point of disappearance, and different entirely from the ordinary country rock.

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Q. What kind of a rock is it? A. It is an extremely coarse, dark gray-green, heavy rock, distinctly basic, made up largely of large augite crystals, interlaced and closely woven together, as it were. I have a specimen of that in my pocket if you would like to put it in as an exhibit.

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Q. Yes. I would like to put it in. A. Which I took out myself. (Witness hands counsel a specimen of rock).

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Q. That is a specimen, is it? A. That is a specimen of that rock.

Specimen referred to marked Exhibit 139.

Q. How do you account for the occurrence of that rock there? A. In the first place, at all points where I have seen the contact of that rock with the other rock, with the ordinary country rock, the divisional line is very sharp; that is to say, if there is a transition from that into the country rock, it is extremely short, covered by a few inches. The rock appears not only at this particular place, but extends up the eastern side of the shaft, perhaps 20 feet above the point I have formerly named, but in a mere edge; but below the point which is 80 feet above the bottom of the shaft from that point it extends continuously to the bottom of the shaft. At the extreme bottom of the shaft

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there is a little recess cut, southward, from the drift, in which the ladder stands to ascend the shaft, and this rock forms the left-hand wall or eastern wall, of that cut. It does not appear on the other side, but from that point it extends up the shaft to the point I have described, about 75 or 80 feet up. Following it along the drift, Centre Star north drift, it only extends a very few feet, and then gives place again to the ordinary country rock. So far as we know, therefore, it is a narrow body there; it occupies the whole shaft, after about 20 feet up or 30 feet up, it occupies the whole shaft until the 75 foot point, or until the 60-foot point.

Q. Is that an intrusion? A. That rock is either a dyke or a magmatic segregation.

Q. Just explain, please, what you mean by that. A. I mean to say that in all these composite rocks, composed of a large, or even small, number of different minerals, eruptive rock, there are passages in which one mineral will aggregate; for instance, the most acidie mineral will aggregate and make a great segregated, irregular mass, which was evidently a chemical segregation during fluidity, characteristic of granites, and of diorites and of almost all eruptive rocks; in this case the pyroxene, which is the chief element visible in this rock, is characteristic of the whole country, but in this case it is aggregated together and has made a mass which is far tougher in texture, far stronger under a tearing strain, owing to the interlacing of these strong crystals, and I should think from the boundaries that we are able to get from a hasty examination; in an examination, in fact, which covers all the open ground (we could not make any more examination without mining) I should say that it was more likely to be a segregation of pyroxene matter than a dyke, though on future exploration it may prove to be a dyke.

Q. What effect, if any, has that had on the vein in the No. 2 shaft? A. I have described a vein coming down with great regularity to a certain point; on the bottom of the drift the vein is seen in the entire formal conformity with the upper vein extending for 100 feet or so in perfect condition, its walls undisturbed, its fissures continuous, its ore to be seen from foot to foot; between the two lies this mass of rock of different texture and tougher qualities. In that the continuity of the vein is entirely lost as a single fissure. The rock is characterized by great, blocky, irregular fractures, running in different directions, no signs of parallelism, no formal planes, but strained fractures running in every direction. By carefully following and studying these fractures from the point of disappearance of the vein below to the point of disappearance of the vein above, we are able to trace small passages of mineral sulphides, largely of chalcopyrite, existing in the form of stringers, sometimes two inches in diameter, often very much smaller, but we are able to follow from crack to crack, and



from face to face, sulphides enough to see that through this labyrinth of coarse, interfering and conflicting cracks there has been a mineralization which actually extends from the formal vein below to the formal vein above, and I attribute the whole of this lack of continuity in the vein to its passing through this zone or region, or limited space of rock of excessively dense, tough texture. 5

Q. Now, you say that the vein loses its continuity there so far as the fissure is concerned. What about mineralized rock? A. There is mineralized rock throughout the whole of this interval. 10

Q. Throughout the interval? A. Following the No. 2, the raise of No. 2 shaft.

Q. And is that mineralized rock continuous? A. It is continuous; that is to say, there is no interval of 4 or 5 feet in this cracked mass, as followed by No. 2, that we failed to get mineral sulphides. 15

Q. Apart from the sulphides, what about the country rock between? Was that altered or unaltered country rock? A. It is all more or less altered. 20

Q. And altered, as I understand, means mineralized? A. No, not necessarily mineralized. It may be the abstraction of elements necessarily changed. 25

Q. Is the rock which you found there outside—I am speaking now of the sulphides—is that rock mineralized? A. I am unable to say whether it is or not. The exposure is very limited, and we did not get it outside of this line of action, and I am unable, in other words, to compare it with its own unaltered form to see if there has been a difference. 30

Q. Now, about this point where the vein meets this dyke or magmatic segregation, at any rate, this rock of a different type, above that point, how do you find the vein in No. 2? A. From that point up, at the lower 20 or 30 feet of that vein, it is weak; I mean in the presence of visible mineral, visible sulphide minerals. 35

Q. How do you account for that? A. From the fact that the solution has been interfered with by the tangle of crevices and had not been able to match themselves up very closely with the fissure above. 40

Q. Go on, please, with your description of the vein above this rock? A. After striking the attenuated point of the vein above, the values increased to



the summit—I do not mean the commercial values, but the ore minerals increased all the way to the surface, with the exception of that single body of pyrrhotite, which is just below it and is really a connected part.

Q. And what about the walls in the shaft just above this tougher rock? 5

A. The walls of the vein proper are good, and there is a companion wall, a hanging wall, visible at one or two places for short intervals; afterwards it is cut in two by the mining.

Q. What about fissures there? A. There are fissures connected with the vein itself, absolutely evident. 10

Q. What about the continuity of mineral-bearing rock? A. Absolutely continuous from this attenuated point I speak of to the collar of the shaft. 15

The Court: That is about 80 feet?

The Witness: Yes, sir, about 80 feet. 20

Q. Now, I will come to the fissure, which has been called the flat fault, Mr. King. What is a flat fault, in the first place? A. A fault is the dislocation which occurs by the passage of a fissure through rocks, accompanied by a relative displacement of the walls of the fissure. 25

Q. That is, if you have a fissure without displacement, you have no fault? A. You have no fault. And a fissure may be a simple fissure at one time and a fault later.

Q. Now, you know what I am referring to as a so-called flat fault? A. I do. 30

Q. Have you made a thorough examination of that cross fissure? A. I have. 35

Q. What is its general dip and general strike? A. I think I would have to get that from my notebook, (referring to book), to give it with any sort of accuracy; I would have to lay it on the map.

Q. All right, Mr. King, do that. A. (After measurements on the map). It is about north 80 west in its longest course, but it has slight curves in it. But you are asking for the general distance? 40

Q. Yes. A. North 80 west.



Q. I presume it varies somewhat, and varies in different strikes. A. That is the reason why I am unable to give the general strike.

Q. And about what is its general dip? A. An average dip, I should say, was about 36 degrees, though it runs as high as 46, and as low as 22, locally. 5

Q. Now, at what various points in these workings have you seen and examined this mud-seam, or so-called flat fault? A. At this point (indicating).

Q. When you are giving the points, if you will indicate them by the station or something, the record will shew what you refer to. A. At a point close to 47, at a point about 12 feet west of 47; throughout the whole length of this drift from 47 to 45. 10

Q. That is, the Iron Mask water-course drift? A. Water-course drift. Throughout this working which extends about due east from 45, and a little cross-cut from the end; in the Iron Mask winze; in the bottom of No. 3 shaft, near station 39; near station, 10 feet west of 35; at the No. 3 raise; between No. 42 and No. 43; at 48, and near 47; in No. 2 shaft, in the vertical upraise, which starts at the foot of No. 2 shaft; in No. 4 raise; in No. 2 raise, and in No. 1 south cross-cut; a little working extending west from near the indicated end of the first cross-cut, No. 1 cross-cut; also in the winze in dispute. 15 20

Q. Centre Star winze? A. The last winze below 61. 25

The Court: That is all, is it? A. I don't for the moment remember any other.

The Court: Can you possibly shew me those on the model? This puzzles me a little because some of these drifts are 40 and 60 feet below others, and of course, they are not clear. A. I can shew your Lordship perfectly well if I can get a piece of stiff paper. (Witness illustrates on paper). 30

(The witness here illustrates on the model to the court). 35

Q. Now Mr. King, I want to get from you a description of the various characteristics of this mud-seam, looking both to the question of whether or not it causes any great dislocations of veins that it encounters, whether or not it causes any large amount of shearing of the rock adjoining the fissure, as to its size, and in fact, everything in connection with it; and I would ask you therefor to go over consecutively the different places where you have mentioned having found this mud-seam and describe what you found there, and especially those points where the mud-seam cuts any vein. 40



The Court: I never had the opportunity of going into this before. I never understood anything about it.

Mr. Davis: Outside of a model it is almost impossible.

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The Court: I don't suppose any engineer could understand definitely from the plans. A. If your Lordship will permit, I would rather begin here; it will save time to follow this from my note book.

The Court: Most assuredly. I do not want to interfere at all in a matter that I don't understand. A. (Continued.) It is only the sequence. The most western point at which I have studied the flat fault is at a point about 12 feet west of 47.

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Q. Twelve feet west of this shaft? A. No. 47, this point here, I would say where I hold my pencil; that is the westernmost point in which I have seen the flat fault to be sure of it. At that point it is a seam from 3 to 6 inches, weak, having a dip of about 40 degrees, and it comes in contact there with a great north and south dyke which is seen upon this level near 48, and which crosses diagonally from the region of 48 to the region of 47; in passing northward, extending gradually a little more to the westward of this cross-cut it passes from 47 to 48.

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The Court. That is all in Iron Mask ground. A. That is all in Iron Mask ground. As I lay my pencil there I indicate the course of a dyke of great geological importance in this case, or rather in its structure. A flat fault comes up against that dyke, and is there dislocated. This dyke is a compound body, consisting of two parallel intrusive dykes, with an enclosed body of crushed and altered country rock between the two.

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The Court: A double dyke, as it were? A. A double dyke with an interval of country rock; two dykes having come within 6 or 8 feet of each other, and by their movements and by their heat they greatly altered the block of the enclosed country. Thence eastward from station 115, which is not marked, I don't know what it is, the end of this long drift, 60 feet from 45, which is continuous, and I will take down the point from my note book.

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The Court: Still on the Iron Mask tunnel?

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The Witness: Still on the Iron Mask tunnel.

The Court: Water-course, rather.



Mr. Davis: Call it drift on the water-course.

The Court: Still on the Iron Mask drift on the water-course.

A. (Continued.) Immediately at 45, the ground not being very smooth, 5
and the dyke not being susceptible to as good measurements as a little further
to the west, I took its dip 10 feet to the east.

The Court: The dyke you say? A. The flat fault; I took its inclin- 10
ation at 10 feet east of No. 45, which fault dips 78 degrees to the south; the
seam is about 5 inches wide, with considerable loose crystals of calcite. There
is at this point very little parallel sheeting of the rock.

Q. You may explain what you mean by sheeting, Mr. King. A. If 15
one were holding a block of paper upon his hands and it slipped, so that the
sheets slipped, slipped relatively to each other, that is geologically known as
sheeting. In this point, 50 feet east of 45, at the end of that drift——

The Court: At the end of the drift. A. The water-course produced 20
50 feet further east. There is again a dislocation of the fault by the dyke;
again the double dyke with north and south bearing, and again the fault breaks
through one dyke, and is faulted by a fissure between the two and faulted 8 or
10 feet back on the north and south course, back onto the south.

The Court: Dislocation occurs there? A. Dislocation occurs there. 25

Q. That is, the flat fault is dislocated? A. The flat fault is dislocated.

Q. Not that it dislocated anything else? 30

The Court: No, no, the flat fault must be dislocated.

A. (Continued.) The next station I observed is 10 feet west of 46; 35
here the seam is but 4 inches wide. It is overlaid by a considerable crushed
rock about 18 inches thick, and there is a little shattering underneath the dip
here 35 degrees to the south. The seam itself varies from 6 to 12 inches wide,
and beneath it there is a little to the eastward and a little to the westward sheet-
ing of two feet in thickness, parallel sheeting.

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Q. That is, they are split? A. Split to a certain extent in seams par-
allel to the flat fault itself. The next is station 104, which is about here; it is
not marked.



The Court: Do I understand that sheeting means a kind of abrasion?
 A. A kind of slipping of the rock.

The Court: And abrasion. A. Abrasion and division. At 104 the dip is from 46 to 49 degrees, and the seam is only about two inches wide, and its position is too low to determine whether there is any sheeting beneath it or not, because it descends on the edge of the drift and is lost. 5

The Court: That means lost underneath this drift here. A. Underneath this drift here. It appears in an edge of the drift but you are not able to see as it comes down. 10

The Court: As the drift is above it? A. As the drift is above it. At 52 feet west of 104 the dip raises to 42, the seam is one foot wide, sheeting of four inches above the seam and about two and a-half feet below. 15

The Court: What station would that be? A. Fifty-two feet west of 104, between 104 and 47. For some reason or other the numbers are not consecutive along there; at stations 47 and 47-A and 10 feet west of 47-A the dip is 33; the streak there is 8 inches wide, and 15 inches of abraded and crushed matter underneath; that is to say, the flat fault, having this inclination when seen upon the upper wall, this crushed matter is only 8 inches wide, but where it passes out upon the foot of the drift on the other side, it is about 15 inches wide, half way between 47 and 47-A. The next point is the Iron Mask winze. 20 25

Q. Before we come to that there are one or two questions I would like to ask you about that; and then we will put in a sample; you have spoken of the seam as varying in width from two or three inches up to 10 or 12. What do you mean by the seam? A. The seam is a rather loose use of terms, but I mean by that the more or less comminuted and compacted and decomposed matter between two walls of the fissure. 30

Q. There is a kind of mud between the walls. A. It varies; sometimes it is a streak of more or less crystallized calcite mingled with mud; sometimes it is all dry comminuted country rock, sometimes it is comminuted country rock welded with transported, water-brought mud, and coloured off with oxide of iron. 35

The Court: Let me ask you would the whole of that be transported from the north where it commenced on the top, or run east and west? A. Probably down the plane where the water would trickle; wherever it would per- 40



ulate it would take the abraded and other material and transport it, and in some places that material would be dammed up, and in other places it would be free, leave the clear particles of the clear mud.

Q. What else is there to the so-called flat fault outside of this mud-seam which you have just described; that is, would you understand by the flat fault—a very unfortunate term which has been used—anything more than a mud-seam, and if so, what? A. I suppose that the term "fault" was given to it from the slight depression it has made.

Q. Now, outside of that, does the flat fault cover anything else so far as your idea goes? A. No, it does not; it is simply a fissure which has suffered a certain amount, an unknown amount, of relative motion of the sides which has caused abrasions, which has worn off the rougher particles, which have afterwards been transported by water and circulated and accumulated in some places and been washed out in others.

Q. Now, I suppose every fracture that you find in the earth's crust causes a certain amount of crushing? A. There are very few fractures probably that are so smooth that there is not some roughness to be abraded off if there is a relative movement of the sides.

Q. And they are attended sometime or other, are they not, by a certain amount of crushed rock? A. It is frequent.

Q. But not necessary? A. Not necessary.

Q. Now, is this particular fracture called the flat fault attended above and below the fissure by masses of crushed rock? A. It is accompanied varyingly by rock-sheeting parallel with itself; that is to say, there are a few places where there are a few feet of it; I never remember seeing more; and those sheetings may be coarse or fine; they are very often entirely wanting. There are considerable stretches in which there are no parallel platings, and the parallel plating has never played, in my opinion, any part in the fissure except as an ocular accompaniment. It has never or very rarely permitted the percolation of water downward; the very fact of this distinct line of demarcation between the mud of this seam and the underlying rock is proof that there was no water connection of any importance between it and the sheeted rock below.

Q. (By the Court): Now, when you speak of sheeted rock, it is simply plated longitudinally? A. Parallel plating.

The Court: It must have been impervious to water? A. Yes, sir.



The Court: Because otherwise the water would find its way down? A. Because the water would find its way down and it would have been the mud-seam.

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The Court: It always puzzled me to find out why the water was not naturally at the bottom of the fissure.

The Witness: It is at the bottom of the fissure.

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Q. (By Mr. Davis resumed.) From the very necessity of things, it must be at the bottom of the fissure? A. Yes, sir.

Q. Could you give any clearer idea on the blackboard of just what you mean by this sheeting and all that does accompany the mud-seam? There is a contention, Mr. King, I may as well tell you now, probably you are aware of it, that this fracture which they call the mud-seam has produced remarkable results in the way of crushing and dislocation and so on. The dislocation we will deal with later on, but now please shew how much crushing or shattering has been caused by that mud-seam? A. Have you any special point.

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Q. No, no special point, but simply to give a general idea of the results of the mud-seam, so far as crushing and shattering the country rock above it or below it goes. A. (Illustrating.) Let this be the mud-seam, running east and west and dipping south.

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Mr. Davis: Do you want to put that on one of these sheets of paper and have it filed, or will you put it on the blackboard?

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Mr. Bodwell: I have nothing to say about it; it is your own evidence, Mr. Davis.

The witness illustrates and explains on the blackboard as follows: This line represents in vertical section the fissure which passes down from north to south; if that fissure were made under a compression, if it were made with nothing but weight of gravity to it, it would probably have been a single fissure without any accompanying plating, but whenever there is a compression of any kind, if, for example, when this fissure was made the rock here were, say, 1,000 or 2,000 feet higher, there might have been compression, undoubtedly would have been compression of this matter in close contact; in that case any motion which disturbed this compression would result in parallel platings following fissures like that. Now, as I say, these parallel platings I have seen in many parts of the mine, accompanying this fissure, but they never permit the water to go down and through and make a new channel. The entire water and mud

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phenomena are on the top of this fissure and between it and its upper wall, and is made of comminuted material which in no case that I have seen exceed two feet in thickness—and that is a very rare exhibition. The average thickness between the two fissure walls is, I should say, not above seven inches, and in no case has the water broken through from the so called water-course and entered 5 one of these others. I mention that to shew that these correlative fissures, while they are present in many places and indicate an origin in common with this, are never of sufficient importance to have grown into the main fissure and drawn off its water.

The Court: You might put that on paper if you want to. 10

Mr. Davis: I will get Mr. King to draw it on a sheet of paper to-morrow.

The witness: Or now if your Lordship prefers. 15

The Court: No, we are going to adjourn now.

Thereupon an adjournment was taken to to-morrow, April 26th, 1899, at 20 11 o'clock a.m.



EIGHTH DAY.

Rosslund, B.C., April 26th, 1899.
 Eleven o'clock, a.m.

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Trial resumed.

Present: The Court and same counsel as before.

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CLARENCE KING—On behalf of defendants.

DIRECT EXAMINATION RESUMED.

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By MR. DAVIS—

Q. Before we go on, Mr. King, with the mud-seam, I want to ask you
 about a point I omitted yesterday; that is the No. 4 raise. Do you find any
 vein there, and what do you say with reference to it? A. I find a body of
 ore which is seen on the south face of the drift at the foot of No. 2 and that body
 of ore extends upward about 22 or 23 feet, slightly diminishing in concentration
 as it goes up until it reaches the flat fault. Above that there is an interval of
 about 10 feet in which the ore is very sparse indeed, and above that it reconcen-
 trates and continues in force to the head of the raise at the time when I last saw
 it—at the head of the upraise as I last saw it. It is a large, strong body of
 pyrrhotite, both at the top and bottom of the upraise, with visible chalcopyrite
 at both points.

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Q. And when you speak of interruption of continuity, what do you mean exactly? A. I mean simply the severance, where the fissure passes through.

Q. The space of the fissure itself? A. The space of the fissure itself, no more.

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Q. What is the next point where you take up the flat fault?

The Court: That is the severance of the fissure of the vein? A. The severance of the vein. It is merely cut through and the parts are left merely in their original position.

The Court: Because in one sense, I suppose they are both fissures? A. They are both fissures.—The next observed point was at station 48. It is rather a critical point, and is shown there (indicating on the model). The dip of the flat fault here is about 28 degrees. It contains a small quartz seam on the upper side. There is little or no sheeting and the fractures of the rock indicate no system as affected by the fissuring of the flat fault. Do you wish me to describe the intersection of the vein there?

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Q. Yes, Mr. King, what vein, if any, intersects between that point, and how does it affect it? A. At that point it intersects the vein which I have identified to my satisfaction as the Iron Mask vein, which vein follows for a considerable distance west of 48, practically the direction of the drift. At this intersection the Iron Mask vein presents—

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The Court: Not the Centre Star? A. No, the Iron Mask vein presents a narrow fissure filled with pyrrhotite from an inch to two inches in width; dipping about 70 degrees to the north and striking, as I have said, with the drift. At the point of intersection of the two planes, that of the Iron Mask and the flat fault, there is a displacement in the normal direction of about 21 inches; that is to say, the fault dipping to the south and the vein dipping to the north, the upper section of the vein above the fault has been mismatched from the lower one by slipping down about 21 inches.

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Q. Could you explain that action by sheets of paper or book, or something of that sort, or blackboard, or any way to give the Judge a clear idea of it?

The Court: I have a good idea of that, if I might be allowed to say so, but you better get it down in the notes. A. There is a peculiarity about this fault which will be better illustrated after the other intersections have been given.

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Q. Very well. Now, you say that you find the displacement at this point, section 48, to be what you call a normal fault? A. Yes, sir.

Q. Whereas, it was a reverse fault in the Iron Mask winze? A. Yes; but in this case the data are clear and in the other they are obscure. 5

Q. Have you any explanation as to how this might be a normal fault at one place and a reverse fault at another? A. This is a very well known phenomenon of a torsion or swinging fault. 10

Q. You may explain what a swinging fault is. A. If you will allow me to illustrate (taking two books), in the case of where the action of the fault or displacement is in a single line, has a single axis of action, a section which measures the displacement across the strike of the fault would show an equal displacement at all points. But if, instead of moving on one vertical plane—I mean on one vertical axis of action—it received from any cause, a slight twist like that, the portion on one side, the axis of the twist would be uplifted and the other one thrown down, so that an observed discrepancy at that point would be normal, and at this would be reversed; it is like a twisting motion. 15 20

Q. Apart from the displacement which you have referred to of 21 inches, does the so-called flat fault have any other effect on the Iron Mask vein at that point? A. So far as I can detect it has none. I made no chemical examinations, but physically it made no difference. 25

The Court: Might I ask you what you mean by the word "physically" as applied to that? A. It means that so far as the action of fractures, and movements or displacements or behavior of the bodies, the action would be called physical. If the flat fault had made any difference in the value of the ore above or below, that would be chemical. 30

The Court: Then your answer is that physically it makes no difference, but chemically——. Chemically I have not examined it. Physically it makes no difference. 35

Q. What is the next point where you observed the flat fault? A. It was at a point in the south crosscut No. 1. At the intersection where a small crosscut southward drifted on the vein—rather, starts out on the crosscut, which is not given here on the map; it has been opened since this model was completed. 40

The Court: Do you mean a crosscut? A. A little drift on the vein there.



The Court: Eastward? A. A westward direction.

The Court: Westward? A. Westward. The dip of the fault here is about 33 degrees, and the seam is 6 inches wide and the rock fractures do not indicate any considerable sheeting, or any relation to the fissure action. 5

The Court: Would you mind, Mr. King, marking that on the plan?

Mr. Davis: No, sir. 10

The Witness: I think the surveyor is here, and he would be more sure of the distances. That is correct in principle, but it may not be located to a foot (referring to the model as he indicated it thereon). 15

Q. Which is the flat fault? A. The flat fault comes through in the plan like this. 15

Q. You might mark that 'A'. It is 50 feet south. A. That indicates the position; the crosscut is not on this map. 20

Q. That you intend as the flat fault? A. Yes, sir. I will mark it "flat fault." This is not scaled; I have not put the scale on, it is only a sketch. 25

The Court: Yes, I understand.

Q. You say it crosses a vein there? A. It crosses a vein, yes, sir.

Q. What vein? A. A vein which I took to be the Centre Star, without doubt. 30

Q. Just describe what effect, if any, it has on that vein? A. It is very difficult to see any definite effect at all. It simply cuts it and there are some indications of a slight normal displacement; but the fractures of the rock and the mix-up of dislocations make it impossible for me to be sure; but there is an appearance of a moderate normal displacement. 35

Q. Not exceeding how much? A. Not exceeding 10 inches. 40

Q. Outside of that displacement, not exceeding 10 inches, has the flat fault any other effect upon the Centre Star vein at that point? A. It has no physical effect, except the mere cutting through it.



Q. What about the ore above and below? A. The ore is continuous above and below.

Q. Is the displacement, whatever it is, but not exceeding 10 inches, sufficient to disconnect the ore, to throw the ore body clear of the other? A. No, it is not. And practically there is an unbroken line, with some slight mixing-up near the contact with the plane. There may be no dislocation there.

Q. What is the next place where you found it? A. At the No. 3 raise. That is No. 2 raise (pointing it out on the model). It starts from that level; this is a small level—

The Court: Which is not shewn on the model? A. That is as far as it goes; it is only the beginning of a raise. 15

The Court: At No. 3 raise, you say, the flat fault is a seam? A. No, I have not come to that. I was just about to speak of it. No. 3 is a short raise continuing the roof of the tunnel up to about a height of, perhaps 22 feet, and cutting into the south wall of the drift and rising there to about 20 feet also; making what is practically a very tall drift with an extension to the south. At 14 feet on the north side of this drift and raise, the flat fault enters, having a dip of 23 degrees. On the north side, where it emerges from the country rock, it is only 2 inches wide, and on the south side also is a very narrow, tight seam. Where it has any comminuted matter— 25

The Court: On the north side where it enters; that is from this side? A. From this side.

The Court: It is how wide? A. It is 2 inches wide. 30

The Court: And then as it comes through, finally departs from it? A. Departs from it, and is a mere, thin seam. There is a little comminuted matter on the north side. 35

The Court: Yes, it is broader where it enters than where it leaves? A. Broader where it enters than where it leaves. And there are no particular indications of sheeting parallel to the fault. 40

The next station observed was 4 feet east of 47. Station 47 is here at the turn (indicating on the model). My station was 4 feet east of that No. 47. The dip taken there is 29 degrees. The width of the flat fault is from 2 to 3



inches, and there is a foot of parallel shattering or sheeting above it. I noted also that in passing westward from this point the flat fault rises into the roof of the drift and disappears at 13 feet west of the station.

Q. Are there any veins at that point? A. Nothing whose relations 5
can be satisfactorily made out.

Q. What is the next point at which you find a flat fault? A. The 10
next station is at 10 feet west of station 39. There the dip is 29 degrees. The
seam here varies from 8 to 14 inches; the seam of the flat fault here is from 8 to
12 inches (indicating on model). It is there upon the Centre Star north drift
where it is bent to the southward.

Q. Here on the yellow level? A. At station 39 on the yellow level.
At this point the flat fault intersects a body of pyrrhotite ore containing the 15
usual mixture of chalcopyrite. That ore appears in the wall overhead, in the
coiling rather of the drift, which is an independent fissure itself and not directly
connected—near to, but not directly connected with the flat fault. The flat
fault intersects this body of ore and a clear displacement is seen of about 15
inches, and the displacement is reversed. That is to say, that the ore above 20
the fault is solid, uphill, as regards the ore below the fault.

Q. Outside of the displacement has it produced any other effect at that
point? A. It has not. It has produced no physical effect at that point,
except the mere cutting. 25

Q. Am I to understand from you that the ore comes down to the hang-
ing wall of the fissure which constitutes the flat fault, and up to that foot wall
from below? A. Up to the foot wall from below.

Q. What about sheeting there? A. The whole rock is very much 30
strained and broken, but in the immediate neighborhood of the flat fault, par-
ticularly above it, there is a rude sheeting, but not parallel to the flat fault,
but parallel to the overlying fissure which forms the roof of the drift.

Q. So would you connect that then with the flat fault? A. I should 35
not; I should not connect it with the flat fault.

The Court: Is this different from vein No. 2, this short piece of vein?
A. I think it is a part of that system, sir, without doubt. I shall come to 40
that later. I think this is a part; it underlies it.

Q. Where do you find the flat fault next? A. I find it next near sta-
tion 37—near station 38.



Mr. Bodwell: Mr. King, will you put the pointer on those places as you mention them; we can not all find them? A. I can show it here very well (referring to the large map). Here is the point; there is station 39, just described. I pass now to a point just west of station 38, which is the next station here and at the intersection of those two drifts. The dip here is 37 degrees to the south. The seam is but one inch wide. The region is very much generally fractured and there is no system of parallel sheeting which can be connected with the flat fault. 5

Q. Is that general fracturing, in your opinion, due to the flat fault? A. It is not at this point. 10

Q. Have you given the width of the seam at that point? A. I did; one inch wide. 15

Q. What is the next point at which you find it? A. It is in the sump at the bottom of shaft No. 3. The dip measurement was taken on the east side of the sump, and I noted it at 35 degrees. Sheeting parallel to the fissure and probably related to it, continuous about three feet below the seam. The seam itself varies from three to eight inches. 20

Q. Does it intersect any vein at that point? A. It intersects the vein which has been observed from the top to the bottom of incline No. 3.

Q. That is Centre Star vein No. 2? A. Centre Star vein No. 2. 25

Q. What effect, if any, has it upon that vein? A. It produced a reverse dislocation of a trifle over a foot.

Q. Is that sufficient to disconnect the ore bodies above and below except by the width of the seam itself? A. It is not. 30

Q. Has it had any other effect upon that vein than the displacement you have mentioned? A. None that I can detect. 35

Q. Do you know whether or not there is any ore in the mud-seam itself between the body of ore above in the No. 2 Centre Star vein and the body of ore below in the No. 2 Centre Star vein? A. There is a little. I took a sample from there which yielded upon panning fine fragmentary ore of the same character as the vein which has been traversed at that point. 40

Q. Where next do you find the flat fault? A. In the foot of the Centre Star winze.



Q. Have you given No. 4 and No. 2 raise yet, Mr. King? You gave No. 3 raise, but I don't think you gave No. 4 and No. 2.

Mr. Bodwell: He gave No. 4 raise.

A. I did give that. No. 2 I did not.

Q. You found it in No. 2, did you not? A. At about 40 feet high; it traverses the upraise No. 2 at a dip of about 22 degrees. The seam is from three to five inches wide, and there were apparently no platings of importance; in fact, no plating at all parallel to the plane of the fault or connected with it.

Q. What effect, if any, has it on the vein at that point? A. Apparently none. That is to say, the vein is up here both above and below for a considerable distance, but on carefully chipping it it seems to have about the same proportion of ore above and below.

Q. And how as to continuity? A. There is no effect—there is nothing to measure an effect by. In the way of dislocation, if you mean dislocation.

Q. No, I mean outside the question of dislocation. You say you can see no dislocation there? A. No.

Q. Outside of that, what about the continuity of ore; that is, how is it up to the foot wall of the fault and down to the hanging wall? A. It is continual ore-impregnated matter from below to that point and on above and about 25 or 30 feet above that point the ore comes in very strong. I should say the ore is also in force at the base of the upraise. You, therefore, have a heavy body of ore from the top of the shaft, a considerable body of ore at the bottom of the shaft, between the two and a rather thin interval of ore, the flat fault coming in the thin interval and making no effect on the character of the vein above or below it.

Q. Is that thin interval you speak of in any way due, in your opinion, to the flat fault itself? A. None whatever.

Q. Now, you were going on to the Centre Star winze. Mr. King, you might, perhaps, go pretty fully into that place, as it is an important point here. A. I would like to have that large section now.

The Court: That is the one at the foot of the east drift, is it?

Mr. Davis: Yes, my Lord.



The Court: What we are going to deal with now is this winze (referring to model)? A. That is the winze, yes. This (referring to the large section) is a cross-section of the vein and country, showing in projection the ideal position of the Centre Star vein, which is 100 feet back of it.

The Court: That is No. 3 shaft? A. No. 3 shaft, but it is an ideal section 100 feet in front of the shaft. When you come to the winze itself, it is in two sections; that is to say, the plan of the section cuts exactly through the winze. Here is the end of the 59 drift, the east end of the 59 drift. 5

The Court: That is that 100-foot drift? A. Yes, the 100-foot drift; and this figure here indicates the exact section of the winze. This point is a drift near the station, or this point here is just close to station 39 on the Centre Star north drift. 10

The Court: The point marked "ore seam"? A. The point marked "ore seam". This is the face of the Iron Mask east drift from their winze. This section is made so that it cuts longitudinally through the winze and exposes a true section of it, and also cuts through the east face, or touches the east face—cuts exactly the east face of the Iron Mask vein on 69 east drift. At this point on the Iron Mask upper drift, the Iron Mask vein is seen. We have projected on these paper sections all of these formations a very little beyond the line of vision, simply to catch the eye; but the observed truth lies between the colored areas and not beyond. 15

The Court: That is, within the permanent lines. A. The permanent lines. You see the Iron Mask vein at this point, and see it at that point. 25

Q. What is "this" point? The roof of the Iron Mask upper drift, would it not be? A. The roof of Iron Mask upper drift, at a point about 18 feet, or 17 to 18 feet, east of 105. 30

Q. And the other point is the floor of the same drift? A. That is the floor of the same drift. Here is the Iron Mask No. 69 drift; this section, C-D, cuts it exactly at the face, so that the points of interest here are the cutting of that face of the east drift which is shown, the cutting of Iron Mask main drift east of 105, the passage through the winze at the end of 59 east drift, and the cutting of Centre Star north drift between these stations 40 and 39. That locates it. This picture cutting near the bottom of the Centre Star winze represents the flat fault, which is also identified here on the Iron Mask drift, from the water-course. 35 40

The Court: I understand it now. That is the tunnel. A. That is the tunnel.



The Court: Of course, this is to give one an idea of the general direction of the vein. A. An idea of the probable direction.

The Court: This, of course, is actual. A. Actual, yes, sir. 5

The Court: This is where the water-course comes through north and south? A. Yes, sir; exactly; and this is actual, on the water-course drift.

The Court: What drift is that? A. At this point (indicating on the 10 large map).

The Court: That is the Iron Mask drift? A. Yes, sir, the Iron Mask drift, but the water-course is seen the whole length of the drift. This is one of the described points before. I can show on the model, Your Lordship. It is 15 from this point here.

The Court: Yes, I know where it is; it is marked "water-course"? A. Yes, sir; and from this point here the water-course dips down and cuts the bottom of the winze. 20

The Court: That is the Centre Star winze there? A. Yes, sir, the same flat fault starts there off the Iron Mask and cuts down.

The Court: Yes, in the same direction; taking the same course and direction? A. In the course of its dip it intersects the bottom of that winze. 25

The Court: This being, as it were, an intervening point? A. So that that point is actually on the flat fault and this point is actually on the flat fault; 30 the dips are true, as observed here and there, and the rest is ideal between the two.

Q. Now, go on and describe what you found in the foot of the winze so far as the water-course is observed, the effect on the ore and the small dyke at the east side, in fact, everything in connection with the bottom of that winze. A. I have previously described the ore as passing continuously from the intersection of this drift with No. 3 shaft and stated the fact that I followed it continuously from the shaft to the east face of this drift. 35

The Court: One hundred or one hundred and ten feet? A. One hundred and ten feet, which is the face given to the section. From this point I followed the ore continuously down at an angle of about 45 degrees to the flat fault. I there found the flat fault coming in from the north, coming straight through the winze, but intersecting the ore and disappearing in the southern foot 40



of the winze. I will give you the exact dip of that. There is a slight difference of dip in the exposure of the flat fault on the west and on the east side.

The Court: As it passes through? A. As it passes through. On the east side the dip is about 27 degrees and on the west side the dip is about 33 degrees? This slight difference is plainly due to the amount of attrition and fracturing which the origin of the fault caused. 5

The Court: What is the width of the fault? A. The width of the fault on the facing which it enters, namely, on the north side, is about 2 feet, including all the attrition matter and where it passes out, as far as it can be seen, it is not over 12 or 14 inches. That is to say, the parallel fracturing and attrition matter which accompanies the flat fault is greater at this point than at that. 10

Q. These figures which you give include not only the attrition matter in the seam, but the fractured matter above and below, does it? A. No, there are 2 feet of attrition matter on the upper side, the north side of the drift. 15

The Court: A sort of washing? A. Partly, and— 20

The Court: An abrasion of the rock? A. Abrasion of the rock, in washed mud and oxide of iron. Accompanying this ore which I have traced down this winze is a somewhat imperfectly seen fault, limiting the bottom of the ore—a fissure, I should say, not a fault. And on top of this ore another and far better-defined fissure which accompanies and limits the ore all the way down to the flat fault. Two feet above this wall is a parallel wall. 25

The Court: That is on the north side? A. On the north side.

The Court: Two feet on the north side of the wall? A. Two feet on the north side. So that we have here three planes accompanying the ore, one illy-defined largely on account of the opening which does not fully expose it, one capping the ore which is well-defined and is plainly visible, and a third which overlies the accompanying plane, overlying about 2 feet above. When we come to the flat fault it is seen that a dislocation has taken place and the ore is found on the downward course farther down on the dip of the flat fault than it is above; in other words, there has been a reverse of this position of about 15 inches. 30 35

Q. Does it throw the body of ore below clear of the body of ore above? A. It does not. The body of ore in approaching this flat fault has widened from above until it has swelled out into a groove, making a figure—if I can take 40



a pencil to indicate it a little better—there has been a slight upward swelling of the ore there, and a slight downward swelling; in other words, the ore at this point is wider than it is 20 to 40 feet above. Directly beneath the fault the ore is found—this upper wall of the ore is found—14 to 15 inches to the south and below the other. 5

The Court: What is the breadth of that ore? A. The breadth of the ore there is something like 3 feet.

Q. Do I understand you to say that where the upper wall is found here it is found in this continuous mass, except so far as it is interrupted by the seam? 10
A. I am going to add to the diagram, if I may.

Q. Certainly, so long as it is from your own observation, and describe what you put on so the reporters can get it. A. The top of the ore being at that point where it's cut off by the fault, abuts against country rock, but 15 inches below, the same dislocated top of the ore is found beneath. And since the ore here was far broader than the dislocation you can pass from this point straight through and across the fault and find ore in full force below. 20

The Court: That was the meaning of my question. A. In other words, the ore is far broader than the dislocation, and the dislocation being 15 inches and the ore from 2 to 3 feet, you can pass in continuous ore with no break except the cutting of the fault, and the whole bottom of this winze is in ore, which is the mere displaced portion of the ore above. This is further proved by the position of the upper wall which I described as a companion wall and by the wall which immediately caps and limits the upper side of the ore. These two walls are found dislocated in exactly the similar distance and manner that the ore itself is, proving that the entire dislocation is an even movement. 25 30

The Court: Is there anything between the companion wall and the upper wall? A. No ore observed. We have not studied it chemically.

The Court: Is it usual? A. I think not in this part of the mine, certainly. I do not know that I have made this clear. 35

The Court: Oh, yes. A. That is, the ore descends and follows consecutively to the bottom, and the whole bottom of the winze from the north corner to the south all the way is in ore underneath the flat fault. 40

Q. What about the dip of the ore in the bottom of the winze below the mud-seam; can the dip be got there? A. The dip is defined by the upper limiting plane which accompanies the ore, and that dip is identical below the



flat fault and above, so that there is proof that the portion observed underneath and the portions observed above are not the casual meeting of two ore-bodies brought together from a distance, but that they are the identical body.

5

Q. That dip you get, I understand, from these walls you speak of, not from the ore at all in the bottom winze? A. Not at all; from two walls; one which immediately caps the ore and one seam immediately above.

10

Q. Could one get the dip of ore in the bottom of the winze by standing there and looking at it? A. You could not. Unless you could strip it, unless you had the authority to work it and strip it, or unless you had some corresponding planes which could be seen above and below the fault, and whose identity could be proved by their interval, by their strike and by their dip and 15 by their relation to the ore.

Q. Now, is there anything else, Mr. King, which you wish to add to your description of the bottom of that winze? A. There are various points of geological interest there. Near the east face of this pit which form the bottom 20 of the winze is a small lamprophyre dyke which traverses the country from north to south, and which is earlier than the flat fault, since the flat fault itself passes through it.

The Court: It is a vertical dyke, is it? A. It is a vertical dyke, or 25 nearly a vertical dyke, but with the flat fault in position.

Q. Does the flat fault displace the dyke as well as can be seen? A. It does not.

30

Q. What would that prove? A. It would simply prove that the flat fault was later than the dyke.

Q. And the fact of there being no displacement. A. That the line 35 of action is on the direction of the strike of the dyke.

Q. So that what you mean is, you would not notice a small displacement in the dykes? A. No, it would be merely a displacement of the dyke upon itself, and not a mismatching of the parts of the dyke. 40

Q. But what I want to get at there is this: you have given a displacement in that direction which would not shew—— A. It would not shew upon the dyke in any way whatever.



Q. But finding no displacement in the dyke, would prove something with reference to there being no displacement horizontally, would it not? A. Yes.

Q. It proves that—— A. It proves that there is no horizontal displacement there. 5

The Court: But if the seam is more modern than the dyke it must cut the dyke. A. Yes, must cut the dyke.

The Court: Does it do that? A. It does cut the dyke, most assuredly. 10

Q. But does not displace it horizontally? A. It does not displace it horizontally.

Q. So that the mud-seam has no horizontal displacement at that point? 15

Mr. Bodwell: You say the flat fault cuts the dyke?

Mr. Davis: Yes, at that point. 20

A. To be exact, the flat fault in approaching the dyke divides, and one of the main fissure faults goes directly through the dyke, and the subordinate and the less important part curves on the dyke and goes down its side. 25

The Court: That dyke, you say is a small dyke. A. It is a dyke not above a foot wide, and I have traced it in many other places, and it continues its course and its width and its dip, and its average width.

Q. By the way, where else have you seen that dyke? Just ment on one or two of the important points. A. It is seen upon the outcrop, it cuts the outcrop. 30

Q. Yes, that is the point I wished to get particularly. A. It also cuts the railroad embankment just below, which is not on this map (referring to large map), but passes about here (indicating). It is also seen between 39 and 40 on the Centre Star north drift. 35

The Court: That is in its downward course? A. In its downward course. And in its northward course, it is seen to the west of 104. 40

Q. Now, that dyke, I think you stated before in your evidence, was later than the vein and earlier than the mud-seam? A. Yes, sir, later than



the vein, and earlier than the mud-seam. The dyke cuts the vein without displacing it.

Q. And you stated before in your evidence that the ore of the Centre Star No. 2 vein was found to the east of the dyke in its proper position. A. 5
To the east of the dyke in its proper position.

Q. So that the dyke has not displaced the ore at that point—displaced the vein? A. No, it has not.

10

Q. Now, what I was coming at, with reference to the other points where you have found it, is that the outcrop. You say you find this dyke at the outcrop. What about any displacement of ore there or vein? A. It cuts across the outcrop without displacement.

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Q. That is, the ore is on either side? A. It is on both sides.

The Court: I suppose the depths of these are interminable. A. They might go to the melted region, whatever depth that may be.

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Q. Now, you find the Iron Mask drift, which is known as the Iron Mask drift No. 69, some 40 or 50 feet below the Centre Star drift No. 59, do you not? A. I do. It is this one (indicating on large map).

Q. Now, have you made a thorough examination of that drift? A. I 25
have.

Q. That is, Iron Mask drift No. 69? A. I have.

Q. What did you find in that drift? A. I found an intersection of 30
both the Centre Star and Iron Mask veins.

Q. You may just describe it. You say you find an intersection of the two veins in there, Mr. King? A. Yes.

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Q. Will you describe, shortly, just how you found them? A. The Centre Star vein, as displayed in the winze lately described, dips at an angle of 45 degrees.

Mr. Bodwell: Just wait a moment, Mr. King.

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A.—(continued)—(Indicating on section C-D, ex. 20). The Centre Star vein, as just described, displays in the winze which I have traced a dip of 45

degrees. Its bottom is all in ore. The whole structural system of lines making up the body is placed at a dip of 45 degrees to the north, in the Iron Mask upper drift, at the point which I will indicate on the large map, approximately 18 feet east of 105.

Mr. Davis: This is section C-D, Exhibit 20, is the one that the witness has been referring to right along, and the large map is Exhibit 15.

A.—(continued)—In this Iron Mask upper drift, at a point approximately 18 feet east of station 45 the Iron Mask vein appears, very distinctly, disappears downward into a floor of the drift, disappears outward into the mouth of the drift. Its dip is about 70 degrees. If these two planes of 45 and of 70 were projected downward they would meet at this point, at the face of the Iron Mask. Accordingly they are found and by me identified and found to intersect, as theoretically they should. I find the system of the Centre Star planes with its 45-degree dip in the winze of the Iron Mask. About 10 feet below a point upon that winze, which is called station 16, on the northeast corner of the winze, appears a plane corresponding in dip to plane of the Centre Star as developed here and as developed in No. 3 shaft.

The Court: This is No. 3? (illustrating). A. This is projected in front of No. 3. No. 3 is a little back of it, but the plane is the same. That plane appears to be the hanging wall of the Centre Star vein. Immediately below it appears a heavy body of ore, which coincides in its position with its bounding wall, so far as its top surface goes.

The Court: May I ask you where is the Iron Mask winze? A. This yellow drift comes forward to it; it is back.

The Court: This is a drift from—— A.—(interrupting)—From the face where it cuts straight back to the winze.

Q. Between 90 and 100 feet?

The Court: The winze, of course, you have a course up here somewhere (indicating). A. The winze has its course up like this (referring to section on map G-H, Exhibit 21). I only wish to shew the position of the point I have described. Here is a section of the Iron Mask described. This is the top of the drift of the Iron Mask winze. This station 106 is at the west end of their drift. In the roof of that drift, immediately over the Iron Mask winze is seen the Iron Mask vein, having a very considerable width of ore a little further to the east, 20 feet east, it has a width of 2 1-2 feet, narrowing as it passes westward until the point of the section, which is directly over the mouth of the



winze, it is about 8 or 10 inches. This winze displays the Iron Mask vein down for about 15 feet, where it passes into a hanging country of the winze and meets the flat fault. A little digging just at this point, upon the surface of the flat fault—this point being 20 feet below.

The Court: Below 106? A. Taken on the east side 23 east, 24 feet.

Q. What relation to the mud-seam—I guess we better put it—is the point you refer to? A. On the surface of the mud-seam, on the north wall of the winze. A slight digging up there has shewn that the vein, the Iron Mask vein, which disappeared at 15 feet, is still just behind the wall of the winze, and is shown there by digging. Passing down this winze to a level of 69, which is here, this is the section of the junction of drift 69 with the winze, and which comes forward to the point where the other section cuts it, where it is displayed on section C-D. Here is the point 16 about 10 or 12 feet above the bottom of 69 drift, and 10 feet above that is encountered the wall, which I identify as belonging to the Centre Star, and which dips northward about 39 degrees.

I will come back to the other section (C-D). The ore of the Centre Star, 20 which I indicated as having been discovered with this plane at 10 feet above 16 passed down into this drift and may be followed along the east side of the drift with almost perfect continuity to a point of intersection which I will indicate on the large map (indicating on large map), about midway of the length of this drift 69. About midway of the length of this drift appears very clearly the intersection of the two veins; the ore, as I stated, is traceable continuously in the mouth of the drift to this midway point. At this point a considerable rise or opening has been made, apparently for stopping, although I don't know whether the ore was stoped below, but at any rate the slight upraise of perhaps 15 feet above the roof of the drift has been made, in this direction (illustrating). In that upraise the plane of the Centre Star vein with its ore is seen coming into the roof at an angle of 45 degrees, and the Iron Mask vein descends through the roof of the drift at its normal dip of about 70 degrees. One of the planes of the Centre Star meets the fractured plane of the Iron Mask in the tunnel at about 15 feet above the bottom of the tunnel.

Q. Which tunnel do you mean? A. Of the drift, 69. This intersection of the 70-degree plane and the 45-degree plane, make a trough-like body, which may be followed for 20 or 30 feet, clearly defining the two systems of fractures.

The Court: You mean downwards. A. Both going downward and going upward; the Iron Mask extending upward at—



The Court (interrupting): Are they to be seen east and west? A. They are to be seen for an interval of about 20 or 30 feet.

The Court: In the drift. A. In the drift east and west, and also quite clearly seen at the east face of the drift, which is the point of the intersection. 5
The intersection of these two veins in this drift at the midway point which I have indicated on the map is in ore, a large body of ore, which comes down on the plane of the Centre Star, ore 3 or 4 feet thick at that point, and in this upward excavation here is also seen the upward continuation of the Centre Star ore and its intersection with the Iron Mask plane; and between the two is a well-recog- 10
nized "V" of country rock included between these two vein-planes, which shew that they—

The Court (interrupting): I understand exactly what you mean. In coming to a point, a "V" must be described. A. An intersection "V" is 15
made by the planes, coming now to the east face of the winze, which is the point of the intersection—east point of the drift, which is the point of intersection, the two planes are again seen very plainly. A large part of the eastern wall at this face of the drift is made by the ore planes of the Centre Star vein entering from above at an angle of 45 degrees, approximately 45 degrees, and upon the 20
west side of this face is seen the Centre Star vein, cutting down on its normal plane, and the same type of "V" intersection described back in the stope is here plainly visible.

The Court: Excuse me for asking you: of course, you have got the face 25
of the tunnel here and the drift? A. The drift.

The Court: Now how far does that "V" shape, how far does it go, the meeting of these ledges show? A. It shows east and west, which is the last 30
east point which shews here, because we are the face of the drift.

The Court: I suppose I have got the idea. A. Yes, sir, it shews about 30 feet from the westward.

Q. Clear in the breast for 50 feet. A. Wherever the openings of the 35
mine are such that permit the shewing of the walls. They go for some distance back from there and up into the stope described, making in all about 45 or 50 feet of intersection of the two planes.

The Court. Of course, it would be regular. A. Depending on the 40
opening of the mines, your Lordship. An examination underneath the "V" described shews that the Centre Star ore is departing downward in its own regular 45-degree course.



The Court: Now, is there such a difference between the ore of the Centre Star and the ore of the Iron Mask where they meet—or course, there must be a difference. A. No, there is no characteristic difference in the ore where they meet.

The Court: No appreciable difference? A. No.

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The Court: Allow me. I want to have this clear in my mind. I see what this is from the legal point of view. The information you mean to give me, if I understand it, is that this body prevails, this inclination prevails as against the other. A. That they intersect, one goes on in its own way, and the other goes on in its way.

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The Court: They do intersect? A. They intersect; that the Iron Mask vein, which we find here (illustrating), and which we find here has departed here, and in my opinion will be found by crosscutting into the foot wall. They have maintained their directions, though they intersect.

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The Court: I mean that one does not disrupt the other. A. Not at all at that point, certainly.

Q. And generally, so far as you have seen? A. Generally, so far as I have seen, there is nothing to indicate that one vein absorbs the other. The indications, to my mind, are that they are entirely independent fissures, and entirely independent structures with a widely separate origin below and that they simply intersect each other in the country under consideration.

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The Court: In an intersection of that kind, of course, the country rock disappears underneath the "V"? A. Underneath the "V" entirely. In the face of this, there is 4 feet of ore, having the 45-degree plane, and a very little ore following the 70-degree plane as it intersects. In other words, this intersection of veins and this body of 45-degree dipping ore, with its structural planes, also at 45 degrees, is precisely on the course, the downward course, of the Centre Star vein, as developed. Throughout the whole of that winze, from the intersection of the 59 east drift to its bottom and as again displayed here (indicating), that is the I. M. drift.

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Q. Now, Mr. King, I wish to have you explain fully to His Lordship, preferably from the model, unless you think you can explain it better from one of these sections, what the work is that we applied the other day to have done, the object of having it done, and what, in your opinion, it will disclose, if done?

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A. I would like to shew that on both.



Q. Take it on both? A. This being a section (referring to section C-D, Exhibit 20) displays very clearly the relation of the dip and the actual distance between the bottom of this winze and the ore displayed, having the 45 Centre Star dip, at this point is not above 15 feet. I have no doubt from the structural relations, as shewn above and below, and this is one and the same ore body and that the winze, a continuation of this winze, from 15 to 18 feet would undoubtedly display and give it the continuity of that Centre Star ore body straight into this drift. That can be very well shown on the model (indicating on model). Here is the winze whose westerly edge, if produced—— 5

The Court: I understand it very well. 10

The Witness: It will not be necessary for me to continue then.

The Court: Oh, yes, I do not want to cut you off. 15

Q. You might go on and answer the question, Mr. King, so that we will have it down in writing. A. If produced downward at the regular 40 or 45 degree dip, would in 12 or 15 feet come into the east face of the Iron Mask 69 drift; and the ore bodies of the two would be shewn to be one continuous ore body and belonging to the clearly proven and plainly shown ore body of the Centre Star vein. 20

The Court: That is its projection further beyond the intersection? A. No, above and below too, if the work could be carried on. But I mean to say that the opening of that 15 feet of interval by mining would show that that ore body at the east end of Iron Mask 69 drift is the same ore body that we have followed throughout the whole depth of that winze, and the ore body as shewn in the depth of that winze is the same one displayed in the green crosscut and at the top of No. 3 shaft. 25 30

The Court: I have not the least idea that I have anything but a very severe puzzle.

Mr. Bodwell: A most ingenious attempt to create it. 35

The Court: I mean on both sides. It is like the battle Judge Phillips described before him, an army of witnesses on both sides, perfectly conscientious most of them in their belief. 40

Q. Now, Mr. King, you have described this Centre Star vein going down to the Iron Mask winze and to the Iron Mask east drift. Have you found that vein at any lower working on this model? A. Yes, sir, in the blue level.



Q. That is Iron Mask? A. That is Iron Mask.

The Court: What is the name of it?

Mr. Davis: Iron Mask 71 east drift. That is the only blue working 5
there is in the plan.

The Court: Then you have been down in those works? A. Yes, sir.

Q. Have you made a careful examination of that drift also? A. I 10
have,

Q. Now, where in that drift do you find the Iron Mask-Centre Star No. 2 vein, and in what way, by what means do you identify it as the Centre Star vein? A. (referring to memoranda) I will begin on section G-II, if you 15
please. The approach to the Iron Mask 71 level is down the Iron Mask winze. I passed down from station 69, tracing a little ore all the way, scattered, but indicating to me the continuation in the vein. I also followed down through this a small, well-defined fissure-plane which traverses the wall to the east and to the west, and shews itself more particularly on the east side of the winze, and 20
which fissure occupies the theoretical position of the Iron Mask vein and fits the position as defined at the top of the shaft. It is characterized by a little seam of ore all the way. Now, I come to the model.

The Court: The drift is eastward or westward? A. The drift is both 25
east and west. Identifying the seam or fissure, which I consider to be the Iron Mask, from its dip and position, I identified it at the bottom of the level, I follow it until it barely hits the great north and south dykes, which is at the west end of this drift. Then following a crosscut into the north country, I find 30
well distributed but sparsely distributed ore, and the presence of the characteristic 45-degree planes of the Centre Star. Following the same drift eastward I see the plane which I judge to be the Iron Mask—

The Court: Eastward you mean? A. Following the same drift east- 35
ward I see the fissure, which I consider to be the Iron Mask, departing into the south country rock, but following the drift eastward I trace vein-matter in ore quite to the east end of the drift. About midway between the bottom of the drift and the east end of the drift is a short easterly crosscut in which is cut diagonally what I believe to be a foot wall of the Centre Star vein. It corresponds in dip and strike to the planes above, and seems to be the boundary of the local mineralization of the plane. In the foot-country as far as the short crosscut has penetrated, the appearance of vein matter does not—I should put that, 40
no vein matter recurs, and the fissure appears to be a boundary between the ore-

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bearing vein and the barren foot-country. At the east end of this drift the ore of the Centre Star, as I found it to be, is developed on a liberal scale, a body of something like a foot wide, which extends along this drift for at least 20 feet and gradually departs, as it ought to, in the hanging country. All the structure planes on this whole level, with the exception of the Iron Mask planes mentioned as appearing about the foot of the winze and to the westward, are the 45-degree planes of the Centre Star system. 5

The Court: From the foot of the winze. A. Yes, sir. 10

Q. At what portions of the Iron Mask 71 east drift do you find the Centre Star vein the most clearly shown? A. I find it clearly shown at this end (indicating), but not very clearly shewn here. 15

Q. Clearly shown on the west end and not very clearly shown on the east end? A. The reason for this obscurity on the west end here, it comes in contact with, or follows in contact, practically in contact with the great north and south dyke which always dislocates—I mean crushes and metamorphoses the country. So far as I have seen none of the vein phenomena on the east side of that fault are as clear and legible as they are some little distance east from the fault; there is that characteristic difference that they have, the phenomena are not as plain. 20

Q. "Here" being the west end? A. Here being the west end, in contact with the dyke or near a contact with the dyke, whereas to the eastward and for the eastward half of the drift the position and characteristic 45-degree structure are plainly visible. 25

Q. Now, the points which you refer to in the west and east ends of that drift, as shewing the Centre Star vein, the best, are the most northerly points of the drift, are they not? A. So far as ore they are the most northerly parts of the drift, but what I believe to be the foot wall is very plainly visible in the— 30

Q. No, but those are the most northerly points of the drift, are they not? A. I beg your pardon. 35

Q. This is the most northerly part and this is the most southerly? A. Yes, but the foot-wall I described is the south wall. 40

Q. But the points you described are the northerly points of the drift? A. Yes, sir.

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Q. Now, taking the line of the Centre Star vein, where would you expect to find it most clearly shewn, that is, at the south or north of that drift—southerly of it or northerly of it? A. Northerly and at its main portions should be most clearly connected with the hanging wall portion of the ore above.

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Q. So that what you do find, then, is what you would expect to find from the dip of the vein? A. It is.

Mr. Davis: Now, before I go on with the other intersections which you found in the disputed workings, that is, the intersections of the vein—I do not think I asked you about the veins in the No. 1 crosscut, that is the crosscut from the north drift to the Centre Star No. 2 tunnel.

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Q. Do you find a vein in that crosscut? A. I do find a vein in that No. 1 crosscut.

Q. At about how many feet—did you have in your notes how many feet from the No. 2 tunnel? A. About 50 feet. Mr. Clarke, the surveyor, gave it; it is not down on my map.

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Q. Have you your notes there? You can scale that. A. (Witness measures distance) About 50 feet.

Q. Now, what vein is that? A. That, I have no doubt, is the Centre Star vein.

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Q. Do you find any other vein or anything that appears to be a vein in that south crosscut? A. There is a little about midway, say 20 or 25 feet from the mouth of the drift, south from station 51; there is a small seam of rather steeply dipping ore.

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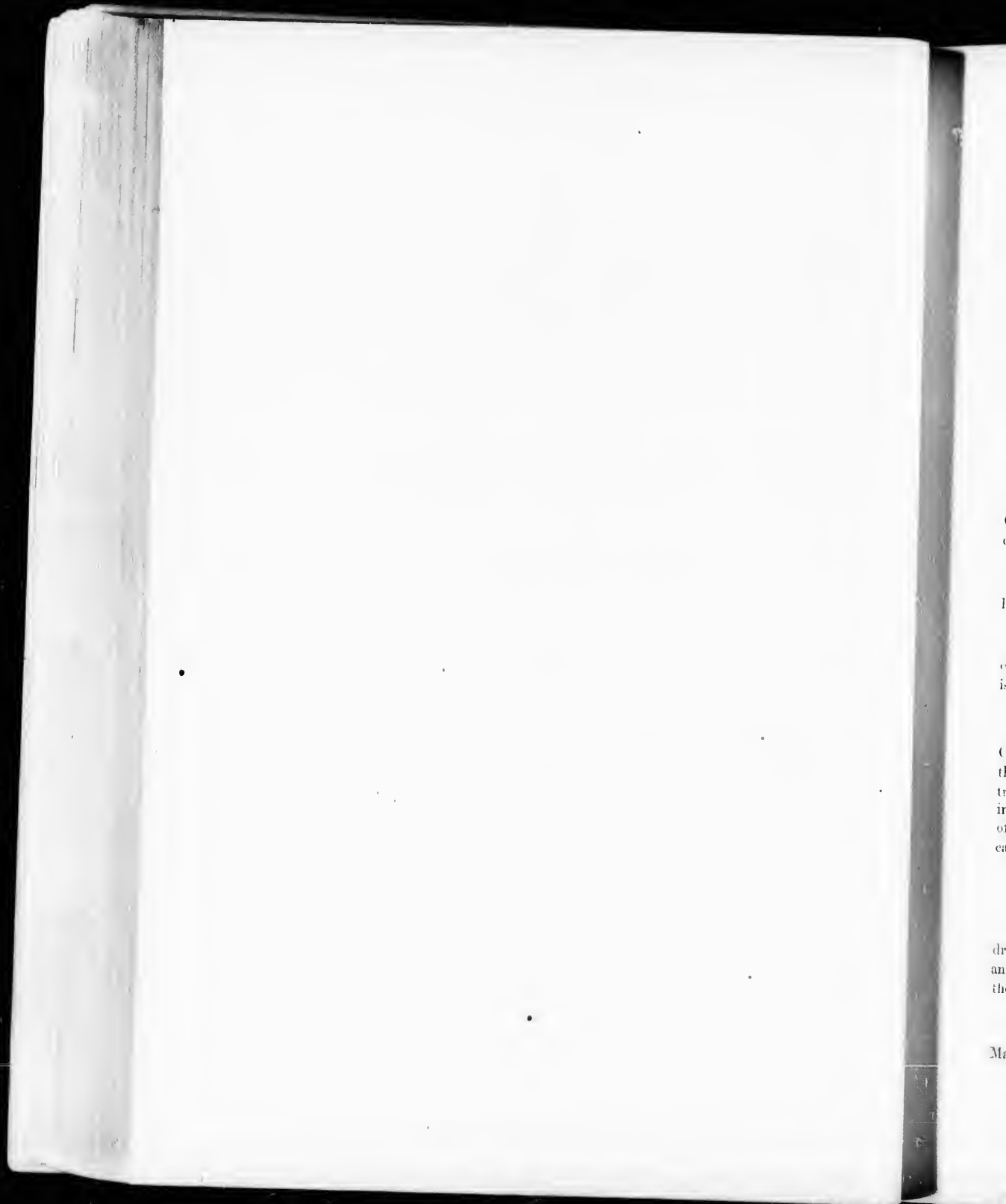
Q. Can you form any idea as to what that is or what it might be? A. It might have some connection with the vertical ore body in upraise No. 4, but no connection in the drift.

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Q. Beyond that, that is, north of the Centre Star vein and the No. 1 south crosscut, do you find any vein? A. North of it?

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Q. Yes. That is, south of it, I mean south of it. A. At the present breast of the drift or the breast three or four days ago, a strong body of pyrrhotite ore was discovered.



Q. What, in your opinion, is that? A. In my opinion, probably that is the Iron Mask vein projected eastward from station 48.

Q. From where you see it at station 48? A. But I should explain that neither of these bodies are exactly in the mathematical position they would be if produced eastward from the other, from 49 and 48, which is probably due to a small dislocating dyke, which is very clearly seen in the Iron Mask tunnel which crosses the Centre Star tunnel, and which interferes with the exact position of those ore bodies.

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The Court: Did I understand you to say, Mr. King, that while it might be an Iron Mask vein, that it is on Iron Mask property?

Mr. Davis: No, it is in the Centre Star mineral claim. A. It is in the Centre Star mineral claim, but I am only identifying it with the vein which is called Centre Star vein

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The Court: That is what I am asking you. A. It is the eastward projection in Centre Star ground of the Iron Mask vein, in my opinion.

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Q. You said before, it is well known the veins do not keep a uniform dip or strike. That is correct, is it not? A. An absolutely mathematical plane is very rare in connection with an ore vein.

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Q. Now, there are one or two other intersections of the Iron Mask and Centre Star veins, I believe, Mr. King, which you wish to refer to. What are they, where are they shewn, and you might give his Lordship the general trough of the intersections of those veins. A. I have described already two intersections, one in the middle of that Centre Star 69 drift, and one in the face of that drift. There is another very good intersection at about this point (indicating) near the east end.

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Q. Of the Iron Mask east drift?

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The Court: I did not follow you there. A. The east face of the 69 east drift, and the middle of that drift, I have indicated two intersections. There is another very good intersection at this point, which is about 20 feet eastward from the breast of this drift, as shewn here.

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Q. That is the Iron Mask east drift that you are speaking of? A. This Iron Mask east drift is now being extended from the point at which it ended, where



the face was at the bottom; the model was made 20 feet back, which would reach an intersection of the two veins. At this point (illustrating) and for some little distance along the vein, for 12 or 15 feet, the plane is seen coming in at 45 degrees from the south, dipping northward, accompanied by a large body of ore. It is the capping wall of a large body of ore, which here is seen to be dipping at 45 degrees. It appears above the drift in a little excavation, and appears at the lower side of the dip, dipping out. The intersection of those two planes is seen very well upon the nose of the drift, whereas in the section (C-D) the Iron Mask plane is seen coming down at a 70-degree dip and the other one at a 45-degree dip, where it passes on past the intersection, which is laid bare by the mining, and the two planes with their angle of intersection are beautifully displayed with their characteristic dips and strikes.

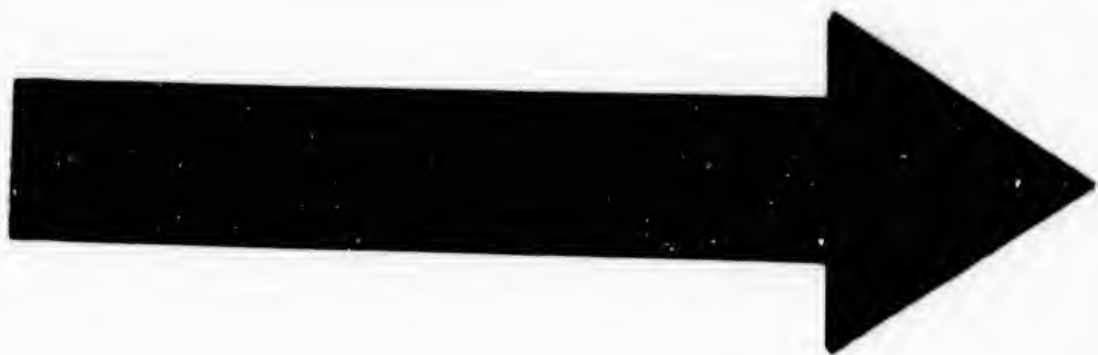
Q. Why is the intersection of those two veins at a higher level at the place you have described than where you described it in the Iron Mask east drift? A. Because you are farther back on the rise of the Centre Star vein.

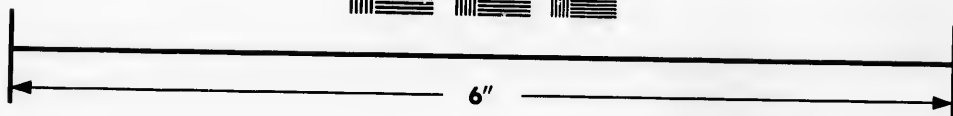
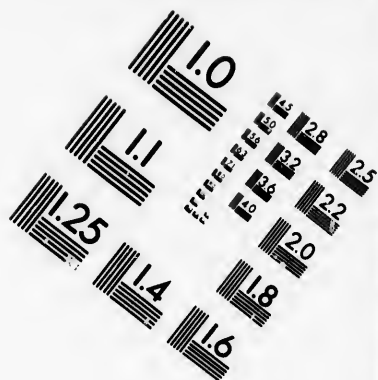
Q. Can you explain that on the blackboard. The strike of the two veins is different? A. I don't know that I quite understand. Since the general strike of the Centre Star vein differs from that of the Iron Mask vein, and since in passing eastward the two strikes indicate converging planes, there will be an intersection to the eastward as well as an intersection downward, that is to say, the plane which passes through the green drift and returns on the Centre Star 60 east drift, if produced, will interfere with that plane, and must necessarily intersect it. That intersection is at the point indicated. Does that explain it?

Q. Perhaps you can shew it by two sheets of paper. They are in different levels; for instance, one level intersection is there, and over here it is up there. A. (Illustrating.) Let the large sheet of paper represent the 45-degree dip of the Centre Star vein, and the folded paper represent the dip in the Iron Mask vein. In passing eastward it will be seen that the intersection of the two rises—

The Court: (Interrupting.) On a different strike? A. They are on a different strike.

Q. Now, is there any other intersection that you wish to refer to, Mr. King? Is there any question, Mr. King, about the identity of the Centre Star No. 2 vein above and below the mid-seam at the different points, that is, as to the vein you find above, being the same vein that you find below? A. There is no doubt whatever in my mind; that is proven to my entire satisfaction by the relationship of the structure planes, the 45-degree structure planes, which 1





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have described in the Centre Star winze and which occur in exactly the same sequence and exactly the same relative distance apart as above.

Q. And is there any other reason, if any other were needed? A. Only the fact of it following the sequence of its dip, which occur regularly and the proof of dislocation is only 15 degrees different. 5

Q. Is it possible, as might be suggested, that there was ever displacement which brought some other vein from a distance off along under the Centre Star vein where you find it? A. The coincidence of finding a vein displaced from far off which had the same ore and the same three structural planes is too remote to be considered. 10

Q. Then, in addition to that, you have more than one vein which is cut by the water-course? A. By the water-course. 15

Q. So that that would make the improbability increase, I suppose, in geometrical ratio? A. The fact of the intersection of the flat fault with a number of other structural features, mostly veins, indicates clearly that the entire displacement before, admitting these swinging or rotating faults, cannot have been over 20 inches at the utmost, and therefore no body of ore, foreign body, or distinct cap of ore can be brought into contact with any other member of the Centre Star by the flat fault. 20

Q. Even if the mud-seam did cause a dislocation of some three or four or eight or ten feet, would that as a matter of practical mining, destroy the continuity of the vein? A. Not from a practical point of view at all. 25

Thereupon an adjournment was taken to 2:30 o'clock p.m., at which time the direct examination of the witness upon the stand was resumed as follows: 30

Mr. Davis: There is a trifling error in this model that I may as well point out now. It does not affect the point of the dispute at all. The east stope is run out to the surface of the ground in this model, when it should not be that far up. It does not alter anything. 35

Q. Now, will you describe, Mr. King, the condition of affairs that you found in the extreme bottom of the No. 3 shaft, and from there to the point in the Iron Mask winze where you pointed out on the section that the Centre Star vein was seen? 40

The Court: Fifty feet below.



A. (Referring to sectional map A-B.) Like I and K; it is a line which cuts through. There is A-B and I-K which cuts through the diagonal drift from 58 toward 38 which drift communicates with the sump of the No. 3 shaft.

The Court: This is the bottom of the No. 3 shaft (illustrating). A. 5
That drift this way, it is about 10 feet above the sump pit exactly. The ore and the vein which has been traced unbrokenly from the collar of No. 3 to the flat fault at this point, marked "A" in pencil (referring to Exhibit 16), meets the floor described, is intersected by the flat fault. An examination of the ore above, at the point "A" and directly below upon the east wall of the pit, 10 discloses the fact that there has been a reversed fault, of 12 or 15 inches similar in character and extent to the one described at the foot of the Centre Star winze.

The Court: Allow me to ask you. I am a little bit confused about this 15
plan. Of course, it is a different section. It came around and turned this way, and a part of it was through the water-course as it is called there. A. Yes, sir, the water-course is here. This is the bottom of the sump, of the shaft; this sack is the bottom of the sump.

The Court: As if there was nothing in there at all. A. Exactly, and 20
this is a section of that diagonal drift which I indicated on the map which proceeds out to 58.

Q. You can show it on the model perhaps better. A. (Illustrating on 25
model.) This diagonal white work here, which extends from the bottom of the shaft out to over 38; it has to be connected there, but it is a little over.

The Court: And this is the Iron Mask, and then there is about 15 feet 30
between these two points. A. Between those two points, yes, sir. This is all on the lower level.

The Court: This is where the work was stopped. A. I do not 35
know, sir.

The Court: That is where I recollect it. Then they came down this
winze the second time. A. Yes, sir.

The Court: The workings are somewhat different to me. There have 40
been new workings; besides, I had only a few to deal with at first. Then this is a hill of the sump, as it were. A. The hill of the sump. The natural course of the water is to that point, to which point it has naturally followed; it is there found to be faulted upward, a reverse fault at 12 or 15 inches.



The Court: That is to the east, isn't it? A. To the south, on the upward movement. We are looking westward in this section; the two ores are in contact, only separated by two or three inches breadth of the flat fault. Beneath the flat fault the ore is traced downward about five feet. There is, perhaps a foot or a foot and a-half of ore at the bottom of this body and it diminished somewhat downward, but it can be plainly identified for five feet beneath the flat fault as it is equally plainly identified from the top of the shaft to the flat fault at that point. 5

The Court: Above this flat fault, as it is called here, what is the character—there is ore there? A. There is ore there. 10

The Court: Broken or unbroken? A. Unbroken, from here downward. 15

The Court: Down to the flat fault? A. Down to the flat fault. 15

The Court: This is about 8 or 10 inches, is it, or what? A. Say 10 or 12 inches or 14 inches. It is a little hard to tell exactly. 20

The Court: The reason why I am asking these questions—Mr. Bodwell knows—is because some of the men talked wildly about 12 feet on a former occasion. A. I am coming down to what I think your Lordship means later. This larger section line A-B lies a little to the eastward (illustrating on large map) of I-K. This is I-K and this section is about 14 feet eastward. The vein which has been dislocated at this point, or not exactly at this point, but directly back of it, 12 feet back of it, is the dislocation—this is not exactly the same plane—is traceable in this drift, which is a branch of the Centre Star north drift, and passes from No. 37 to No. 38. 25

Q. You mean 68, don't you? A. It is from 38 to 68, this drift. This is a curving drift. 30

Q. Shew it on the model, Mr. King. Perhaps the Judge can see it better there. A. It is this yellow drift on the level of the Centre Star workings, which proceed through here diagonally to the strike and dip of the vein, and joins this opening from the sump pit at this point near 38. There is a continuous open drift from the point 39 here to the point 68 here. That drift passes diagonally to the plane of the Centre Star drift. It is sparsely mineralized at a point about here—what I believe to be the foot wall of the Centre Star vein, appears having about the right strike and carrying with it a seam of sulphide mineral. It dips to the north; it strikes east and west. It corresponds practically in position where the wall if produced from the shaft and carried downward should intersect. 35 40



The Court: Which intersection now, which is dipping to the south? A. No, sir, it is the flat fault dipping to the south. The vein always dips to the north, always.

The Court: Of course, there is the dip over there. A. From this point where I see sulphide marked, what I believe to be the foot wall of the Centre Star vein, this diagonal drift passes through the material of the vein. There is the country rock restricted to vein influence, more or less impregnated by sulphides, which can be traced by careful examination from point to point. The point to which it is traced is where I indicate at the foot of the upper half of the Iron Mask winze. At this point it encounters what I believe to be a hanging wall ore body of the Centre Star vein, which I have previously described as having been disclosed at 10 feet above point 16 east, with a northerly dip and carrying its ore in exactly the relationship, northerly dipping wall, that it would have if that were the true hanging wall of the vein, which I believe it to be.

The Court: It would amount to this, that in this drift they were nearly always on that vein. A. In that drift both veins appear.

The Court: The Iron Mask? A. It is Iron Mask workings; that occupies largely the two sections that I have previously described, and both veins are there in my opinion. That indicates a vein from the foot wall as identified here, and the hanging wall as I identified there of about 20 feet in thickness.

The Court: Just about in point 16. A. Yes, sir; about point 16 of the hanging wall. In describing the continuity of the ore in the No. 3 shaft I was careful to say that I did not know whether in the immediate country overlying and underlying the No. 2 shaft there were further planes, which would explain the visible thickness of the No. 3 vein.

The Court: Of the superior vein. A. Of the superior and inferior vein, too.

The Court: That is to say, there might be one or more. A. One or more. In arriving at the drift just described it is evidence that a superior wall and a superior ore body has come into view, that which I described as being encountered at 10 feet above position 16. The seam which I identify as the foot wall of the vein lies about 20 feet back of that, so the vein at that point is fully 20 feet wide, according to my determination and belief. It may be equally wide in the No. 3 shaft above, only there being no cross-ents in it, the hanging or foot, there is no manner of deciding whether it is narrowed upward, or whether it is in full force in the upper portions.



The Court: Now, whether my memory is correct or not, counsel on the other side will know. When they sunk this incline it passed off at this elbow as it were, turned off on account of its meeting with that dyke? A. Yes, sir.

The Court: Now, notwithstanding that, it does not proceed down with the dyke, does it? Does the dyke appear below this at all? A. It appears directly east. 5

The Court: So if they kept along the dyke it would have been driven in? A. It would have been driven in by the invasion of the dyke in that direction. 10

The Court: So it is not a mere question of their coming against the dyke here and then not choosing to go on there, but they finally had to follow the course of the dyke there, and in that way their shaft is bent? A. Their shaft is bent; otherwise, if they had followed the downward course of this upper portion, they would have gone off the vein altogether, abandoning their vein and lost it altogether. 15

Mr. Bodwell: They continued the direction in order to follow on ore. 20

The Court: There are other reasons. I recollect it as well as can be; they wanted to follow the dyke. 25

Mr. Bodwell: Yes, because they did not want to be stopped on the way and the minute they got off of ore they would have been stopped.

The Court: That is my recollection, but I did not recollect that the explanation that was given was that they wanted to follow along to avoid the dyke. 30

Mr. Davis: There is no dispute about that. A. Now, there has been some work done since this. This section cuts the green drift which is the 59. 35

The Court: The 100-foot-drift. A. The 100-foot drift of the Centre Star. It is between the winze and the shaft.

The Court: To the east you mean? A. Yes, sir, this section is between the winze and the shaft. 40

The Court: It is not, then, the marked end of the shaft? A. No.



The Court: The main thing is to give this as the shaft pierced it. A. No, sir. The shaft is supposed to be a little behind this, and this cuts between the winze and the shaft.

The Court: You call it shaft; I call it drift.

5

The Witness: I can indicate exactly.

The Court: I understand now. The drift comes out this way and the winze is between that. A. Yes, sir; at this point the section intersects the Iron Mask No. 69 east drift, not very far down, 10 or 12 feet east of the point where it leaves the Iron Mask winze. This plane indicated here is the plane produced 10 feet eastward of the Iron Mask vein that I have described it, where it was encountered 10 feet from point 16; 16 is above here; it is encountered up here in the winze. Therefore we have the vein in green level at this point of same section—this is an actual mathematical section—we have it down here, for its hanging wall there, and its hanging wall here (illustrating). These are ideally connected between the two, but in order to make this ideal connection the clean, smooth 45-degree dip, it has proceeded from the collar down to about here (indicating) so as to be ideally changed to meet, so that this wall can be swung in contact with that wall, and that is done.

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The Court: How do you know that there is dislocation here? A. Because it occurs both to the east and to the west of it.

25

The Court: Any other places? A. In other places. I can indicate those places exactly. That dislocation is to be seen at this point (illustrating on large map) on the edge of the pit of the No. 3 shaft; at this point, at the bottom of the Centre Star winze, and since the plane of movement of the flat fault comes through here and makes these intersections, and makes these dislocations, what has taken place this side and that side, prove what has taken place in between the two. It would not prove any distant point.

30

The Court: Inferentially. A. It would prove for such a short distance as that comparatively positively, if one may use such an expression. I don't know that there is anything further.

35

Mr. Davis: No, I think that covers it, Mr. King.

40

Q. Now, Mr. King, what in your opinion is the extent, both lateral and on the dip as shewn in these workings here on the model of the Centre Star No. 2 vein and its relationship to the Iron Mask vein and to the mud-seam, and I



would ask you to answer that question fully. A. Am I to understand that that involves the country west of the—

Q. No, not west, east of the vertical dyke. A. Shall I describe it on the model or map? 5

The Court: I don't know; describe it in your own way. A. (Referring to the large map.) It will require both a reference to the model and to the map. Perhaps I had better take the model and sections; it will be less confusing. I will take the numbers from the large map. Upon the level of the Iron Mask tunnel, the Iron Mask vein is shewn from a point—the point is not numbered—is shewn from the point 106 at the head of the Iron Mask winze, is a southeasterly direction through the whole length of that drift to its breast or to near its breast. It is shewn also in a stope above this—I should go back and particularize it. Directly over the winze the vein is seen to approach the north and south dyke, and is there a width of a few inches, 7 to 9 inches, passing eastwardly to the centre, reaches a depth of 12 to 15 feet; it reaches a width of 2 or 2½ feet of solid sulphide ore. Its dip is disclosed from point to point, and passes from 68 to 71 or two degrees to the north. The strike, according to the points of the compass, is about east and west or about 15 to 18 degrees south of east. 10 15 20

The Court: You always take the strike at the horizontal? A. Perfectly horizontal; otherwise an oblique error is introduced. At this point it is about 16 feet east of 106; a stope has been worked for 24 or 25 feet to the eastward, and that stope, so far as I understand, (though I have never been up more than about 40 feet in it), I have myself personally examined the open stope casually for 30 or 40 feet up. In passing still eastward through 105 a vein is seen overhead in the drift, continuously carrying ore from the stope straight on to a point about 12 feet south of 41, although 41 is on the yellow drift beyond, or giving it as a dating point, there being no number. 15 30

The Court: This would be about where your hand is held from this drift? A. Yes, sir. The ore is carried on the fissure of this vein to a point about here, (indicating) where there is a considerable upward opening, and where a junction occurs with the Centre Star vein which intersection and junction I previously described. The object of giving those data are to shew that throughout the length of that drift there extends a true fissure vein, having a strike of 15 or 18 there to the east, and a dip of approximately on an average east of north; that vein, so far as I know, carries with it no companion fissures. It seems to be a single, definite, remarkably well characterized fissure vein, and wherever I have seen its filling it is filled apparently, not only by substitution or replacement, but by actual vein filling, such as is common to many of what are known 35 40



as true fissure veins. There are no truer fissures than compound veins, but they received that name before compound veins were really understood and recognized. This vein may therefore be said to be a single, simple fissure so far as we see it, in following this vein down the Iron Mask winze. The vein, as I have before said, being easily and fully apparent in the roof over the winze, is followed down, diminishing somewhat in width, but still carrying the characteristic ore and the defined fissure until at a point about 15 feet above and below the bottom of the winze (illustrating on Exhibit 21), below that there is a fissure there which we conceived to be the continuation of that and from here down a diminished fissure which occupies the plane and is, in my opinion, the Iron Mask vein reduced to a seam. 5 10

(Referring to large map). A third manifestation of the vein exposure is to be seen from the point 44 in the Centre Star No. 2 tunnel to a point a little east, about 15 or 18 feet east of point 48. At point 48, the mud-seam also comes down on its appropriate dip, where there is a body of sulphide ore, the strike of which crosses it, directly across in this manner, east and west. The dip of that ore body is about 68 degrees to the north. In other words, it has the characteristic strike and characteristic dip of the Iron Mask vein. From that point (which is 48) it cuts into the hanging wall, and re-appears in this drift, the drift being in 48, and I will describe from 48 to about 20 feet east of 41; it does not shew all the way, but may be followed from point to point, carrying a little ore, or shewing its characteristic fissure to about a little north of 43, 4 or 5 feet north of 43. Its natural course, which has been even in general from that point, from 48 to nearly 43, a little north of 43, the vein disappears into the right-hand side or the north side of the drift. At this point an obvious dislocation has taken place. There courses through here a dyke having about this inclination (illustrating), a little east of north. That dyke appears very clearly in the angle of this Iron Mask tunnel about 50 feet east of 45. 15 20 25

Mr. Davis: That point is 105, and you might as well mark it on the map so that you will be able to refer to it, but it does not matter anyhow. A. (Referring to the large map.) The dyke displayed at the point "X" faults the flat fault, and I will make a diagram of that, because it is very difficult of explanation. (The witness draws a diagram on the blackboard and then continues): This, my Lord, represents the floor of this cross-cut on the cross-cut drift— 30 35

Q. From "X" to 45? A. From "X" to 45. This diagram (on the blackboard) represents a portion of the drift from 45 to "X". Along the south wall, the south side of this drift, the flat fault if produced nearly horizontally, 40 its dip to the southward being thus,—

The Court: Does this represent the floor of the drift? A. This is the floor of the drift; it is really a diagram from the side of the drift; this is the



floor and this is the roof of the drift. Along this south side of the drift comes the trace of the flat fault to this point, and here meets dyke No. 1, a dense lamphrophyre dyke with a slight dislocation at the contact which traverses this dyke, cuts it, and is there met by a prominent and powerful fissure which separates dyke No. 1 from dyke No. 2 and throws backwards. It appears around the angle part of this drift in the face of it. I cannot represent that very well. This face here is 10 feet back from the raise of the—

The Court: Displaced? A. Displaced. There has been a lateral fault between there and here of 10 feet, throwing this part backward. This dyke which we last saw at the point "X" re-appears at the point of No. 3 raise. The dyke coursing through here has made one dislocation here, of about 10 feet, and here brings into view the Iron Mask vein in the bottom of No. 3 upraise; also displaced—that is to say, the vein which left the drift a little to the north of 43 has slipped down until it appears there, making a corresponding displacement with that shewn at "X".

The Court: The dyke is older than the vein? A. The dyke is younger than the vein.

The Court: Because it has cut it? A. Because it has cut it.

The Court: Then the water-course is younger, too, is it not; it has cut both? A. It has cut but one; it cuts through the dyke No. 1 and is fissured on the dyke. Now, these two dykes are of very different texture and very different character of rock. This is a fine-grained, extremely fine-grained, gray rock carrying no visible mica; and this is a coarse-grained rock of piteley lustre and characterized by a large amount of mica. The two dykes are quite different; they are entirely different from the enclosing country rock. The flat fault faults one of them and is slipped up on the filling between the two. A slight dislocation of 10 feet has thrown the Iron Mask vein from the north where it should be about under the letter "N" to the south 10 feet, so that it appears in the bottom side, the lower side, of this short upraise. From here it is traceable very distinctly through this drift to a point about 12 or 15 feet east of 41, where, following its natural course, it disappears into the hanging wall country. In passing from the dyke to 42 the fissure gradually grows more evident, more filled with attrition material, and at a point about a few feet east of 42, begins to be characterized by a body of ore which rises to 6 or 8 inches in thickness. But passing westward the ore gives out, except in small quantities and the vein, as I said before, continuing on its natural course, disappears into the hanging country.



The Court: Then, they have not drifted on it? A. They have not drifted on it. Therefore, from 48, with slight intervals of going out and coming in by the interrupting fault, from 48 to a point between 41 and 42, the Iron Mask vein occupies this level, carrying a characteristic strike and its normal dip. I believe that there are but two further points where the Iron Mask vein 5
shews itself.

The Court: That is, of course, all in Iron Mask ground? A. That is in Iron Mask ground; but it contains, as before shewn, both veins and their intersections; and the Iron Mask vein is to be seen through that dip, practically 10
to the end. At a further point I have already described, as it goes to the bottom of the winze it appears here in a small seam——

Q. Where is "here"? A. From near point 75 to a point between 74 15
and 72, and then disappears in the foot wall.

The Court: You say it is on the same level; as I understand this yellow coloring—— A. The coloring does not imply ownership or claim.

The Court: Oh no. But I was going to remark that although it is all in 20
the same level, this is in Iron Mask ground, and this is in Iron Mask ground, and the Centre Star does not claim it. A. They claim their own vein.

Mr. Davis: Our vein is in there. 25

The Witness: Both veins are in that drift at the horizontal intersection.

The Court: The reason I asked, I wondered why you should shew it.

Mr. Davis: This is a most important point. 30

The Witness: Because it shews the intersection of the horizontal veins. East of the dyke, therefore, the Iron Mask vein——

The Court: I think you told me that intersection occurred about half way 35
across here, did you not? A. That intersection is about midway between there and there, although the vein of the Centre Star is in here and along here all the way, yet the planes make their intersection on the north side of this drift on its level and upward on the dip of the two veins. So far, then, as the Iron 40
Mask vein is disclosed by workings of the great north and south fault, it is a vein extending from 48 to 106, and from the surface downwards to 71, its strike being coincident with the Iron Mask level here, and its dip of 70 degrees maintained with the slight and usual geological variations.



Q. The Iron Mask level "here" being Iron Mask drift? A. From 106 to 105. Thus developed it is a plane fissure of permanence, of unusual regularity, enriched in places by ore masses which I only know as at present left, reaching certainly two and a-half feet of ore, and probably more in the slopes above, which have not been stripped. This, in other words, develops one system. It is a true vein; it is characterized by its own dip and strike. 5

The Court: And perfectly distinct? A. Perfectly distinct from any other.

The Court: Perfectly distinct from the Centre Star? A. Perfectly distinct from the Centre Star. Now, the Centre Star vein is a vein which is developed by the No. 3 shaft from top to bottom, by the outcrop to the top of No. 2, down No. 2, and from a point 25 feet east of 49 to near point 53; up the upraise No. 2 to a point nearly vertical from point 43. It is also developed in the green level from 59 to 61, in the Centre Star winze from 61 downward to the bottom, in the Iron Mask winze at a point 10 feet above point 16, through the Iron Mask 69 drift from one end to the other, down the Iron Mask shaft from 69 to the bottom, and throughout the entire drift, 71 drift, from end to end. 10 15

The Court: Centre Star? A. Centre Star. As developed from the wall shown in the Iron Mask winze at a point 10 feet above 16 and from a wall which I believe I can identify, or have identified, between 38 and 68; it shows a vein which also occupies its own individual plane of fracture. That plane of fracture has a dip of about 45 degrees. 20

The Court: The two veins do not meet at all here, do they? A. No, they meet at 71. A slight fissure, which is all that remains of the Iron Mask at that point, is within the Centre Star vein at that point, as it has been from 69 down. 25

The Court: Then this Iron Mask drift is really along— A. A Centre Star vein. The strike of this Centre Star vein has certain curvatures, notably at this point, being over the No. 2, over the lettering No. 2 on the map as it defines the No. 2 shaft. There is another number there. 30

The Court: It is on the outcrop? A. On the outcrop. 35

The Court: Between No. 2 and No. 3 shaft? A. Between No. 2 and No. 3 shaft. And this develops on the surface two courses, one general course from the top of No. 3 to a point bearing above the lettering "No. 2"; and the second course due to a bend from that point on to No. 80. This curvature is also indicated under, id. Through the green drift from 59 to 69 the strike 40



of the vein is roughly parallel with the strike of the outcrop at that point. That is, it carries the same strike as is shewn in the eastern part of the outcrop to the last 50 feet to the west of No. 80. Therefore, the structure underground corresponds in general with the structure on the surface. I have previously stated that I was unable to tell whether the distinct, clear, well-marked, continuous ore body which is shewn in Centre Star shaft had companion planes above and below, and was unable to define its thickness during the course of the shaft. That thickness appears to be, as I stated, about 20 feet as developed from a point 10 feet above 16 to a point 15 feet or 12 feet northwest of 38. The Centre Star vein is, therefore, over a part of its course, at least, a wide vein, and it might be that it is wider than is there claimed; there might be other companion planes above and below. We do not know that.

Q. Can you form any opinion from the brown drift? A. We are unable with the small amount of development that has been done, and incidentally development itself on the Centre Star vein, to absolutely correlate the second of the upper planes as seen in the green cross-cut with the wall well defined at a point 10 feet above 16.

The Court: Let me interrupt you a moment. Now, here is the outcrop? A. Yes.

The Court: That is its conformation. In a general way, one might say—at least you do say—that these lines, in a measure, run parallel, allowing, of course, for ordinary sinuosities and unevenness. A. Allowing for ordinary sinuosities and for the fact that this is a higher point than this.

Q. That is in Centre Star ground? A. That is in Centre Star ground.

The Court: I was going to ask, why you were allowed to run this drift; but you say that is in Centre Star ground? A. Yes, sir.

The Court: And you could run as many cross-cuts, or anything else, as you liked? A. Yes, sir.

The Court: Yes, that is what has puzzled me a little. I see now quite plainly that they could do anything they pleased there. Now, that being in a rough way parallel to the outcrop, was this the first or the second drift, do you know? A. I do not know the order in which they worked in the shaft.

The Court: I know there was only one tunnel before. That is the reason I am asking. My attention has been often attracted to two different courses



apparently of the same vein. A. There are certainly two veins there. There is the Iron Mask vein in this drift and the Centre Star vein in this drift.

The Court: I understand it now better from your explanation. This is the one that runs parallel to the outcrop, the upper one? A. Yes, sir; that is to say, it carries its ore from 20 feet east of 49 to 53 in general parallel lines with this curve. 5

The Court: I suppose it is an extraordinary parallel for nature, is it, or usual one? A. No, they are occasionally seen; that is to say, a prominent curve in an outcrop like that is often seen. 10

The Court: That is the reason I made the remark that it is 320 feet deep, going down so far with all this superincumbent pressure. A. I have seen those curvatures followed more than a thousand feet. Now, the relationship of these two veins—the dip of these two veins—requires geometrically that they intersect in the downward course. The 70 degree and the 45 degree must cut one another. Accordingly at this point of curvature of the Iron Mask drift, about 50 feet west of 105, and from that point eastwardly, the actual intersection of the two walls is plainly to be seen. It is also plainly to be seen— 20

The Court: Where does the intersection take place? In that particular drift, or the lower one? A. In that particular drift. It occurs there on this drift (the Iron Mask drift) and also on the lower drift. 25

The Court: That is the lower one? A. No, it does not occur on that, because that projected would go over that level. But in the middle of Iron Mask No. 69 it does occur where geometrically it ought to, taking the dip from the point a little west of 105 downward into the 69 drift. There are, therefore, the two intersections on two different levels bearing the proper geometrical relation with reference to each other; that is, the steeper dip of the Iron Mask has carried it from there to there, and the gentler dip of the Centre Star has carried it from there to there; the 45 and the 70 have crossed twice. 30

Q. That is the place where they are about 15 feet apart? A. Yes, that is the place. 35

Q. Now, Mr. King, looking at the various places where you have found the Centre Star vein in these workings, that is, in the outcrop, in the green drift, the blue drift, and various places you have mentioned, what have you to say as to the possibility of these ore bodies found at these points not constituting a vein? A. I think there is practically no possibility whatever of their not constituting a vein. In every part of their course they have been followed, and 40



when sections are constructed on the actual working openings and the theoretical positions plotted down they always intersect a body of ore or a body of vein matter accompanied by the appropriate walls which are always approximate in strike and dip to the Centre Star.

Mr. Davis: That is all, my Lord.

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Mr. Bodwell: I think, my Lord, with your permission, I will begin the cross-examination of Mr. King in the morning.

Thereupon the Court adjourned until to-morrow, April 27th, 1899, at eleven o'clock A. M.

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NINTH DAY.

Rossland, B. C., April 27th, 1899.
Eleven o'clock a.m.

Trial resumed.

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Present: The Court and same counsel as before.

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CLARENCE KING—A witness for the defendants.

DIRECT EXAMINATION CONTINUED AND CONCLUDED.

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By MR. DAVIS—

Mr. Davis: Before my learned friend begins his cross-examination, there is one question I want to ask Mr. King about which was omitted in his examination in chief.

Q. Do you know that small winze, Mr. King, near the east end of the Iron Mask east drift? A. I do.

25

Q. About how deep is it (referring to the model)? A. I should say it was 6 or 7 feet deep.

Q. How far is it from the place where you were showing the intersection of Iron Mask and Centre Star veins?

30



The Court: Is there no number or anything else by which you can identify it?

Mr. Davis: There is no number there, my Lord. You have the number 5
on the large map there, as 105, haven't you? A. Twelve feet east of 105,
as I identify it.

Q. East or west? A. West of 105.

Q. You better mark it on this plan, then. A. (The witness marks it 10
on the map which is the base of the model).

Q. Where is that point as regards the place that you pointed out yesterday as being an intersection of Iron Mask and Centre Star veins in that drift? 15
A. About 10 feet east.

Q. What did you find in that winze? A. I found a body of ore about
4 feet in thickness, dipping—I can give you its exact dip—(referring to memoranda) dipping about 46. 20

Q. Which way? A. To the north. It is underlaid by a considerable
seam of calcite, but the ore is practically solid, though a little mixed at the top. 25

Q. What vein is that? A. Centre Star No. 2.

The Court: Do I understand you to say the vein is intersected? 25

Mr. Davis: They intersect near that point.

The Court: The veins intersect near 105, east or 105? 30

Mr. Davis: Near 105.

The Court: What is the point of your evidence?

Mr. Davis: I was merely fixing the point. The fact is, he finds in that
winze which is sunk from the level of Iron Mask east drift, the Centre Star vein. 35

Q. Which side of the Iron Mask winze? A. On the north side.

Q. Is it where that vein would be found following its dip as you see it in
the level above? A. What level do you refer to? 40

Q. I am referring to the drift itself. A. It is exactly; it corresponds
with its natural geometrical place.

Mr. Davis: That is all.



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CROSS EXAMINATION.

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By MR. BODWELL—

The Court: Mr. Bodwell, a moment. It is only fair, because this question may lead to cross-examination. Mr. King, is that the only Iron Mask tunnel or drift amongst these different drifts on this level (referring to model)?
 A. I do not personally know the history of these drifts, or which company—

The Court: I thought you said there was a portion here of this yellow drift (in your evidence) belonging to the Iron Mask. A. No, sir, it was that which is in the level below. 25

The Court: So that this is Iron Mask also? A. That is Iron Mask also. 30

The Court: Well, will the Iron Mask Company, Mr. Bodwell, be good enough to use these stripes to distinguish their own side from the other side. It will make the evidence of your witnesses clearer to me.

Q. (Mr. Bodwell beginning the cross-examination). You had no trouble in identifying the vein at that point as being the Centre Star vein, Mr. King? 35
 A. I had no trouble in identifying its geometrical relationship with the dip and strike of the Centre Star vein.

Q. You call it the Centre Star vein because it has that dip and strike? 40
 A. Not wholly.

Q. Partly? A. Partly.



Q. Then what other identification did you have besides the dip and strike at that point?

The Court: Which point?

Mr. Bodwell: The point he was just speaking about, the winze below. 5

The Court: Near No. 105?

Mr. Bodwell: Yes. 10

A. Because directly to the west of that the westward continuation of the same body comes into intersection with the Iron Mask, keeping its regular dip and strike, and—

15

Q. (interrupting) Therefore, you identified it by the dip and strike of a body in the drift above? A. There is no drift above which appears.

Q. Well, the drift in which the winze— A. Oh, that one? 20

Q. Yes. You found a corresponding dip and strike in the Iron Mask east drift? A. I found—if you will allow me to explain—I found in the east face of that drift a body of ore several feet thick, dipping about 45 to 48 degrees. Passing westward I found the same body in the winze. Passing still westward I found the same body in intersection with the Iron Mask vein. 25

Q. But you identify it by the dip and strike in these particular places you mention? A. I do.

Q. By any other characteristic feature? A. Yes. 30

Q. What? A. By the width of ore; I distinguish it from the Iron Mask, if that is what you mean?

35

Q. No, I was asking you for the characteristic distinction, for the characteristic feature of the Centre Star vein beyond its dip and strike at that point. A. And its continuity of ore. There is nothing in the—

Q. There is nothing in the ore itself? A. Nothing in the ore itself. 40

Q. But you are satisfied from your observation that that is Centre Star vein at that point? A. I am satisfied, for the reason that projected west-



ward and projected upward it would be a natural part of the plane which is otherwise, in other places, developed as the general plane of the Centre Star vein.

Q. That is to say, if the Centre Star vein did cross at that point, the conditions are consistent with that hypothesis? A. It is. 5

Q. Do you go further than that? A. I do. No further in general, but further in particular. (The witness goes to the model.)

Q. I am going to ask you about the other places, Mr. King. A. Very well. 10

Q. You find also a crossing under similar circumstances at several other places that you have referred to in your evidence in chief. A. Two other 15 places.

Q. Three, I thought; one in the Iron Mask winze, one in the drift from the winze— A. Oh, yes, you are quite right. 20

Q. And one in the face of the east drift from the winze? A. Yes, sir.

Q. And these are sufficient to enable you to form an opinion that the Iron Mask and the Centre Star vein do cross at these particular points? A. Having established the general plane of the Centre Star vein, and the general plane 25 of the Iron Mask vein—if these are correctly established, as I believe they are—it is essential that they should intersect. And since they must intersect, their intersection must be at certain geometrical points, and those points correspond with the predicted and necessary points very closely, and when you arrive at the predicted point you find the Centre Star vein, certain characteristics of the 30 Centre Star vein; the ore of the 45 degree dip; and putting together all of that I have no doubt.

Q. Then you are able to say from your observation and from the evidence of your senses from points which you have seen in the mine that there is that crossing of veins? A. I am. 35

Q. And other witnesses from similar observation will be able to agree or disagree with you upon what is actually obvious to the senses? A. If 40 besides what is obvious to the senses at those places they take the pains to establish the planes which I have established, they can relate their ocular experiences at one place to their ocular experiences at another and form a correct idea, if they wish to, I should suppose.



Q. Do you mean to say they cannot agree with you unless they adopt your line of reasoning from the beginning? A. They cannot agree with me if they do not establish the plane of the Iron Mask and Centre Star veins.

Q. Then I understand the crossing of veins, so far as your evidence goes, depends upon the evidence of a 45 degree plane at a particular point? A. At a great many points. 5

Q. I speak of one particular point you have mentioned, say in the Iron Mask winze? A. It does not depend upon that alone. It depends upon it and the relation of— 10

Q. (interrupting) I did not say depend alone, but it does depend upon that, Mr. King? A. To a certain extent, but never in distinction to the relation of the two veins. 15

Q. And it is possible for any other witness to see the same point which has come under your observation in the mine? A. Absolutely.

Q. And, therefore, they can arrive at a conclusion which will either agree or disagree with yours from what they see actually in the mine at present? A. If they see it as I think intelligently. 20

Q. Well, Mr. King, but they can either agree or disagree with you on that? A. They can. 25

Q. The continuation of the work at the Centre Star winze downward would simply afford corroborative evidence of what you are already prepared to swear to? A. It would. 30

Q. If it turned out as you think it would? A. At that point.

Q. If your inferences are correct with reference to these other points there can be but one result from the sinking of that winze. A. There might be two results. 35

Q. There will be a result which will indicate a plane parallel to the other planes of the Centre Star vein? A. I don't quite understand your question. 40

Q. There will be developed planes parallel to the other planes of the Centre Star vein, or planes of the Centre Star vein in other places (perhaps I had better put it that way)? A. What I said was, that it was my belief that



if that winze were carried down on its predicted dip and course, ore would be continuous from the present bottom of the winze to the face of the east drift from the Iron Mask?

Q. I understand that perfectly well. According to your theory ore 5
would be continuous in planes such as are found in the Centre Star vein at other points? A. On the general plane which is found at other places. This winze itself is on the plane that I am establishing.

Q. I think you are drawing rather finer distinctions than I am. A. I 10
do not mean to; I mean to be entirely frank.

Q. You do not expect to find any characteristic difference in the ore 15
itself? A. There might be some characteristic difference.

Q. You have not found it so far? A. No.

Q. At the other crossings? A. No; but I will mention a fact which 20
may produce a difference at the other crossings. In the fact of the east drift of the Iron Mask, their drift from the winze, there is the part, at least, of the intersection, in my opinion, of the Iron Mask with the Centre Star. The mineralization of these two may have been at different times, and the ore at that point would combine, as it would westward in the drift at the point I have indicated as the main intersection on that level—a combination of the ores of 25
the two, if both had ores, and there might be some chemical differences which I would not give and which I should not now deny.

Q. All that amounts to, then, is that you can not say there would be 30
some characteristic difference in the ore? A. Not without full chemical analysis.

Q. Will you say, Mr. King, that you expect to find the characteristic 35
difference? A. I will not.

Q. I understood you to say that in this camp the metallic contents of the 40
mineral vein often impregnates the wall of the enclosing rock, or at least, the rock of the enclosing wall? A. I do not know as I should use exactly the word "impregnate." There is undoubtedly a certain amount of impregnation, and there is probably a larger amount of replacement.

Q. If this ore-body extending along this Iron Mask 69 east drift is the 45
ore-body of the Centre Star vein, according to your idea, it would be a large



body of ore? A. I have before stated—I will answer the question in a somewhat round-about way.—

Q. You could not answer it directly, Mr. King? A. If you will put it directly, I will answer it directly. 5

Q. If I have put it so you can not answer it directly, I will not object to your answering it indirectly. A. Kindly repeat the question.

Q. (The question was read). A. But it is not the Centre Star body 10 exclusively, according to my idea, and, therefore, the answer can not be direct.

Q. Then would it be a combination of Centre Star and Iron Mask veins? A. It would. 15

Q. And would partake of the qualities of both? A. Would partake of the qualities of both.

Q. And the main characteristic of the Iron-Centre Star vein is that it is a 20 broad body of ore? A. It is a broad body of ore in some places.

Q. The narrowest place you have found it is in the No. 3 ineline, is it not? A. No, sir.

Q. Where? In the green drift? A. No, sir. 25

Q. Where? A. In No. 2 shaft.

Q. In the No. 2 shaft? A. Yes, sir. 30

Q. Where it passes through that peculiar body of rock which you found there? A. Just before passing through that peculiar body of ore. 35

Q. You do not mean to say that it is characteristic of the Centre Star vein as it appears at that point? A. I do not.

Q. Would you expect to find it? Here you have, to a certain extent, the 40 Centre Star vein developed on its course? A. On its dip.

Q. Yes; I should have said dip; and here you have it developed on its course, and from the work which has taken place in here (referring to the



model) you infer that it will run out in the immediate neighborhood and pass through this brown cross-cut? A. I do.

Q. Therefore you would not expect to find the Centre Star vein in the No. 69 east drift a small or insignificant body of ore? A. The size of a vein and of its ore are not necessarily coincident. 5

Q. I understand that, Mr. King. A. A large vein may have a very small body of ore in it, and the very largest vein may go thousands of feet without any ore. 10

Q. I understand those are general characteristics of veins; but I am asking you now what is your expectation from what you saw developed in the green drift and at the brown stope, the brown crosscut, from the Iron Mask's stope? A. I should expect a considerable body of ore. 15

Q. You also have found near the No. 69 east drift on the same level, is it not that the Centre Star vein broadens out to a horizontal distance of about 40 feet where the hanging wall gives way there? A. That horizontal distance is taken on the long diagonal to the strike of the vein, but does not give its width at all. 20

Q. Would you give the width of the vein at more than 20 feet at that point? A. About 20 feet. 25

Q. And towards the hanging wall? A. Well, the width from hanging to foot. 30

Q. I understand you to say you did not find the foot wall at this point? A. I found a plane with a certain amount of ore on it, which is the furthest foot wall we now have. 35

Q. But you won't say it is the ultimate foot wall of the vein? A. I will not; no, sir. 40

Q. Therefore, you can not be sure you have found the foot wall? A. I can not be sure that we have developed there the full width of the vein. 40

Q. So that the Centre Star vein in 69 east drift, according to all human probabilities, is a very large vein? A. The—?



Q. The Centre Star vein? A. The drift is not wide enough to develop the whole of any broad vein.

Q. I understand that, but you do not consider that the drift has developed the whole width of the Centre Star vein? A. I never have considered it so. 5

Q. Consequently you will find mineral impregnating or going back for a considerable distance beyond the known boundaries of that drift? A. In which direction, hanging or foot? 10

Q. Which do you say, Mr. King? A. I think the probabilities are decidedly in favor of expansion on the hanging wall side.

Q. You would not undertake to say there would be expansion on the foot wall side? A. No. 15

Q. You are in a country there of considerable disturbance, are you not, Mr. King? A. At that point not very great. 20

Q. You know where the door "M" is, what we have called the door "M" in these proceedings? A. I do not.

Q. Station 38, I think, on the new map. A. I am familiar with station 38; I think there is no door at 38. 25

Q. Perhaps it has been taken away; but near 38?

The Court: You better stick to the stations. That door bothered me a good deal the last time. 30

A. There are two doors there, but I do not know that there is any letter or them.

Q. I suppose the letters have been taken off. A. There is 38, and my impression is that both doors are between 38 and 39. 35

Q. You know the crosscut that proceeds from 38 to Iron Mask winze, don't you? A. I do. 40

Q. Have you not noticed a very strong jointing and fissuring of the rock at that point? A. I have.



Q. That is not in the immediate vicinity, but in the very close neighborhood of a line which would be projected if the Iron Mask winze were carried down; or, at least, if the Centre Star winze were carried down? A. That shattering is about 30 feet from the axis of the winze.

Q. That shattering discloses a considerable amount of movement there where it occurs? A. I should not say that. It would describe a considerable amount of shattering, which does not necessarily imply a considerable amount of movement. 5

Q. Is that shattering above or below the mud-seam of the flat fault? A. It is largely above it, though considerably below it also. 10

Q. As a matter of fact, there are there disclosed two mud-seams are there not? A. There are, temporarily for a short distance.

Q. Of course, your theory of the flat fault is that it created no considerable amount of displacement? A. No considerable amount of what? 15

Q. Displacement? A. My theory is that its maximum amount within view is about 21 inches. 20

Q. But at any rate, the flat fault is there? A. The flat fault is there.

Q. Strongly defined? A. Strongly defined.

Q. With an attendant mud-seam? A. It always has more or less mud-seam in itself. 25

Q. Will you indicate the distance between the two mud-seams at that point, or have you noted it? A. I never measured it, but I should suppose they were about three feet apart, from memory. I never noted the distance. But I traced very carefully the lower mud-seam westward underneath the shaft and saw that it very quickly curled in and came into contact with and disappeared on the main mud-seam. 30

Q. Then you have the mud-seam above in the Centre Star winze? A. In the Centre Star winze. 35

Q. You have the mud-seam again. A. The characteristic mud-seam. 40

Q. And you have the characteristic rock which accompanies the mud-seam and the characteristic fissuring of the flat fault? A. Of what we call



the flat fault, yes. I should say that was not strictly a characteristic plane on account of my being unable anywhere else to find as wide an attrition mass between the upper fissure and the lower percolation limit.

Q. If the attrition mass, then, is an evidence of movement, at the Centre Star winze you found greater evidence of movement than at any other point?

A. I see no reason for that.

Q. You found a greater amount of attrition? A. Yes, but I did not say that the attrition was an evidence of considerable movement. 10

Q. I know you did not, but I say, if an attrition mass is evidence of movement, you would find stronger evidence of movement in the Centre Star winze than at any other point? A. Yes, I should think so if it were. 15

Q. Will you say that the attrition mass is not consistent with movement? A. I will not say that it is not consistent with movement, but I will say that its width does not at all indicate any amount of movement—any considerable amount of movement. 20

D. Do I understand you to confine yourself to this, then, that the extent of movement on a faulting fissure is not in all cases to be measured by the amount of attrition mass in the fissure? A. Never.

Q. Never? A. I never said that. 25

Q. You would not say that? A. I would never say that.

Q. It would depend altogether on the general character of the rock in which the flat fault was made? A. Not altogether at all, it would depend on very many things. 30

Q. In tough rock you would not expect to find as great amount of attrition mass? I don't know how to describe it—an easier rock to break. A. That, in my opinion, would not be the main determining cause. 35

Q. At any rate, we may take that as a fact, may we not, Mr. King, that there are very strong fault fissures, sharply defined and extending over a great extent of territory, with little or no selvage on the walls of the fissures? A. Quite so. 40

Q. Then you won't undertake to say that the amount of the attrition mass in the flat fault—in the planes of the flat fault—is not consistent with a move-



ment of considerable extent? I don't know whether I made my question very plain? A. Yes, you did. That depends upon other conditions as well. It would not—with that single condition alone I should not care to form a judgment or state an opinion. 5

Q. Well, all I wanted to ask you was to say, Mr. King, was—— A. Perhaps I did not understand.

Q. No, I think we understand each other. A. I am not fencing. 10

Q. No, I do not suppose a gentleman of your position will fence; I do not expect that, and if any of my questions indicate that, I hope you will not take it in that way. A. No, I will not. 15

Q. Because I sometimes get mixed on your geological terms. A. Won't you please read the question.

Q. (Read as follows): Then you will not undertake to say that the amount of the attrition mass in the flat fault, in the planes of the flat fault, is not consistent with a movement of considerable extent? A. Taken by itself it is not. 20

Q. Now, the distance between the Centre Star winze and the end of the green drift and the point which would be run when connected with No. 69 east drift, is how far, Mr. King? A. (referring to the model) From the head of the winze, do you mean? 25

Q. No, I mean from the bottom. I should say, I suppose, from that point. I don't want it exactly. It is within 14 or 15 feet, is it not? A. About 15 feet. 30

Q. Now, Mr. King, if there had been a large amount of movement in that vicinity, knowing the character of the—— A. (interrupting) At what period, will you allow me to ask you, because it makes a very great difference in answering the question. 35

Q. Well, I understand you give a different age to the flat fault and to the winze? A. I do. 40

Q. That the veins were formed before the flat fault? A. They were formed before the final movement of the flat fault, and probably before any movement of the flat fault.



Q. Before the vertical faults which you have discovered in the neighborhood in the disputed territory? A. Some of the dykes are, vertical fissures and dykes, are later and some earlier than the flat fault.

Q. And before the small dyke which comes down on the east side of the winze? A. The vein or flat fault? 5

Q. The vein, I believe, you say, is older than that flat fault? A. Then I should correct the last answer. The dykes, so far as I know, are all later than the veins. Some earlier than the flat fault and some later. 10

Q. Then, any movement which occurred at any period during the formation of the fissure of the flat fault or the vertical faults or the small dyke would affect the veins in that vicinity? A. The original fissure of the vein would be independent of any action of the flat fault and of the dyke fissures, and those lower fissures locally affect it whenever they cut it or cross it. 15

Q. Am I right in expecting, then, there would be disturbance in that neighborhood which must necessarily affect the veins more or less? A. That would be absolutely a question of local determination in every particular case of intersection. 20

Q. I am speaking now, Mr. King, of the local conditions in the neighborhood of the Centre Star winze No. 2? A. In answer to that I say that there would be evidence of the displacing action, and the limits of that displacement are clearly shown in that Centre Star vein. 25

Q. Do you say, then, that the movement there would not have affected the veins which are the earliest formation in that neighborhood? A. They would intersect. The flat fault would intersect the veins, being later. 30

Q. Knowing the character of the country rock in that neighborhood will you say that a strong movement might not segregate patches of ore at different places in that rock? A. I would say that when any fissure crosses a vein and displaces it, a certain amount of local fracturing of the ore would be quite possible, and that a drag, as it is technically called—that is, a running of the ore on the plane of displacement—and limited practically by the amount of displacement is probable and in this case exists. 35

Q. This was hardly what I was referring to; I suppose we would agree on that. But will you say there would not be out of the original constituents of the rock itself segregations of ore created by strong movement in the vicinity, or result from strong movement? A. I would say, so far as I have seen the 40



rocks, the veins, the neighborhood of the veins, and the geological conditions of the camp, that I should doubt any primary metallic mineral in the country rock. And if there are no primary metallic minerals of the category of the ore minerals in that rock, no segregations can occur of it.

5

Q. I will come to that point a little later, Mr. King. A. I thought I was answering your question.

Q. Oh, yes, that is quite in order. I was only indicating that it might 10 not be necessary to elaborate it just at the moment. You will not agree, then, that that was a likely event, the segregation of mineral matter out of the original mass of country rock at that point? A. I would. I would say it was not likely.

15

Q. But there would be a certain amount of drag created by the crossing, by fissures crossing the veins already in existence? A. By a fault fissure.

Q. Taking all these conditions into consideration, will you say that it is 20 not a likely event, if that winze is continued on its present direction to the 69 east drift, to create the appearance of a vein continuous there without the reality? A. I say that it would be impossible.

Q. Why? A. Not of a vein, but of this vein.

25

Q. What distinction do you make, Mr. King? A. Well, that if we had some other kind of a vein going through there, then local segregations, if they were impossible—which I deny—might simulate the vein which now does not exist, but which might exist.

30

Q. You will agree that there may be impregnations, using the word in the sense in which you understand it? Going back from the 69 east drift towards the Centre Star vein that exists there (referring to the model)? A. That there may be impregnations going into the country rock? 35

Q. Yes. A. I should like to see the specimens always to know, but it is quite possible that there should be infiltration, which is the term, I suppose, that would cover what you mean, from any vein into any small crack into the interior. It is always possible there are secondary developments of minerals 40 due to the decomposition of the primary minerals.

Q. Would you expect to find a general mineralization of that section between the point where the Centre Star winze now stops and the point at



which it would meet the No. 69 east drift? A. Is that under the supposition that there is no body of ore there? Is this a hypothetical case?

The Court: It is in the 15 feet, is it not? A. Yes.

Q. You would expect, of course, to find a continuous body of ore? A. I expect to find a body of ore practically continuous. 5

Q. Then if it is practically continuous it must depend upon mineralization in the immediate neighborhood? A. It must, as I have said; it is a part of the original mineralization of the vein itself. 10

Q. Do I understand you to say this, that you would find a mineralized continuity of rock, or a continuity of mineralized rock? A. I mean to say I would find an absolute continuity of vein following down that vein from top to bottom. 15

Q. I know, Mr. King, that is acceding to your definition of vein. But would you find a continuity of mineralized rock between those points? A. I expect to find an absolute continuity of ore. 20

Q. You will not say—that continuity of ore you would find in the rock between those points; of course, that goes without saying. A. That is my belief. 25

Q. But you would also look for 45 degree dips in that body of ore? A. I would look for its general limits, upper and lower, to be on the 45 degree dip.

Q. You have already said that the general limits are the 45 degree dip? A. Yes. 30

Q. Then you would look for the 45 degree dip? A. When I say 45 degree dip I mean approximately, that—in general. 35

Q. I am not trying to limit you to a figure. Approximately the 45 degree dip, but you would look for a plane occupying the 45 degree dip in that continuous mineralized rock? A. I should look for a development of some plane there, without a doubt. 40

Q. And if you found mineralized rock and a 45 degree dip in the plane you would think you had the Centre Star vein? A. I should look at it very carefully and determine from all the conditions that were visible.



Q. It would be open, at any rate, to an ingenious contention that it was the Centre Star vein? A. If the vein when through it would be open to any assertion that it was there.

Q. These things are affected somewhat from the point of view, are they not, Mr. King? A. Apparently. 5

Q. Now, then, is it your opinion that the Centre Star vein continues from the bottom of the incline and joins the Iron Mask vein in the Iron Mask winze? A. It is. 10

Q. At what point would you think it joined the Iron Mask winze on its downward course? A. At 10 feet above station 16.

Q. You think it joins here, then (indicating on model)? A. Ten feet above station 16; yes, sir. 15

Q. You think it joins there? A. I do.

Q. You do not agree with what other witnesses in this case have said, that it would join farther down. A. I do not. It would exist further down its hanging wall. 20

Q. Perhaps that will do me just as well. The Centre Star vein would exist further down? A. Yes, sir. 25

Q. Going down, when you were outside of the winze, you would be approximately in the neighborhood of the Centre Star vein? A. Outside of the wall on which side, sir? 30

Q. On the south side, I would say, if I understand you right—yes, on the south side? A. Yes, quite so.

Q. So you would find continuous ore proceeding from the incline down to some definite point towards the north side of the Iron Mask mine? A. If you will allow me to show a section there. (Referring to section A-B, Exhibit 18). On a plane at or near the No. 3 shaft it is necessary, in order to establish connection with the body which appears at 10 feet above 16, and which I conceive to be the hanging wall, the hanging wall body of the Centre Star vein, at that point it is necessary to suppose a flattening in the region of this drift a slight flattening, and then a recurvature on the original dip. 35 40



Q. Yes, but as I understand you, Mr. King, that flattening would not be sufficient to merge the foot wall of the Centre Star vein within the limits of the Iron Mask winze? A. No, it would not at that point.

Q. So you would find the mineral on the foot wall, at any rate for a considerable distance down from the bottom of the No. 3 incline? A. No, I do not think the foot wall of the Centre Star vein anywhere appears in the Iron Mask winze. 5

Q. I did not quite mean that. I think I said you would find the mineral that lies on the foot wall, not immediately adjoining the foot wall—the Centre Star vein? A. No. You do not find the foot wall at all, if my conception of the question is right. If my conception of the question is right the foot wall does not appear. (Referring to section G-II). According to my conception of the structure, the hanging wall as found is against the east side of the winze, at this point 10 feet above 16, dipping about 40, and the foot wall would be always under that winze. 15

Q. That is exactly what I meant, although I did not express myself correctly. Therefore, there would always be ore in the Centre Star vein south—I am speaking as it looks to me, Mr. King—South of the Iron Mask winze? A. Not necessarily ore. 20

Q. The indications of the vein, perhaps, would be the better way to put it? A. The indications of a vein. 25

Q. If not the ore, the planes and the fractures which indicate the vein? A. And the substance of the vein, which is not always ore.

Q. Either ore or the vein material, then,—at least conditions which would physically demonstrate the existence of the vein at that point? A. Did you ask me are those the conditions? 30

Q. Those conditions would be there. A. Those conditions should be there. 35

Q. Should be there? A. But not necessarily ore.

Q. Would those conditions exist to the level, the blue Iron Mask level, as shewn on the model? A. In my opinion they do and— 40

Q. That would be a vertical distance, Mr. King, of how far, speaking generally, roughly? I do not ask you exactly. A. Roughly, 100 feet.



And if you will allow me to finish that answer, I will say, that what I believe to be the foot wall does appear on that level, in the small cross-cut from the level.

Q. You are now referring, Mr. King, to this cross-cut (indicating on model)? A. That little cross-cut there--that little south crosscut. 5

Mr. Davis: In the middle of the drift? A. Middle of the drift, and according to—

Q. That work, then, would be free from any of the suggestions that might be made with reference to work prospected from the Centre Star winze at the end of the green level? A. It might not at all. That is to say, when you have got a body of ore it is a good safe thing to stick to it. 10

Q. But I understand that you have a body of ore down the incline to the mud-seam, this No. 3 incline? A. Yes, sir. 15

Q. And I understand that you have found positive indications of that ore beneath the mud-seam? A. Five feet in. 20

Q. Do you say it stops there? A. I do not.

Q. You have found the foot wall of the Centre Star vein in the south cross-cut, from the north level— A. What, from its position, I took to be the foot wall, but further cross-cutting may develop that there is another parallel wall. 15

Q. Then the extension of that work would either demonstrate or refute the correctness of your theory? A. Of what work, sir? 30

Q. From the foot of the foot wall down to the north level, sinking from here down? 35

Mr. Davis: That is the blue level.

Mr. Bodwell: Yes; it is our north level.

A. Not at all. That would not determine anything except— 40

Q. It would determine whether or not the foot wall planes of the Centre Star vein were found there? A. It depends on how much you cross-cut.



Q. How far do you say you would have to cross-cut? A. I do not think even with cross-cutting we could be sure of anything?

Q. Why? A. Because you are following down the east side of the biggest structural disturber in the whole country; that is, the north and south faults. 5

Q. You say you found the Iron Mask vein pursuing an unbroken course, unbroken fissure down that structure? A. No, sir. 10

Q. Does it not? A. Oh, yes sir; down the structure of the vein.

Q. Now, the structure of the Iron Mask vein maintains its existence there, why does not the Centre Star vein do so? A. The Centre Star vein might very well be earlier, in which case— 15

Q. It might be earlier. Do you say it is? A. I do not. I say it might be, in which case the conditions of the— 20

Q. Mr. King, pardon me, please. A. Yes, sir.

Q. You have at least one vein there which maintains its existence along that disturbing element? A. I stated that it is my opinion that the slender seam which goes down from the flat fault in that winze was, in my belief, the Centre Star vein—the Iron Mask vein. 25

Q. I think you put it a little bit stronger than that, Mr. King, but I am willing to take it at that. You were satisfied that the Iron Mask vein maintained its structural condition along that disturbing element? A. Yes. 30

Q. Now you say it is possible that the Centre Star vein may not do so? A. It is quite possible.

Q. But it is more than probable that it does, is it not? A. I do not think so. 35

Q. Because it is a larger vein than the Iron Mask vein? A. It is larger, but it has not a single definite fissure, which is always the easiest thing to follow and maintain. 40

Q. But it is so wide that any irregularity caused by the north and south vertical fault could be rectified, probably, in the plane of the vein itself, could

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it not? A. I doubt it, for the reason that whereas the north and south disturbance, which is a very compound disturbance of two dykes and a fault, whereas that disturbance has got one inch or two inches of Iron Mask vein to play with, it has got 20 feet to smash up and disturb of the Centre Star larger vein.

5

Q. But it has to create a correspondingly larger movement or smashing up in order to destroy the identity, has it not? Do not the two things balance each other? A. No, I do not think they do.

10

Q. Would you say they do not come nearly to balancing each other? A. I say, wherever we approach very close on the strike of the Centre Star to that disturbance, it shows a great deal of dislocation and bonding and crushing.

Q. Suppose you took an intermediate point and kept away from the disturbing forces of the north and south vertical fault? A. As a practical miner I should want to get far enough from that fault to be sure that any disturbances were practically over.

15

Q. And would you like to get close enough to another vein to make the connection easy? A. Not necessarily.

20

Q. It would be open to that objection? A. I am not aware at all, that the presence of the Iron Mask there makes it any easier.

25

Q. At any rate, Mr. King, it would be open to that suggestion, would it not? A. I do not know. I should never have suggested it.

30

Q. Have you given us all the reason why you would not advocate a continuance of the work from the bottom of the No. 3 incline? A. I should never advocate that, because already, in the sinking of the shaft, they have been thrown fully 40 feet off of their natural line; and if they went on down from there it would be a continual struggle with that dyke, and I would be free of it, once and forever—go off where I did not have it.

35

Q. But that is simply another condition attached to the disturbing element of the dyke? A. Yes, sir; but—

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Q. It does not alter anything; it does not make any other condition than the influence of the dyke? A. No, I am not implying any other reason than that.



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Q. You would have a vertical distance for that exploration of 100 feet instead of 15? A. When I got that 15 I would try to get some more.

Q. Yes; but I understand you to say the 15 feet here demonstrated the continuation of the vein? A. Between those two points. You would then, 5
in my opinion, have the Centre Star vein to the east end of the Iron Mask drift.

Q. Will you shew me your section on which you shew the intersection of the vein now, the first intersection with the Iron Mask? Perhaps I can get it this way, without troubling you. You show an intersection here in it (referring to model), do you not? A. I do. 10

Q. Of how many feet in vertical height? A. Oh. I should say 15 or 18. 15

Q. And you shew an intersection in the upper drift of how many feet in vertical height? A. Oh, 8 or 10 approximately.

Q. And you shew an intersection in the Iron Mask winze of how many feet in a vertical height? A. (Referring to section G-H). About 68 feet. 20

Q. Sixty-eight feet? A. About 68 feet.

Q. The crossing? A. I think so.

Q. At about 68 feet, you say? A. No, I say of about 68 feet. 25

Q. Will you explain just what you mean? A. (Indicating on section G-H.) As in my opinion, the Centre Star vein enters the Iron Mask winze at a point 10 feet above the station 16, and as the Iron Mask vein comes in contact 30
with the same Centre Star vein at or near 69, and remains within it to the bottom of the winze, therefore the vertical height you ask for would be about 60 to 70 feet, roughly.

Q. Of course, you are speaking of conditions that are visible to the eye? A. 35
Visible to the eye. And I am assuming that I am correct, as I believe I am, in identifying that 70 degree seam——

Q. I am assuming that, also, for the present. A. Yes, sir; for the present. 40

Q. Now, then, you would simply add, then, as I said some time ago, you would simply add 15 more feet in vertical height to evidence that already exists, by the construction of that winze? A. That is true.



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Mr. Bodwell: Mr. King drew certain pencil marks on section G-II, Exhibit 21, which he states to be only approximate, and which are connected with his answer, and which he marks with his initials, the letters "C. K." on the section G-II.

Q. Mr. King, you were connected with the Geological Survey before the passage of the United States Mineral Act of 1872, were you not? A. No, sir, with the United States Geological Survey. 5

Q. That is a department organized; but with the United States Geological service would be a better way to put it. A. The United States exploration of the 40th parallel; yes, sir. 10

Q. I think that began in 1868. A. In 1868; I can't exactly remember; the spring of 1868, I think. 15

Q. And at that time the quartz veins which are most familiar—mineral veins, perhaps I had better say—those that were most familiar were the quartz veins of California? A. They were; they were the type known. 20

Q. And they were the typical fissure vein? A. They were a peculiar type of fissure vein; they were a fissure vein, but a peculiar type. 25

Q. They were considered to be the typical fissure vein at that time. A. They were not the typical fissure vein of the books, but they were a type for the Coast. 30

Q. The typical fissure vein of the books was a fault plane extending downwards to an indefinite length, was it not? A. Not necessarily any open fissure mineralized after the Freiberg pattern. 35

Q. Perhaps we had better have that on the notes, what that is. A. The true fissure vein was a vein which was primarily an open fissure; secondarily, filled with mineral matter distinct from the enclosing walls. 40

Q. But it had distinct and well defined walls? A. It did.

Q. And continuous ore? A. Not, necessarily at all, sir.

Q. A continuous fissure vein filled at intervals with ore. A. Filled at intervals with gangue stone or ore or both. 45



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Q. Within reasonable limits, that kind of a vein would answer the description you gave of the Iron Mask vein at the close of your evidence yesterday.

A. Within reasonable limits. I said at the time, that without more study and much time it might be impossible to tell whether that was filled with foreign matter wholly, or was partly the result of the replacement work of attrition in the vein. 5

Q. Have you any knowledge, Mr. King, of the history under which the Mineral Act of 1872 was compiled or drawn? A. What was the date of the first one? 10

Q. 1868. A. I think the Act of 1872, if I remember rightly, was drawn by Senator Stewart. 15

Q. Of California? A. Of Nevada. I may be wrong about that. 15

Q. I suppose we can assume that it was drawn with reference to the type of fissure vein that was then most commonly known? A. I think it was drawn chiefly in order to gobble the Comstock lode. 20

The Court: And it was gobbled? A. And it was gobbled.

Q. And under it other lodes have been gobbled ever since, have they not? 25

A. Yes, sir. It was a very bad law.

Q. The commonly accepted fissure vein was the fissure vein as seen in California? A. That was the best known type. 30

Q. Was it the normal type, or at least the typical vein? A. For the west coast.

Q. For the west coast, yes. I understood you to say that those compound veins did not come into existence until a long time afterwards. A. You mean come into recognition. 35

Q. And into recognition, I should have said. A. Their recognition and comprehension is somewhat recent. 40

Q. The idea of applying the Mineral Act to a zone began with the Eureka-Richmond case, didn't it Mr. King? A. That was not an application to a zone in the sense that I have used it for zones at all.

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Q. No, but a zone of mineralized country? A. To a body, I should say, of mineralized country.

Q. A body of mineralized country? A. A broad body of mineralized country. 5

Q. And it would in limit be called a zone? A. I should hardly apply that to the Eureka deposits.

Q. I know about that, Mr. King, but you—— A. (Interrupting.) 10
If you happen to have read my testimony over——

Q. (Interrupting.) I think I have, and I don't propose to take you over it now. I am not asking questions with reference to that point at all, but I think I may be—— A. (Interrupting.) It was a broad mineralized body of 15
ore.

Q. I am near enough correct if I say that the application of the Mineral Act to zones or belts of mineralized country within defined limits began with the Eureka-Richmond case. A. Legally I cannot say, but as a miner that 20
was not at all the first.

Q. I beg your pardon. A. In a mining sense that was not the first.

Q. But you cannot speak of the Mining Act and its application to a mineral zone in a miner's sense, can you? A. No, I understood if that was the first recognition of the zone. 25

Q. No, I said the first application of the provisions of the Mineral Act to the zone. A. So far as I know, it was. 30

Q. I think it is correct. A. So far as I know it was.

Q. Now you have described the formation here as being a shear-zone. A. Shear-zone veins. 35

Q. Shear-zone veins. A. Shear-zones may occur in rock where there are no veins, or when occupied by mineral solutions and made into an ore deposit, which would be a shear-zone vein.

Q. Do you recognize distinctly patches of ore within the zone? A. In 40
this case or always?

Q. Well, either way you look at it, Mr. King? A. I do in this case, most decidedly.

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Q. Do you always? A. I say that there are many shear-zones which are purely geological and exterior to the mineral zones and not impregnated.

Q. We will leave those out of the question. I am speaking of those bodies within the limits. Do you recognize those shear-zone veins within the limits of the zone? A. Very decidedly. 5

Q. The existence of a shear-zone implies boundaries of some sort, does it not? A. It does.

Q. I understand that my friend asked you on several occasions, Mr. King, if such and such a thing was physically possible or impossible; as, for instance, speaking of the inclined shaft, he said was it physically possible that the body of ore seen in that was not a mineral vein. I understood him to ask you a question of that sort. A. And I said that in my opinion it was not physically possible. 10 15

Q. And I also understood him to ask you a similar question with reference to the inclined shaft No. 2; but at any rate at other points in the mine. A. And I replied as regards No. 2—or at least I don't remember my reply. 20

Mr. Davis: I don't think I did. A. (Continued.) But in my belief that No. 2 also exhibits a vein.

Q. I suppose those questions would not have been answered, and those answers would not have been given, except that your evidence is a series of inferences, Mr. King? A. Not a series of inferences. It is a series of applications to the statements of facts. 25

Q. Am I right in saying this—I did not mean to cast any reflection on your statement, of course you understand that. A. I know that. 30

Q. But am I right in saying this, that in the first place you infer a deep-seated origin of the minerals in question? A. Yes, sir. 35

Q. That presupposes a fissure? A. That presupposes fissures or a fissure. 40

Q. Or a fissure? A. Yes, sir.

Q. Consequently, when you have conditions which are consistent with the existence of a shear-zone, you conclude a shear-zone, a fissure or a set of shear-zone fissures? A. If I see those fissures and should conclude they are shear-zones. 4

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Q. May I put it this way: that if you see conditions which are consistent with these fissures, you conclude a shear-zone fissure? A. I don't think I quite understand the distinction.

Q. I say you presuppose for the existence of that ore a fissure extending 5 to the depths the ore would be found? A. I do.

Q. And when you find conditions in the rock which are consistent with the shear-zone, you infer a shear-zone fissure for the mineral. A. If the mineral and the shear-zone coincide. 10

Q. Well, will you say that the conditions are inconsistent with anything but the shear-zone? A. As regards the Centre Star vein, I do.

Q. Do you take that out of the general body of the country rock? A. I 15 have not in sufficient detail examined the rest of the veins to see.

Q. Do you think you have exhausted every fact which relates to that subject? A. I do not. 20

Q. Then may I not be correct in saying that you find conditions which are consistent with a shear-zone, and therefore conclude a shear-zone? A. No, sir; that is not my attitude. My attitude is, that I find conditions which are inconsistent with any other hypothesis. 25

Q. Without an exhaustive consideration of every fact which may bear upon it? A. Without—no, I will modify that, so far as this vein goes, I have neither doubts nor misgivings nor fears when I announce it to be a shear-zone vein. 30

Q. You speak particularly and entirely of the Centre Star vein? A. I do in this case.

Q. And without reference to the bearing which the other conditions of 35 the country in the neighborhood had? A. I have seen something of the other veins.

Q. Yes, but you have not seen it at all? A. I have not. 40

Q. Then do you still think I am going too far when I say that you find conditions consistent with the Centre Star vein being a shear-zone fissure, and therefore conclude a shear-zone fissure? A. No, sir; you are not correct in that. 40

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Q. I am not correct? A. No, sir. I find conditions which are consistent with nothing else than a shear-zone vein, mineralized from the dip.

Q. That is, you find conditions which are consistent with nothing else than a shear-zone in the rock where the Centre Star vein is supposed to be? A. 5
It is, in my opinion.

Q. I understand that you are speaking of your opinion. A. Yes, sir.

Q. I say, suppose that you find the conditions for the shear-zone there?
A. I do; in other words, I find a shear-zone. 10

Q. I think we will have to let it go at that. We don't seem to get beyond it. A shear-zone fissure necessarily implies walls? A. Yes, sir.

Q. Having a bounding plane, giving a bounding plane to the fissure? 15
A. Giving a physical bounding plane.

Q. A physical bounding plane. I am ready to take it that way. When you find planes which are consistent with that physical bounding plane, you so denominate them. A. I have tried to explain in several of my answers, 20
that the determination of the exterior bounding plane of a shear-zone plane can only be arrived at by cross-cutting liberally in both directions.

Q. I know, but for the purpose of your evidence in chief you assign bounding planes to the ore in the centre of No. 3 incline. A. To the ore, not 25
to the vein.

Q. But I understand you to say that you find within the wall enclosing the vein, a body of ore? A. A body of ore, yes, sir.

Q. Above and beyond that you find correlative walls which you call the bounding planes of the fissure? A. As far as seen. I particularly said that I 30
had not been able to cut——

Q. (Interrupting.) I did not mean to ask you anything more than that. But you will not undertake to say they are the ultimate bounding planes of the 35
fissure? A. I do not.

Q. But when you find these walls, and believing in a fissure, you denominate them the bounding walls of the fissure as far as known? A. Yes, sir 40
as far as the bounding walls.

Q. Is not that so because you presuppose a condition precedent in the shape of a fissure? A. There must be a fissure precedent to the filling of the vein.

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Q. That is, in your opinion? A. In my opinion, yes.

Q. And a fissure necessarily? A. That is of a fissure vein. There are percolation veins in soluble rocks, which are another class.

Q. I am going to give you a chance on them in a minute, but for the present, a fissure vein implies a wall? A. Implies a fissure.

Q. And a fissure necessarily presupposes a wall or a bounding plane. A. A fissure necessarily supposes one divisional plane through a rock.

Q. But it necessarily must have boundaries? A. One fissure need not necessarily be thicker than a sheet of paper.

Q. No, I understand, but it may be half a mile across. How wide is the Comstock lode? A. About five or six hundred feet.

Q. It may be a considerable distance across. A. It may be a considerable distance across.

Q. And it is in familiar language you speak of the sides of that fissure as the walls? A. Of which fissure; the Comstock?

Q. Of a fissure. A. Of any fissure.

Q. Yes. A. Besides, that fissure ought not to be really called walls unless there has been a separation.

Q. But in familiar language we don't talk of a fissure without a separation, do we? A. We ought to.

Q. I understand that, but I mean in common language that is not an accepted idea? A. Well, I am not quite sure—

Q. (Interrupting.) I will assume for the purpose of my question—we will be on common ground then—that a fissure necessarily indicates an opening. A. So far as the application of a shear-zone goes, I should say that that was not true; that the only opening—

Q. (Interrupting.) Then, Mr. King, may I ask what occasion had you to look for bounding planes to the Centre Star vein and in incline No. 3? A. Because I always look for them where I am examining a vein; always look for them.

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Q. And finding these planes, you call them the bounding planes of the fissure? A. I called them correlative planes, I think, sir.

Q. You simply use that with reference to the planes which include the ore itself, or which surround the ore itself? A. No, I use that also for a plane seen two or three feet above in the hanging wall. 5

Q. Are we hearing of a new term now in the word "correlative" as applied to a plane? A. If it relates to another plane geometrically it is correlative. 10

Q. I understood you, Mr. King, and if I am wrong about it you will correct me—you call them correlative planes, because they were correlated to the planes which enclose the ore. A. Structurally. 15

Q. That is what I understood. I was right to that extent, at any rate? A. Certainly.

Q. And finding them in the direction in which you did, you denominate them the bounding planes of the fissure. A. Not merely because I found them— 20

Q. (Interrupting.) Will you say this, or may I say this, with reference to your evidence, that you did call them the bounding planes of the vein? A. No, I qualified that and said not without cross-cutting could we tell whether we had not the foot or hanging wall of that vein. 25

Q. Then you called them the bounding planes as far as known. A. As far as seen there at that spot. 30

Q. Now, then, do I understand you to say that you disagree with the statement that eruptive rock of the description you find here contains in its original magma the metallic substance of the veins? A. No, sir, I did not say that. 35

Q. You did not say that? A. I did not say that, no sir.

Q. And you will not say that? A. No, sir. 40

Q. Would it not be likely, then, or is it not possible that some other gentleman, having scientific knowledge, perhaps nearly as extensive as yours,

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would take these same conditions and prove the filling of these veins by lateral secretion? A. I think, if he were under examination, an equally learned gentleman would ask him how he accounted for the secondary deposition of pyrrhotite which has heretofore never been described or known or figured upon, and no reaction has ever been given for it. 5

Q. I don't want to get into this controversy, because it has raged with a good deal of violence, I understand. I am simply asking you if other gentlemen would not take these same things as positive proof of lateral secretion as the filling source of the veins? A. I should ask him what his facts were to begin with; I should get him to state distinctly his facts. 10

Q. Now, will you state any possible number of facts, which he would not take to prove the exact opposite of the theory which you advance? A. I should begin by finding the secondary origin of pyrrhotite, and then ask him his chemical formulæ. 15

Q. Has this language a familiar sound to you: "It will be clearly seen from the above quoted views of various writers on the subject that the mode of formation of metalliferous veins is very far indeed from being understood. The manner in which fissures were produced seems tolerably clear, and there is practically a consensus of opinions on that point. The manner in which the minerals were deposited therein admits, however, as has just been shown, of very various interpretations. Even the statements upon which the opposing theorists base their arguments are not by any means unchallenged by their opponents, and even if they were, most of them admit of diametrically opposite explanations. Thus, if it were definitely proved that the rocks within reasonable distance of a fissure vein contain minute proportions of the same metals as are found in the vein, one side would see in this fact a proof that the metals in question were derived from the rocks, whilst the others would argue that the metals in the rocks were derived from the vein; or, if it were proved that no such metals exist, one side would claim this as evidence that the metals had all been leached out, and the other as proof that no such leaching had ever been possible." A. That is quite familiar a long time ago, which was Phillips. 20 25 30 35

Q. That is from Phillips on ore deposits? A. Yes, sir.

Q. You have spoken of Mr. Emmens as a member of the Scientific Society to which you belong in New York? A. I have. 40

Q. He is a prominent man in science, is he not? A. Very prominent.

Q. Has written a very celebrated monograph on the Leadville district?
A. Yes, sir.

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Q. He adopts the theory of lateral secretion, does he not, and argues for it, and finds for it? A. He does.

Q. Will you undertake then to say that Mr. Phillips is wrong when he reaches this conclusion, after reviewing all of those authorities and all of these writings: "In spite of all that has been done and written on this subject we are still reduced to mere conjecture on two of the most important elements in the inquiry, whence the metals were dissolved and how they were precipitated. It is only safe to affirm that they were in very many cases introduced in the form of solutions?" A. That we all believe; most of the metals, some of them were by sublimation, undoubtedly.

Q. Then the only facts on which the scientists are agreed is that mineral sulphides—or sulphides in this case—were deposited from solutions—precipitated from solutions. A. In this case, they were undoubtedly deposited from solutions in my opinion.

Q. Whence those solutions come, is still a matter of controversy. A. I have not heard a controversy as regards those yet; it may be.

Q. Whence those minerals came in other rocks of this description is still a matter of controversy? A. I don't think you can reason on other rocks of this description, for so far as I know, this is the only mineral district known to this rock.

Q. Whence the solution came in other igneous rocks? A. I lost the first part of that.

Q. I say it is still a matter of controversy whence the solutions came—I think I am using the language of the book—that is all of the reason for that phraseology—whence those solutions came in other masses of eruptive rock? A. I think that the application, that the question must always be decided upon each case, and men who have decided the question from one case and not seen another, or vice versa, are not in position to lay down any general and universal law.

Q. Has not there been a fierce controversy waged over the Leadville district between Ascensionists and Lateral-secretionists? A. There might be.

Q. So there might be a controversy between the Ascensionists and Lateral-secretionists in the Rossland district? A. There would have to be an entirely new kind of evidence here which has not yet been obtained as to the character of the mineral, the original primitive mineral contents of the rocks, if they have any.

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Q. Do you say that iron pyrites is not likely to have been erupted in this mass? A. I say that the iron pyrites that I have seen is secondary and local.

Q. And you have seen it in the Centre Star vein and in the mineral deposits of this neighborhood? A. Yes, sir.

Q. So that there is no primary set in the eruptive rock itself? A. I will say that to the best of my knowledge of the character and chemical constituents of rock, the nugites and the hornblendes—in other words, the ferromagnesian minerals which are to be found in eruptive rocks, have, on various occasions and by various analysts been found to contain a very minute quantity of various metals.

Q. That was found by Mr. Lindgren in the Ophir district, was it not? A. I have not read his paper on that, I regret to say. It is the regret of my life that I have not read it.

Q. Then you would say that this rock is so different from any other type which has been examined that it is impossible to infer an eruption with the mass of the mineral constituents of the vein? A. No, I would not. I should say, if I were asked to investigate the origin of this, I would investigate it.

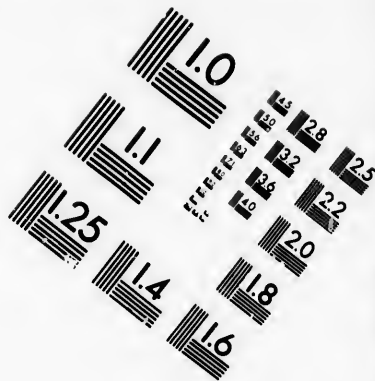
Q. You would say just at present that you do not know? A. I would say at present that I do not know, because in order to know it would be absolutely necessary to separate each of the constituents of this rock and subject it to chemical determination on a very large scale.

Q. But if you found that that had been done in other eruptive rocks, you would be comparatively safe in coming to the conclusion that what had prevailed elsewhere also prevailed here, Mr. King? A. I should not be warranted in assuming a local segregation out of the rock itself under any conditions represented by the present state here, absolutely not, because there are none of these widespread decompositions of rock which give ground and render possible such a theory of Mr. Emmens' theory of Leadville. He there had a body of enormously decomposed rock, out of which these solutions might have come possibly.

Q. Now, Mr. Emmens only reasoned from a particular instance to a general conclusion, didn't he? A. Which I think is the most unwarranted thing in science.

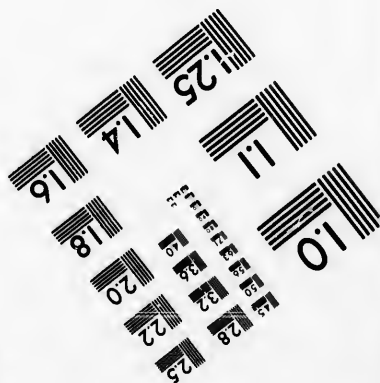
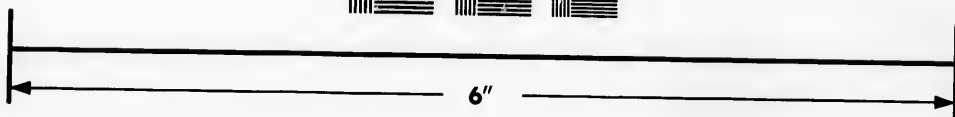
Q. That is your opinion? A. Yes, sir.





Resolution Test Chart Labels:

- 1.0
- 1.1
- 1.25
- 1.4
- 1.6
- 1.8
- 2.0
- 2.2
- 2.5
- 2.8
- 3.2
- 3.6
- 4.0



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Q. And I suppose Mr. Emmens has an entirely different opinion? A. I don't know whether he has been shaken by Prosephy.

Q. Mr. Prosephy is dead, is he not? A. Unfortunately.

The Court: Prosephy is an author? A. An author who died a few 5 years ago.

Q. I suppose, Mr. King, I may assume that you have not searched for conditions which would contradict the Ascensionists' theory with reference to this vein filling? A. I have looked over the country, wherever I have been 10 able to see the country rock, and in my former geological rambles over here, I have looked with a good deal of care to see if outside of the influence of any vein I ever could give cause to the pyrrhotite, and I never did, and pyrrhotite is the characteristic mineral of these veins.

Q. And pyrrhotite is a secondary product? A. Never. 15

Q. It is an original? A. It is an original product; it has never been made secondary, and its whole origin is a mystery.

Q. If you had found iron pyrites you would have found conditions upon which lateral-secretionists have based a theory? A. No lateral-secretionist 20 has ever proposed or ventured to propose a theory of obtaining pyrrhotite from iron pyrites.

Mr. Bodwell: No, I don't think that I said that. 25

The Witness: I mean, that is the position.

Q. I mean, if you find iron pyrites in the mass of the rock, of the eruptive 30 rock, you would find the conditions upon which the arguments of this kind have been based? A. I will answer that in my own way, if you please. If I find primarily iron pyrites in the rock, I should see the source from which secondary pyrites, or the oxidized product of pyrites could be found.

Q. You say you do not find them? A. I did not say that, sir. I 35 said I had never seen a grain of pyrrhotite out of the inflows of veins of fissures in this mass that I see here.

Q. And that is your reason, then, for applying the Ascensionist doctrine 40 to this vein filling? A. My reason is that I have seen no evidence that there was anything to laterally secrete from, or that the process has been attempted by any other formation, if these had failed.

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Q. And you would reach your conclusion because so far no one has demonstrated that the pyrrhotite would be formed in this way? A. Not only that, but after considering seriously the composition and character of pyrrhotite, I have never been able to conceive it possible.

5

Q. Will you say that the exact chain of chemical reaction by which mineral is precipitated from solution is known in any case? A. Some of them are very well known.

Q. Taking them as a rule, are they known? A. There is a great deal of mystery and a great deal of knowledge.

10

Q. So that that subject is open to a great deal of investigation? A. Yes, sir, but so far there is not an intimation anywhere that pyrrhotite can be made in a secondary manner.

15

Q. Has that subject been investigated? A. I never heard of its investigation.

Q. Has it been investigated in rock of the description that you find here? A. Probably not.

20

Q. Then until that investigation takes place, will you say that it is impossible that it can be so formed? A. I would not say that it is possible; I see absolutely no suggestion of any manner in which it can be done, and I would also say that pyrrhotite is the same pyrrhotite found in a cabinet shelf or in the War Eagle vein, and can be investigated just as well from a microscope from any place where found as here.

25

Q. This is not the investigation of the pyrrhotite, but the investigation of the conditions under which the eruptive mass was created? A. The first step on which to found a theory that the pyrrhotite in these veins is secondary and derived by lateral secretions from country rock is to show pyrrhotite as a primary constituent of the rock. Upon examination I can't find it to be in the single instance.

30

Q. Would you say that pyrrhotite can not be formed by some chemical reaction which as yet you do not know? A. Certainly, I would say frankly that the reaction by which it is formed I do not know, and I fancy that nobody else does yet.

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Q. The conditions which induce the precipitation of vein matter are heat and moisture and circulation, are they not? A. And often pressure.

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Q. And often pressure? A. Yes, sir, that has a great deal to do with it; also the introduction of oxygen and superficial waters.

Q. Yes, sulphides would be formed under the other condition? A. The other minerals like carbonates. 5

Q. Will you say that the pyrrhotite ore could not be formed in this rock? A. I simply say to the best of my knowledge it has not been.

Q. But you would not say that it could not be so? A. That it has been deposited in these veins is perfectly obvious; that it exists as a primary mineral in the rock far enough from veins or fissures to be able to base a safe conclusion that it is a primary constituent of the rock, that knowledge does not exist. 10

Q. Can you place the distance at which lateral-secretion must necessarily begin. A. With the experiments in the individual case, under pressure you can. 15

Q. Has it been done? A. I think probably not. 20

Q. Is not that one of the grounds of controversy between scientific men? A. In my mind that is entirely a secondary point. The first point is whether you have got anything to secrete from, and if you have not, hypothetical process will not give it. 25

Q. I understand you to say that you cannot find the conditions necessary to produce pyrrhotite from lateral secretion near enough to the veins or far enough from the veins in this place to found a conclusion? A. No, sir, that is not what I said. 30

Q. Let me understand you. A. I will try to make it clear. I have never been able to see pyrrhotite as a primary constituent in the unaltered region of this rock. 35

Q. Do you mean by "primary constituents" that it never could have been a part of the original magma? A. No, not at all.

Q. What do you mean? A. I mean that that is part of the objection. 40

Q. It never could have been a part of this ejected rock which is in this neighborhood? A. A primary part. So far as my observation warrants the conclusion, and they are, I should say, sufficient; I have looked very painfully and carefully for it and have never seen it.

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Q. Will you indicate the character of the observations that you have made? A. Walking over these hills to me it was a great puzzle when I first came here what the origin and source of the pyrrhotite was, and geologizing over these hills, whenever I could see a good exposure of rock, I have examined it to see what was in it, and I never yet found a piece of primitive pyrrhotite. 5

Q. I understand you to say that that could not be definitely ascertained without a chemical analysis? A. No, I did not say that.

Q. You do not say that? A. I did not say that. 10

Q. Do you say so? A. I say that chemical analysis would not show it; chemical analysis of the rock would not show it.

Q. Microscopic investigation would? A. Microscopic investigation 15 would show it as for the individual slide.

Q. How many slides have you examined, Mr. King? A. Not many, very few. The slides that I have examined I will say frankly was unaltered country rock. 20

Q. So that you never have examined a slide for the purpose of this investigation? A. No.

Q. You say chemical analysis would not help you to a conclusion at all? 25 A. No, sir, not in this rock.

Q. Why not in this rock? A. Because the ferro-magnesian minerals of which it is considerably composed, carry pyrrhotite, and the chemical analysis, if there were any pyrrhotite, that would be lost in and merged with the iron which is contained in the ferro-magnesian minerals, and could not be determined 30 separately under any chemical circumstances without the absolute isolation of the mineral itself for analysis.

Thereupon an adjournment was taken to 2:30 o'clock p. m.



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AFTERNOON SESSION.

2:30 o'clock, p.m.

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CLARENCE KING.

CROSS EXAMINATION RESUMED.

10

By Mr. Bodwell.—

Q. This body of rock is erupted, you say, Mr. King? A. I should say 15
so, yes, sir.

Q. In cooling, of course, that would form jointed planes? A. Not 20
necessarily at the region under consideration.

Q. Not necessarily? A. No, not necessarily.

Q. It is a characteristic of the cooling of eruptive rock, is it, that you find 25
jointing planes? A. In regions near the surface, but the evidence as to
how much has been worn off of this country is not good, or the question has
not been worked off.

Q. Do I understand you that there is nothing to indicate a series of 30
breaks which would correspond to joint formations in this rock? A. Yes,
sir, but they may not be the joints due to the cooling of an eruptive mass, but
to the straining after cooling of an eruptive mass.

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Q. Yes, but you can't say that it would not be the jointing due to shrinking in cooling, can you? A. Not definitely, no.

Q. At least the conditions that you find would be consistent with that, a kind of fissuring, or jointing, or whatever the proper term is, would be consistent with the shrinkage cracks produced by cooling? A. Not all of them by any means; there are certain of them it might be possible which would rank as jointing planes, contracting joints. 5

Q. Part of them might rank as a vein? A. Yes, sir. 10

The Court: What are jointing planes, Mr. Bodwell?

Mr. Bodwell: When the rock cools it splits and those planes break sometimes nearly at right angles to each other. 15

Q. Don't they, Mr. King? A. Yes.

Q. Sometimes they form almost perfect rhombs; that is true? A. Quite true. 20

Q. And they reproduce themselves very often throughout a rocky district, these planes? A. For considerable distance.

Q. Then you have the shear-zone, a shearing course, perhaps, is a better way to express it? A. Yes. 25

Q. I understood you to illustrate that by saying that there was a compressive force coming in two directions or from two sides? A. From two sides primarily. 30

Q. And producing thereby a movement of the rock upon itself? A. Either way, without a tertiary disturbance.

Q. A familiar illustration is to take a pack of cards and move them between your hands to illustrate shearing? A. That would illustrate it. 35

The Court: I understood that would apply to sheeting.

The Witness: That is the same as shearing, your Lordship. 40

Q. Sheeting is rather the physical effect that you see, the planes that you see running parallel with the movement of the rock upon itself; that produces sheeting, doesn't it? A. Also, shearing; they are interchangeable.

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Q. Now, the last expression of a force of that kind would be to close the cracks up, would it not, Mr. King? A. Or initially to prevent its opening to any considerable extent.

Q. Would you find as a result of that also other fissures breaking off at angles to the general line of sheeting? A. Very frequently at right angles to the planes of sheeting or shearing.

Q. Have you noticed that here with reference to this particular zone? A. I have not been able to absolutely correlate any sets of fissures here.

Q. Did you fix in any way the comparative age of this shearing? A. With other planes?

Q. Yes. A. I do in certain instances.

Q. Did you fix the comparative age with reference to the vertical faults which are found here? A. The vertical faults I think are all subsequent; they are all subsequent. All that I have seen. There may be others I have not seen. Pardon me if I correct myself. Outside of the mines there are very large dykes which belong to the general magma of the region and may have preceded even, but I have not seen them in contact and cannot define —

Q. My question related to the vertical dykes which are seen particularly in this disputed territory.

Q. And you would put them younger than the shearing zone? A. Younger than the shearing zone.

Q. Did I use the right word for that? A. Yes.

Q. Have you noticed a system of terraces on Red Mountain, Mr. King? A. I have noticed on the lower slope of Red Mountain, there is a series of what may be called terraces, or fault terraces, not very far from, I think, the Josie ravine.

Q. Would you say that they indicate step faulting upon that? A. I would.

Q. Have you noticed that the plane of the flat fault appears to be coincident with the faulting plane of those step faults? A. No, sir, quite the contrary. There are some secondary planes there that might be related. But the primary planes there are, in my opinion, practically with the axis, parallel to the axis of Josie gulch, and are steep planes.

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Q. Have you made any examination of the Nickel Plate mine? A. I have not.

Q. You do not know whether faulting planes are found there? A. I do not. 5

Q. Do you find this flat fault to be a fissure of considerable extent? A. I do.

Q. Nearly as persistent as the veins? A. I haven't any evidence of its existence west of the great north and south fault, as it is called, nor east of the south crosscut. 10

Q. You do find it to be persistent fissure in the middle ground practically, in dispute in this controversy? A. I do. 15

Q. Say along here? A. I do.

Q. If you found on further examination that there were facts which would indicate an opening fissure partly filled with mineral, then a subsequent lateral pressure of considerable extent causing the ground between to rise and fold until the limits of cohesion were reached and a break occurred, would that give the flat fault any more importance in your eyes than it possesses now? A. I don't know that I understand; kindly read the question. 20

Q. (The question was read) A. I do not quite understand the statement of fact, but so far as I do understand it, it would not give it any further importance. 25

Q. Is your idea—because I understood this from your evidence—is it your idea that the flat fault is a break created by a superincumbent load? A. I do not think I can tell exactly what caused the fissure. 30

Q. Could a fissure like that be caused by an upthrust from below? A. It is quite in harmony with many of what are known as over thrust faults. 35

Q. You think the veins are older than the faults? A. Than the flat faults?

Q. Older than the vertical? A. Older than most of the verticals—the verticals I have seen. 40

Q. Well, the strong vertical you have described coming down the incline shaft cutting north and southwest of incline No. 3? A. I do think they are older than that.



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Q. Do you think the veins are older than the fault which you described in the north drift of No. 3 raise? A. I do. That is a dyke fault, or fault in connections with a dyke.

Q. I suppose that means a faulting plane afterwards filled with intrusive matter. A. No, not this case, which is a double dyke, and the fault is between the two. 5

Q. Have you noticed any other fault further to the east still near the mouth of the Iron Mask tunnel? A. I have not studied anything there. 10

Q. You never studied that? A. No.

Q. If you found in the workings of the Iron Mask vein or in the veins of that vicinity structural conditions which are parallel to the lines of the faulting described by the vertical fault, would that indicate that the veins were older or younger than the vertical faults? A. That could only be told by their actual compacts. 15

Q. I believe you have found evidence of replacement in the vein matter here? A. I have found evidence that leads me to consider them as replacement. 20

Q. Naturally, then, if there were structural conditions created by the vertical fault, would you expect to find those conditions repeated in the minerals which replaced the original rock? A. Not if, as I believe, the vertical fault is entirely subsequent to and has had nothing to do with the filling of those veins or the initial deposition of mineral. 25

Q. Then that condition would not be consistent with the idea of the vein being older than the vertical fault? A. Oh, no. 30

Q. These vertical faults occupy planes of considerable importance, do they not, Mr. King? A. You mean those that are seen here? 35

Q. Yes. A. One of them is of extreme importance, the great one.

Q. And if it cut across the country after the shear-zone was formed it would naturally have considerable effect upon these original fissures in the shear-zone? Do I make myself plain? A. Yes, I understand. I do not know that it would have any great effect, the mere cutting of the dyke; but what would happen subsequently, if I may judge—or what has happened subsequently in this case—has had a very great effect on the whole neighborhood. 40

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The Court: Do you mean cut off the dyke or cut by the dyke? A. When the dyke has cut those veins.

The Court: Cutting by the dyke? A. Yes, cutting by the dyke; the actual cutting, the sectioning by the dyke itself may not have caused any very great disturbance other than slight displacements. But the chemical effects due to the re-opening of the ground here are at present a very important feature. 5

Q. Would not that fault plane be naturally caused by a compressive force cutting the same from the west to the east, or from the east to the west? 10
A. The fault plane?

Q. Yes. A. No, sir.

Q. How, in your opinion, would it be formed? A. It would be formed by direct uplift. It would be formed by compressive stress which would open the vein to permit the injection of melted lava. It must have been necessarily opened for the admission of melted matter. 15

Q. Might not that be said with reference to any fault plane? Must you always have an upheaval force for a fault plane? A. For a vertical fault, yes. 20

Q. Is there not authority the other way, Mr. King? A. There is, but I should qualify. That vertical fault may be made by the meeting of two opposing horizontal forces, but that would not make an open fissure. 25

* Q. No, but when you once have the country slipping down, would there not be a recessional movement and an open fissure then? A. Not necessarily, not so long as there is any compressive stress. 30

Q. It is possible, Mr. King? A. It is possible.

Q. Even if you had an uplifting force there? A. Pardon me a moment to finish my former answer. In any fault or fissure which contains injected melted volcanic matter the forces at the time of injection must have been such as to open this, as to leave it open, and no sliding and no compression would affect that. 35

Q. Do I understand that opening would be created at the time of the intrusion of the igneous matter, the melted matter? A. Often it would have been kept open until it had had an eruption. 40

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Q. It might have been opened before. A. It might have been a line of former fracture.

Q. And then there might have been some other force which opened it wider. A. Yes, but it would have been again a vertical force. 5

Q. Necessarily an uplifting force? A. Necessarily an uplifting force to open it. You can form a fissure perfectly well by the action of two opposed, horizontal forces, but you cannot form an open fissure by that force.

Q. Do not we find diagrams showing that it can be done, in geological looks? A. I do not remember a diagram of that sort. 10

Q. That is your opinion, at any rate? A. That is my opinion.

Q. And would not that force, even if it were an uplifting force, have a compressive action upon the fissures that have already been created in a shear-zone? A. It would not have any effect at all on them. 15

Q. You cannot say that it would not, though? A. It depends upon the line of action, and the position of the shear-zone, and various other conditions. 20

Q. Having here a shear-zone tightly pressing together, and the uplifting forces sufficient to allow the intrusion of this igneous matter—I don't know whether that is the right word or not—— A. That is the right word. 25

Q. (Continued.) This igneous matter and which line may also have been a line of fracture created by some other movement, don't you think the tendency would have been to open these other fissures which were created? A. Very likely not at all. The directions do not suggest any effect of opening. The dykes I have seen are approximately to a north and south direction. The shear-zone I have seen approximates to an east and west direction. In traversing that the only opening effect it could possibly have to my mind would be directly at the points of contact, points of intersection. 30

Q. You have found veins here, Mr. King (referring to the model), in the War Eagle No. 30 west drift? A. I did not visit that drift; I did not go there. 35

Q. Have you been over to station 111 on this higher level? A. I have.

Q. Found a vein there? A. Yes, what I should take to be the evidences of a vein, though I did not examine it carefully; I went in there casually. 40



Q. And on the Iron Mask north drift? A. I know the drift you mean.

Q. Yes, but I want to get it on the notes. A. It is simply called Iron Mask drift.

Q. Well, on the Iron Mask drift? A. Well, I could not remember 5
as to that. That is from 34 to 48. I have visited that without any careful
examination, understanding that the main points of interest were east of the
dyke.

Q. Have you found a vein near station 42 on Iron Mask tunnel? A. 10
I have not been there.

Q. And I understand you to say that you have seen the continuation of
some vein in No. 4 crosscut from the Centre Star No. 2 tunnel. A. The 15
No. 1 crosscut.

Q. Yes, No. 1 crosscut. A. No. 1 south crosscut, the little drift
westward from that is a vein.

Q. And of course you know of the main vein of the Centre Star? A. 20
Yes, have casually looked at it.

Q. Now, do you assign all of these veins to one geological period? A.
I do not at all know. I have only made the most casual examination of any 25
others than the two.

Q. Will you place the north and south limits of the shear-zone in which
the Centre Star vein is said to be? A. No, because I do not know but what
it may continue a mile beyond here; I do not know. 30

Q. It is a compressive force cutting from south to north and from north
to south, is it not, Mr. King?

Mr. Davis: Mr. Bodwell stated in his previous question the north and 35
south limits, Mr. King, and I think you took it as east and west limits.

A. (To Mr. Bodwell) As you indicated I thought it was meant east and
west. 40

Q. I mean the limits in this way, first from where that compressive force
begins, first expresses itself on that side, on the north side. Do you assign any

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limits to that? A. I have no limits because I have no knowledge at all to what depth the vein may go.

Q. Have you any opinion as to the limits on the south side? Does your answer also apply to the south side? A. There again there are no cross-
cunts to fix the bounding plane. 5

Q. Wouldn't it be quite consistent with your evidence that all the veins within the limits fixed by the north side line of the Iron Mask and a line south of the Centre Star main vein, were created by one dynamic force of nature
operating at one geological period? A. I have no evidence to warrant either
the conclusion or the denial of that. 10

Q. I asked you, Mr. King, if that statement would not be consistent with
the evidence which you have given up to date. A. No, because the evidence
I have given up to date does not relate to points which are distant enough to
limit. 15

Q. But you do say that you have not found, or that you cannot be sure
that you have found the ultimate wall of the shear-zone in which the Centre
Star vein is contained? A. I do. 20

Q. What are the physical conditions which lead you to the conclusion that
there is a shear-zone at the exact point where you start the Centre Star vein down
the incline? I take that simply as an illustrative point. A. I did not form
the conception of a shear-zone at that point; it was a conception built up— 25

Q. Do you take the limits of inclination there and in the mine to fix
the scope of your observation? A. The close observations are limited by the
north and south dyke here, the main north and south fault and the drift in the
south crosscut. 30
35

Q. May I ask just what were the physical conditions upon which you
base your conclusion? A. In the overlying companion plane, in this shaft,
in the two overlying companion planes, in the end of the south crosscut from
the Iron Mask stope, in the bottom level—the crosscut south from the bottom
level, and in the Centre Star winze below 59 drift. 40

Q. Isn't it likely, then, that the same forces which created that would be
operating on any mineral which is exposed, say at station 111? A. That
would depend on a great number of conditions which I do not know.

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Q. Do you know of any fact which makes it impossible that that condition of things should exist? A. I have not facts enough for a conclusion either way.

Q. If all these ore bodies between the limits I have stated, were in one shear-zone, wouldn't it be possible to one having a knowledge of the creative forces at work there, to follow from the Centre Star main vein to the Iron Mask north vein cleavage planes or stringers or other indications which would eventually lead him to an ore body which he might work? A. I think it would be a happy accident of it were so, but I have no criterion for judging.

Q. Couldn't you start on one point you have called the correlative planes going down the incline shaft, having the dip and direction of that plane which is exposed there, and land yourself as far north as the most northerly ore body in the Iron Mask vein? A. I have seen no planes there which would correlate with those. If there were planes there I think I would have seen them; but there may be planes there which the condition of the drift prevented me from seeing.

Q. Mr. King, I am told that the planes of that incline shaft come up roughly in some way like the shingles on the roof of a house, but not with the same regularity; that they dip in all directions; that they run in all directions, have strike in different directions, and that if you assigned any one of them as the bounding plane of the zone and followed it you would get over here almost at another place? A. Whoever gave you that information was not a good observer. Let me finish that. Whoever gave you that information was not a good observer, because while a very large number of fracture planes due to blasting and mining are in view, and a few conflicting structure planes are also in view, there is overlying parallel to the upper bounding plane of the ore a distinct parallel fracture or fissure which is the only one that I have included as a correlative plane.

Q. And will you place the distance between the wall which includes the ore, and that correlative plane, at from two to three feet? A. I did not measure it; I should say about that. I did not measure it.

Q. What is the greatest width that you give of the Centre Star vein at any point at which you have observed it above the fissure point we call the flat fault? A. Fourteen feet. But at that point I have not seen any crosscut into the foot country to demonstrate whether it might not be wider there. That point, if you desire to know, is the south end of the crosscut from the Iron Mask stope.

Q. That is about half way up in vertical height to the top of the ground?
A. Forty per cent., perhaps.

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Q. And there are no indications there that the vein is narrowing in width?

A. As it goes upward or downward?

Q. As it goes upward. So would you expect to find it about the same width as the surface? A. If the surface were to be cut down and freed from the oxidized matter and crosscut properly I should expect to find those two planes or their produced sequence somewhere near the surface. 5

The Court: Is that crosscut No. 67?

Mr. Davis: That is the brown crosscut. 10

The Court: You ought to distinguish it that way then, because I have to read this evidence afterwards.

Q. Can you give me approximately the dip of the Centre Star main vein? 15

A. It varies, I should say, from about 38 to 56.

Q. That is the No. 2 vein you are speaking of. I mean the vein shown in the Centre Star main workings, the main vein of the Centre Star. A. Oh, I beg your pardon. No, I know nothing of that at all. 20

Q. It would be at least 60 degrees if that white upraise shown at number 10 indicates its dip. A. I should think probably. I know nothing of it. 25

Q. Can you tell me anything about the vein in 157 east drift, about its dip? A. It is very obscure; I should think, I should fancy about 60 degrees. This is an estimate from memory. I made no note. 30

Mr. Bodwell: That point is on War Eagle ground. 30

Q. And the vein in No. 30 west drift. A. I never examined it.

Q. It appears to be here over 60 degrees according to the white upraise at No. 1 raise on that drift. A. I don't know that it is on a vein at all; I have not been there at all. 35

Q. What you call the Iron Mask vein you do know its dip is 60 and over? A. Sixty and over. It is about an average I should think of 68 so far as I can see. 40

Q. I suppose you don't know the dip of the vein exposed at station 111?

A. I do not.



Q. The vein at Centre Star north level, being station 56, the vein here taking a midway point? A. It has about 56 degrees dip.

Q. The vein as shown in the Iron Mask No. 69 east drift is over 60 also?
A. I should say 68. 5

Q. And also the vein as shown in Iron Mask No. 1 winze all the way down, the continuation of that vein? A. If I am right in identifying it, yes, it has about that dip. (Having reference to station 69 to 70.) 10

Q. Do you know what the general dip of the main Le Roi vein is, Mr. King? A. I have visited the Le Roi, but it was years ago and I have no data. It has rather a high dip to the north. 15

Q. And the War Eagle main workings, taking the average dip of the War Eagle? A. I could not give it. 15

Q. Have you any reason to think it has a flatter dip than the other main veins in this district? A. I could not answer. 20

Q. Then the Centre Star vein in this section has a dip of 45 degrees?
A. From 30 to 56 degrees. 25

Q. Would you average the dip at all? A. No, the reason I would not average the dip is that the strike from a little east of 49 to 53 and onward into the country is not the strike of the vein at No. 2 upraise; but represents in my belief the curve coincident with the curve of the outcrop as defined westward from the collar of Centre Star shaft No. 2. 30

Q. While we are on that point, you have mentioned curve; if this green drift No. 59 east drift, were continued on its course to a point opposite No. 2 incline shaft, I suppose you do not know what the distance between the No. 2 and that point would be (referring to the large model)? A. (Referring to the large map) What is the question now? 35

Q. Supposing you take the green drift as showing the course of the vein, and project that line to a point opposite the No. 2 shaft, say at 56? A. I 40 should have departed from the course of the drift.

Q. Yes, but I say extending the drift in its course. A. I am doing that (making measurements on the large map).



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Q. Now can you give the distance between the foot of No. 2 incline and the point you have reached? A. They would be coincident—oh, you say No. 2 incline?

Q. Yes, how far to the north of the foot of No. 2 incline would you be? A. About 10 feet north of station 56, or 16 or 17 feet from the actual foot of No. 2.

Q. You described the ore coming down in No. 2 incline, Mr. King. A. I did. 10

Q. As reaching a point where it encountered a peculiar kind of rock? A. I did.

Q. Am I right in saying that that rock is found up at the incline for about 70 feet? A. About 70, a little more than 70 feet. 15

Q. And the reason you say the vein finds its way through there is that going through that rock you find small seams of ore at distances of, say 4 or 5 or 8 or 10 feet apart. A. No such intervals as that. 20

Q. Not more than 4 or 5 feet apart? A. Not more than 3 feet.

Q. I suppose you assume that the work on the incline shaft has been done from the top to the bottom, following ore? A. It followed a vein to the point where it meets—a distinct vein, a well-characterized fissure vein—to a point where it meets the top of this intruded body of rock. 25

Q. But you assumed that the work on the incline had been done from the top to the bottom, did you? A. Historically I did not know anything about it; I only knew that my examination was that way. 30

Q. Would it make any difference in your opinion if you know that the work was begun on the north level and continued to this raise for a certain distance, then extended on this crosscut for a certain distance, until a seam was reached coming down that way, then the work was continued up to the top of No. 4 raise until another seam was encountered cutting off in a southerly direction, and then the crosscut was extended to the south until it met that, and then there was underhand stoping on that work in order to make the connection up the incline. Would that suggest any different ideas to you—the description of work performed in that way? A. It would not create any different opinion in my mind as to the connection of the vein in the upper part of No. 2 incline 35 40

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with that displayed in the drift below, provided the exposure of the ore, the vein and bounding wall with its dip and strike was exposed then as now.

Q. But would the obliteration of the existence of these several seams 5 running in the direction I have spoken of in that No. 4 upraise create any different impression? I mean to say the absence of these physical facts, would it affect your judgment in any way about this continuation of ore. I don't think I have expressed myself very clearly, but suppose you cut off the evidence of how this seam dipped across the top, and you cut off the evidence of how the 10 seam came up from above. And then all work indicated in the incline or in the shaft should correspond to the continuous course of ore. If you knew of the existence of these things, would it make any difference in your opinion as to the continuity of the vein coming down the incline? A. Not if I could see as I now can the thorough tracing of the vein from point No. 15 east of 49 to 15 53, knowing the dip and strike it has.

Q. I understood you to say yesterday, referring to upraise No. 2, that you found there ore which might be the Centre Star vein or it might be ore coming up from some other vein and meeting the Centre Star vein at that point? A. 20 No, sir, that applied to upraise No. 4.

Q. Yes, upraise No. 4. A. Yes, which is there (indicating on the model).

Q. Then can you be sure, Mr. King, that the ore which comes down here does not belong to some other vein than the vein which is seen up above? A. 25 I think I can, that is to say, I think there is opening enough and work enough done to show that there is no other vein which would count from the appearance about that point.

Q. But if there are indications here which lead you in the bottom of No. 4 to the conclusion that there may be another vein coming up there, can you say on which one of these veins the work on the Centre Star incline is done up to a point which corresponds with the top of this first upraise? A. I should say 35 unhesitatingly that it went upward and corresponded with the 56 dip and plane which occupies the level.

Q. And you find this vein in the No. 2 incline pinched out to a very small point and practically disappearing above the mud-seam? A. The disappear- 40 ing point of the formal vein, the formal part of the vein, is about 45 or 50 feet above the mud-seam.

Q. And then it makes its way through this very tough rock that you describe. A. Yes, sir.

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Q. But when it reaches the mud-seam in the Centre Star winze, you discovered its continuity by planes underneath the mud-seam. A. I did.

Q. Would not ore—would not a vein—strong enough and persistent enough to make its way through 70 feet of the class of rock you described in the No. 2 tunnel, cut across the mud-seam in the Centre Star winze with great force? A. I don't quite understand.

Q. As I understand the conditions, as you go down the Centre Star winze to the top of the mud-seam you find a considerable body of ore? A. Yes.

Q. When you get across the end of the mud-seam you find very little ore. A. On the contrary, I find the ore quite as strong as it is above.

Q. Underneath the mud-seam in the Centre Star? A. Underneath the mud-seam in the Centre Star winze.

Q. I understood you to say yesterday that you traced the continuity of that ore through the mud-seam by planes which you found underneath the mud-seam corresponding with planes above the mud-seam. A. That was only a correlative part of the proof. The main proof is that the ore is absolutely continuous above and below the mud-seam with the exception of the mere line of surface.

Q. And the same in quantity? A. I should say, if anything, there appears to be more below than above.

Q. And lying in the same direction? A. Lying so far as can be seen in the same direction.

Q. Bounded by the same planes? A. Bounded by the same planes.

Q. Although you did find in the bottom of that mud-seam a great deal of jointing and planes running in different directions? A. I found chiefly attrition matter about, occupying at a maximum two feet.

Q. How far down below the mud-seam did you give this continuity of ore so far as you have seen it? Does it go as far as you see? A. It goes as far as you can see; the absolute bottom of the winze is in ore.

Q. Corresponding in quantity, corresponding in dip, corresponding in strike to the ore above? A. As to the dip, it is defined below only by this plane which is its bounding plane.

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Q. Then that ore lies in planes which do not correspond with the planes which lie above the mud-seam? A. On the contrary, it does.

Q. Then it has a corresponding dip below the mud-seam to what it has above the mud-seam? A. So far as the evidence goes it has. 5

Q. That extends over the whole of the bottom of the winze? A. Practically over the whole of the bottom of the winze.

Q. You traced it there through the bar to the ore? A. I traced it through the dyke to the east, beyond the dyke to the east. 10

Q. Will you say that you did not find beyond the dyke to the east, or beyond the first evidence of the dyke to the east a white colored, probably silicious structure of rock extending in planes parallel to the first planes which you see east of the dyke itself. A. I see a calcite seam on the west side of the dyke, I see a little calcite on the east side of the dyke, I see ore beyond the dyke and beyond the seam which is the easterly boundary of the dyke. 15 20

Q. Do you say that the ore there lies in planes which correspond to the planes in which the ore lies above the mud-seam? A. I say that the development done does not permit the tracing of the observed planes.

Q. Will you say that the ore does not lie in planes which correspond with the planes of the dyke? A. There is very little opening in which you can see this ore beyond and its structure is not perfectly legible, but there it is; there it is, to the east of the dyke. 25

Q. You will not say that it does not lie in planes which correspond with the plane of the dyke? A. I will say that in 99 out of 100 elements of geological probability are in favor of its dip with the Centre Star. 30

Q. Well, Mr. King, you cannot give me an answer from your observation at that point? A. I can, sir. 35

Q. You can say whether it does or does not? A. I cannot say whether it does or does not, because there is a very small amount of work and opening to the east of the dyke. 40

Q. Will you say there is no ore in the bottom of the winze below the mud-seam which does not lie in planes corresponding to the planes of the dyke? A. I will say that both above and below the flat fault there is a widening of

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the ore which takes place a few feet above the mud-seam, and that that widening proceeds deeper into the foot wall—considerably deeper into the foot wall; that the ore in the bottom of the winze is, in my belief, the severed continuance of that ore.

Q. Well, Mr. King, I do not look upon that as an answer to my question. I asked you for this simply, whether you will say that there is no ore in the bottom of the winze lying in planes which are parallel with the planes of the dyke? A. I have seen no ore there whatever that indicates a north and south vertical structure; none whatever.

Q. Still you have not answered my question. A. Well, I have seen no ore, if you prefer it, which seems to me to coincide in structural lines with the dyke.

Q. I do not think you have answered my question yet. A. Then I misunderstand it.

Q. Does it lie in planes which correspond to the planes of the dyke? A. I have never seen any; never.

Q. You mentioned yesterday, Mr. King, that you traced the ore in the Centre Star north drift from station 48 (referring to the model) eastward—
A. Westward.

Q. Yes, westward, and that that ore, in your opinion, belonged to the Iron Mask vein? A. I did.

Q. Do you know, Mr. King, that that is in opposition to the contention which has been made up to date of this trial on behalf of the Centre Star? A. I heard that only the other day.

Q. That that was always claimed to be the Centre Star vein? A. I only learned that the other day.

Q. You say that that ore leaves the tunnel, I think, at a point about station 42, does it not? A. A little east of 42—Oh, no, a little east of 41, between 41 and 42.

Q. Leaves the tunnel at the north?

The Court: But does it intersect it? A. No, it passes out of it.

Q. Now, you find ore, don't you, proceeding from that point towards the point 39? A. I do.

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Q. Do you give any name to that ore? A. I do.

Q. What do you call it? A. There is a parallel ore body lying to the south and parallel with the Centre Star, and in my opinion, very likely to hereafter be structurally connected with it.

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Q. Then is it possible that there are fractures breaking back behind the Centre Star vein which may be mineralized? A. At that point there is a parallel fracture.

Q. Well, if at that point, may there not be also further south another fracture plane? A. There may be.

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Q. And further south still another fracture plane? A. I should never form a limit until the country had been thoroughly cross-cut.

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Q. Each one reaching the surface? A. Or not, as the case may be.

Q. Going below the flat fault or not, as the case may be? A. Going below the flat fault or not, as the case may be. I should never, in other words, say that any fissure at the surface, penetrated anything at great depth.

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Q. Mr. King, with all of these veins following in this immediate neighborhood—assuming that I am correct in saying that there are other veins here, and knowing that the Centre Star vein was formed by a shearing force, would not the natural tendency be to crack and fissure the rock in various directions, some fissures parallel to those shearing zones and some at right angles to them in the immediate neighborhood? A. That depends entirely upon the character and extent of the stress. There is always a limit to shearing strain; it is sometimes a very far-off limit. You can never fix that limit until you have the data.

25

Q. Assuming for the purpose of this question, that I have a vein here at the Iron Mask 69 drift caused by a shearing force, that I have another vein out here at station 111, that I have another vein on the No. 30 west drift, and assuming that they are all formed by shearing stress, is it possible or not that the country between No. 30 west drift and No. 69 Iron Mask east drift would be fractured and broken in fissures parallel to the general course of those veins? A. It might or it might not.

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Q. I asked you if it was probable? A. I can only say that in my experience shear-zones extend from a mile perhaps in width to 10 feet or 5 feet or 1 foot in width, but that a shear-zone has somewhere its definite limits of min-

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eralization; it can only be fixed by actual examination of cross-cutting, and that there might be a number of parallel shear-zone veins which are perfectly independent.

Q. That might be the case, or it might be that the force which created them would create sub-fractures between them? A. Very frequently it does. 5

Q. In the majority of instances does it not, Mr. King? A. I think not. I think that the stress which makes those is not the one which in usual makes the interior and divergent fissures, but some other stress. 10

Q. You differ from the authorities, again, Mr. King? A. I am sorry.

Q. For the authorities? A. Yes, sir. 15

Q. Tracing the vein in the Centre Star north drift back to the eastward from the point where it leaves the tunnel, east of station 41, going back to the east until you reach the No. 3 raise, I believe you follow the vein, the ore, or the fracture of the ore, to that point without any trouble? A. I do. 20

Q. Then over to the east of that at station 43, would that be? A. Near station 43. 25

Q. You find the vein again, or the vein formation again? A. The vein formation again. 30

Q. This is to the north about how many feet? A. About 10 feet, I should say.

Q. About 10 feet to the north? A. Eight or ten feet. 35

Q. Did I understand you to say that you find the flat fault displaced by that same vertical—on the Iron Mask tunnel at or near station "X"? A. I did. 40

Q. Well, did you say, or did you mean to say, that that had faulted the flat fault to the south about 8 or 10 feet. A. I did. 45

Q. The vein being older than the fault, would not the faulting on that develop off in the north, Mr. King? A. No, sir.

Q. Would not the movement which sent the flat fault to the south have sent the vein also to the south? A. Not necessarily at all. 50

Q. Will you kindly explain that? A. With pleasure. (Illustrates on blackboard.) The flat fault we will say, descends at that angle (illustrating)

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which is, we will say, 30 degrees; the Iron Mask descends at that angle (illustrating). This diagram is supposed to be upon the planes of the fault, and the fault is supposed to be the plane of the blackboard. Now, if the displacement was simply a horizontal one above this vein, and that vein would be displaced in the same sense as it is called, that is, both would go either north or south, according to the horizontal plane of dislocation, but if on the contrary, the dislocation was this plane (illustrating), was a vertical one, or one approaching the vertical, and if the east side rose as regards the other one, the section "V" could be lifted up to that point (illustrating) and when you came to your station would be lifted up above this "V," above this intersection, so that you would find your Iron Mask to the north and your flat fault to the south.

Q. Did I get the amount of this displacement to the north? Ten feet, I think you said? A. Each of them is about 10 feet, and it is perfectly possible for a nearly perpendicular uplift to move a section which lies to the east, relative to the section which lies to the west, so that the fault on each one would be 10 feet.

Q. How far down, Mr. King, do you give the distance of the continuation of the ore in the No. 3 incline below the flat fault? A. In the body, as the dump body opened at the bottom of the shaft, I gave five feet.

Q. In your examination of the samples, Mr. King, you constantly used the words "country rock." Will you tell us exactly what you mean by that term in that connection? A. At the time I limited it to a general statement that it was not metallic mineral and was originally the country rock. To what extent it has been altered into vein matter I could not tell without detailed examination.

Q. Well, then, in using the word in your answers you were referring to altered country rock, were you? A. Altered or unaltered, I did not stop to examine it.

Q. You did not give it enough examination to know whether it was vein matter or not? A. The rock?

Q. Yes. A. In most cases not.

Q. You were not attempting then, any distinction between one part of the country rock and the other created by alteration without mineralization? A. I was not. I was simply distinguishing it from the pyrrhotite and chalcopyrite.

Q. I think you said that the Le Roi vein was in some places 40 feet wide and that it narrowed as it went to the westward? A. That was my memory; I visited it some time ago.

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Q. And that your observation of the Iron Mask vein was that it broadened as it approached the dyke? A. No, sir. I said distinctly that it narrowed into contact with the dyke, or it has not quite come in contact with the dyke but at the nearest point.

Q. I may have misunderstood you, but I thought you were referring to the eastward and westward course of the Iron Mask vein? A. Well, I did say from point 105 to 106 it widened until the ore was $2\frac{1}{2}$ to 3 feet thick, and then narrowed again toward the dyke.

Q. Will you compare the dyke at No. 3 raise with the dyke which you find at the No. 3 incline, stating in what points they resemble each other and in what points they differ? A. The intrusion at No. 3 upraise is a dyke in general parallel to the compound dyke course from 48 to 49; it consists, where shewn at the point "X," of two distinct dykes lying side by side; the most western of those two dykes is an extremely fine-grained gray rock, with no visible mineral crystals, at least no mineral crystals visible to the naked eye. The companion dyke, lying to the east of it, is a coarse mica-bearing dyke. At the point of upraise 3 there is a great deal of decomposition; the dyke is much softened, the country rock a good deal softened, and it is sometimes difficult to distinguish the dyke from the country rock, but by careful picking there we found what we concluded to be—I found what I concluded to be the continuation of this dyke. The great dyke system which courses from 47 to 49 consists of two parallel dykes whose exterior walls cover an interval of about 30 feet or 25 feet; the east compounding dyke must be 10 or 12 feet in thickness, the west compounding dyke a little less; between the two is a mass of country rock, enormously altered, very much crushed and compressed, and marked by a vertical fissure, or a very nearly vertical fissure, lying between the two dykes, which fissure at 47, or at a point very near 47, has dislocated the flat fault.

The Court: Now the last dyke you are describing—just so I will understand it hereafter—is the dyke to the west of No. 3 incline shaft? A. Exactly.

Mr. Davis: Now this 47 you mean is 47 on the red level, is it not? A. It is 47 on the red level.

Q. Will you give the comparative width on a level. You had better give it on the level of the Centre Star north drift, if you can, so we will have the width on the same level at two places. Can you give that, Mr. King? A. I have made no note of the width, but I should judge the combined width of the two dykes, as I figured there, is about five feet.

Q. At the No. 3 raise? A. No, sir; at the point "X" which is here (indicating on large map).

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Q. But how far would you say the parallelism of fissuring extends beyond the dyke mass? A. I am inclined to think that they have diverted slightly or else that the country between—I am inclined to think they are not seen in contact at No. 3 raise. There appears to me to have been a little divergence, but the decomposition is such it was impossible for me to determine exactly. 5

Q. How did you give the width of the dyke at No. 3 incline on that level?
A. Taking the whole system?

Q. Yes. A. I should say 25 feet; but that consists also of two compounding dykes and—— 10

Q. Can you give the width of the intruded matter? A. I should say perhaps 10 or 12 feet. 15

Q. In the aggregate? A. I cannot remember exactly.

Q. Now with reference to the outcrop, Mr. King; did you take the direction of the ore shown in the trench for the first 60 feet, say from the No. 2 incline? A. I took no compass-bearing of it, but I saw its relation to the outcrop beyond. 20

Q. Then it will not be any use to ask you as to directions and indications of ore along that outcrop with reference to making a section or a plan of it?
A. No; I could not say—— 25

Q. You would not have any information of that kind? A. No; I would not have any information of that kind.

Q. Taking a direction off to the south from No. 2 incline, did you examine the ground with reference to evidence of outcrop—in this direction, out to the south? A. I did not. I saw one pit that had been opened, I should judge, 40 or 50 feet, practically eastward, from there. 30

Q. Yes, I was going to ask you about that. But you did not come off in this southerly direction? A. Yes—well this direction (indicating). 35

Q. You went to the east and found a pit? A. I found a pit.

Q. Did you take notice of the direction in which the fracture planes across that pit seemed to run? A. I did, but they seemed to me to be very conflicting. You are perhaps asking me about another one that is here (indicating). 40

Q. No, the one over in this direction from that incline (indicating)? A. There is one up here (indicating).

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Q. Yes, but I did not ask you about that? A. This was being opened when I saw it and I never paid much attention to it.

Q. You did not notice that other pits were being opened down the hill here (indicating)? A. I saw they were working there, and requested that when anything interesting was opened up that I should be asked to see it. 5

Q. And you were not invited? A. I don't know whether I was invited or not. I think I was, but I did not go.

Q. You did not go? A. No. 10

Q. You found an opening to the north of No. 2 shaft? A. I did.

Q. About how far to the north? A. I should estimate about 40 feet.

Q. What was the length, approximately, of that opening? A. Thirty or 40 feet, perhaps more, perhaps 50. 15

The Court: Let me ask Mr. King a question. Mr. King, they are using the word, and you are using the word "silicious" all the way through. Is that used in in the sense of its being quartzlike? A. In the sense of its being the same element as quartz, but in the sense of going to enrich a rock that already has some silica in it to a higher percentage of silica. 20

Q. It has the same chemical element? A. Same chemical element exactly. 25

The Court: Silica is a thing different altogether? A. Silica is really the oxidizing of the metal silicon, and quartz is the same thing as silica.

The Court: We will take our adjournment now. 30

And thereupon the Court adjourned to to-morrow morning, at 11 o'clock, April 28th, 1899.

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TEN TH DAY.

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Rosslund, B.C., April 28th, 1899.
11 o'clock, a.m.

Trial resumed.

20

Present: The Court and same counsel as before.

CLARENCE KING—A witness on behalf of Defendants.

25

Mr. Bodwell: I have no further cross-examination.

RE-DIRECT EXAMINATION.

30

By MR. DAVIS—

Q. My learned friend asked you some questions, Mr. King, about the attrition matter in the flat fault at the bottom of the Centre Star winze and the size of it. Upon what does the size of the attrition matter in that mud-seam at any point depend? A. Do you mean the mass of it, or the size of the particles? 35

Q. The mass of it? A. It depends upon the original roughness of the 40 surface planes of the fault.

Mr. Bodwell: This was already gone into in examination in chief of Mr. King.

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Mr. Davis: No, what the size of the attrition mass depended upon was not gone into at all. My learned friend started to ask about it and then said to Mr. King, "I will come to this later on," but I noticed he did not come.

Mr. Bodwell: Mr. King in his examination in chief said the attrition mass was caused by the scraping of one edge of the fissure against the other. That was brought out by my friend himself. 5

Mr. Davis: That is not the question I am asking at all.

Mr. Bodwell: And the size of it was given in definite feet and inches at that particular point. 10

Mr. Davis: Exactly, but that is not the question I am asking. I am asking this question: upon what does the size of the attrition mass in the mud-seam depend.

Mr. Bodwell: I am unable to see the distinction. 15

The Court: Well, Mr. Bodwell, you can cross-examine him upon it. I do not recollect about it exactly.

A. It depends simply on the scale of the roughness, the size of the inequalities of the surface of the fault. In any place where these inequalities are extremely slight the amount of attrition matter will be correspondingly small. Wherever the original roughness of the fissure plane is considerable, there naturally, by the differential movement the attrition mass will be larger. 20

Q. You told my learned friend that the doing of the work for which leave was applied the other day—that is, the sinking of the winze to the Iron Mask cast drift 69—would only add 15 feet of additional evidence to the evidence which is already in and shewn by the workings. Would the importance of that 15 feet be the same or different from the evidence which you have above? A. It would be very different; it would be much more important evidence, since it would finally answer the question whether the vein with its ore extended directly and continuously below the flat fault. 25 30

Q. That is the question of continuity at that point? A. The question of continuity at that point. 35

Q. If in doing that work you found ore between the present bottom of the winze and the Iron Mask cast drift 69, to what and to what alone would that ore be attributable? 40

Mr. Bodwell: I think that very question was asked in examination in chief. And certainly that point was most clearly gone into by Mr. King. The

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whole of his evidence in chief—that is, that part of his evidence—was directed to that point, to shew that if that work were continued the ore would be the same ore as found above. I cross-examined upon it, and I do not think that my friend is entitled to go over this same ground again by way of re-examination.

Mr. Davis: In order to avoid any question of this kind arising—the evidence is very voluminous and my learned friend and myself perhaps would differ as to what was gone over before and what was not—the ordinary rule, I understand, is this: I could take Mr. King out, and then I could recall him and ask him with your Lordship's permission (unless there was some reason to suspect the witness or counsel) and leave would be given to ask the questions. My learned friend would have the right, if there was anything new, to cross-examine upon it, and so far as that is concerned I will not object to it whether I think it is new or not.

The Court: I do not recollect it very well, Mr. Bodwell; there is too much evidence for me to recollect. You better ask the question and Mr. Bodwell can then cross-examine.

Q. (The question was read.) A. The downward continuance of the Centre Star ore body as shewn in the No. 3 incline, the 59 east drift and the winze therefrom.

Q. To what extent, if any, can the mud-seam be the cause of more in this immediate neighborhood? A. The flat fault is essentially a non-ore-bearing fissure, and it could have no effect in my mind to the best of my belief in depositing the ore at or near its intersection with any fissure or other vein except in the case of a secondary deposition from a solution which may have been brought down its plane.

The Court: Would there not be a wash of vein matter? A. There might be a small wash from any part of the dip above.

Q. I wish to read you some paragraphs from the affidavit of Mr. Howe and ask you what you have to say with reference to that. I am referring to page 84 of the Appeal book, which is printed, paragraph 2.

Mr. Bodwell: Before you read that, I should like to know where there is any authority for this kind of examination at present. Mr. Howe has not been put in the box so far. His affidavit is not in this case, and how my friend can say—

The Court: I quite agree with you. I would like some reason for it, because that is not evidence before a court at all so far.

Mr. Davis: I will put it in a little different way, which is not objectionable, assuming that to be.

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Q. If anyone makes the following statement with reference to the condition of affairs at the bottom of the mud-seam, what have you to say with reference to it?

Mr. Bodwell: I think my friend ought to give your Lordship an authority 5
for a question of this kind.

Mr. Davis: I wish to ask this question and then take a note of it. I will ask to have the question read.

Q. (The first question objected to was here read.) 10

The Court: I have ruled that question out, because the evidence of Mr. Howe is not before the Court.

Mr. Davis: Will you read the next question I asked? 15

(The second question objected to was here read.)

The Court: I rule that question out on the ground that it is putting a suppositious case. 20

Mr. Davis: I did not quite complete that question. I would like to put it on the record in full.

Q. If anyone makes the following statement with reference to the condition of affairs at the bottom of the mud-seam, what have you to say with reference to it? The statement being this: "The ore seen in the flat fault is not connected with, or a part of the ore that is seen in the winze above the flat fault, and is not in place, but runs with the flat fault and in a course about at right angles to the alleged dip of the Centre Star vein No. 2." 25

The Court: Overruled, on the ground that the question is a supposititious one, and not pertinent to the issues. 30

Mr. Davis: I now put a further question; I wish to put these questions, your Lordship, to save the point. 35

Q. I wish to read paragraph 4 of Mr. Howe's affidavit of the 4th of July, 1898, as filed in this case, and ask you what you have to say with reference to it, Mr. King.

The Court: That is ruled out, the evidence not being before the Court. 40

Mr. Davis: The question is this:

Q. If Mr. Howe, or anyone else, makes the following statement with reference to the condition of matters at the bottom of the Centre Star winze,

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what have you to say about it, the statement being this: "The winze has not passed entirely through this flat fault and the bottom of the same is still in the fault material. The ore at the east end of the winze is also cut off by a north and south vertical fault."

The Court: That is ruled out as being a supposititious case, the evidence not being before the court now, perhaps never may be. 5

Mr. Davis: The next question is this:

Q. I wish to read paragraphs 5, 6 and 7 of the affidavit of G. F. Kellogg filed in this case and dated in July, 1898, and ask you what you have to say as to them? 10

The Court: That question is ruled out on the ground that it is evidence not before the court.

Mr. Davis: The next question is this: 15

Q. If Mr. Kellogg or anyone, makes the following statement with reference to the condition of affairs at the bottom of the Centre Star winze, what have you to say about it, the statement being this: "The same conditions of rock and ore are found to exist in the bottom of said winze sunk by the defendants, as in the bottom of said incline shaft and in said drift last referred to. In the said winze of the defendants the ore was cut off sharp and clean and between a layer of mud lies the fractured country rock. In the fracture planes of the country rock forming the body of the said flat fault there are some disconnected pieces of ore, but the same do not lie in any vein and are not of any commercial value. 20 25

"Par. 6. From my different examinations of the said winze and of the whole workings of the defendants in the Iron Mask mineral claim, I am clearly of the opinion that the ore followed by the defendants in said winze is permanently cut off by the said flat fault and does not continue beyond the same. 30

"Par. 7. The ore in the bottom of the said winze is also cut off to the east by a vertical fault which is shewn in the east end of said winze."

The Court: That question is ruled out upon the same ground. 35

Q. Now, Mr. King in your evidence in chief, you made use of the word "jump" in connection with the ore passing from one side of the vein to the other. Will you kindly explain what you meant by the word "jump"? A. If I remember correctly the question— 40

Q. I think you said from one plane to the other. A. I did.

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Mr. Bodwell: But it was not with reference to this mine at all. A. No. I was speaking of another mine. I was speaking of a mine of which I am the directing mining engineering in Colorado. Which is a shear-zone vein, and in which the ore passes from one plane shear-zone to another, and I will illustrate what I mean by the jump. (The witness goes to the blackboard.) This represents the horizontal section on the lower country of the Nellie mine; of the parallel fissures of the shear-zone vein. The ore originally comes in upon the foot wall at the lowest and most westward fissures, the ore being represented by the marks I am making. After rising to a certain point it crosses through a break in this long, thin plate which runs between No. 1 and No. 2 fissures, and follows a cross-fissure over to fissure No. 2, and then follows along fissure No. 2, again crosses through a fissure mineralized all the way, and so on. The term "jump" as I used it is a miners' term, simply indicating that it passes from one fissure to the other. It passes through a cross-break which does not enter the country rock on either side, but which is a mere dependent fracture within the limits of the vein, and a very natural thing to occur in such a slender, long-continued plate of rock. This fissure is as much of a fissure as that (referring to the diagram just drawn); that is to say, the cross-fissure which the ore has followed, or as the miners call it, "jumped," is as much a fissure intrinsically as the long fissure which it leaves or the other long fissure.

The Court: As I understood you, this was really horizontal? A. That is a horizontal plane. The term "jump" is a miners' term, simply indicating that it passes from one plane to another on a minor subsidiary transverse interior fracture.

Q. My learned friend asked you about the shear-zone as distinguished from a shear-zone vein; that is, as I understand it, the geological shear-zone in this particular case. Have you discovered any evidence whatever in the ground here which would go to show that the geological shear-zone, if I may so term it, is any more extensive than the shear-zone vein itself which you have described? A. Not in the region of these mines. I stated that beyond the hill in the Josie gulch there is an entirely independent shear-zone which is a geological shear-zone, but which is different in dip, strike, and entire geological relationship to the one under discussion.

Q. But so far as the shear-zone in which the Centre Star vein lies (that is the one I am speaking of), have you found any evidence to shew that it is more extensive than the vein itself? A. None whatever, none whatever.

Q. If it were more extensive what would be the limitations of the shear-zone vein as distinguished from the geological shear-zone? A. The lateral limitation of mineralization.

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Q. You have been in the brown cross-cut from the Iron Mask stope, have you not? A. I have.

Q. Do you discover anything there to shew you whether or not the shear-zone vein extends beyond a certain point, and what is the point? A. I have perfectly clear evidence that above about 10 feet to the north of the vein, beyond that to the— 5

The Court: Of the Iron Mask? A. Of the brown cross-cut; about 10 feet north of the Centre Star vein in the breast of that cross-cut is the last bounding plane of the shear-zone as shewn anywhere. 10

Q. And when you say "shear-zone" there, you are speaking— A. I am speaking of the shear-zone vein.

Q. And do you find any evidence that the shear-zone itself, apart from the shear zone vein itself, extends? A. None whatever. 15

Q. Have you been through the Centre Star cross-cut from the No. 1 tunnel to No. 2 tunnel, that is, the yellow cross-cut? A. On a very early visit, I think the first visit I made here, or possibly the second; I came through there without examining, simply to get out of the mine from another part; but on two occasions I have actually examined that cross-cut for about 50 feet looking to see if there were any more exterior parallel planes which could be fairly related to the Centre Star shear-zone vein, and I found none. 20

Q. You found none? A. I found none. 25

Q. What inference would you draw from that so far as the position of the foot wall of the shear-zone is concerned? A. That it lay wholly to the north of that drift. 30

Q. When you spoke about secondary pyrrhotite in answer to my learned friend the other day, what, exactly, do you mean by the term secondary pyrrhotite? A. I mean pyrrhotite—"secondary pyrrhotite"? 35

Q. Secondary pyrrhotite. A. Pyrrhotite as I have seen it is of undoubtedly profound origin, is brought up by solutions and deposited in rocks and in veins. What I would mean by secondary pyrrhotite would be the solution of that original primary pyrrhotite, its transportation and deposition somewhere else. 40

Mr. Davis: There are a number of places in the evidence, my Lord, which we find incorrect, but the stenographers are checking the report by the other reports which they have, and for that reason I will not refer to them now, because they may all be corrected when the copy is given us finally corrected. I

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merely mention it so that it will not be supposed that we are adopting the report which has been given us as absolutely correct. There are a number of errors, some of them of some importance.

The Court: That can be set right by counsel on both sides. There are, 5
no doubt, mistakes made.

RE-CROSS EXAMINATION.

By Mr. Bodwell—

Q. All mineral is secondary in the sense in which you have just defined the secondary formation of pyrrhotite? A. I was limiting the description on that account. 10

Q. It has to be transported from some place? A. Yes.

Q. It existed some place else before? A. Yes. 15

Q. Do you or do you not know of instances in which pyrrhotite has been found in crystalline rocks as a part of the original constituents? A. I do; that is to say, from scientific description, not from personal observation.

Q. It has been referred to as an eruptive part? A. As eruptive rocks, 20
as an eruptive part.

Q. And instances have been reported? A. And are well known; authenticated. But will you allow me to explain that?

Q. Yes. A. I tried to define the use I made of "primary" and "secondary," that perhaps it would be as well to say if it has been brought from the depth by solution and deposited, my use of secondary would not mean its solution and transportation thereafter. 25

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Q. May I ask you this also? In some of Mr. Emmons' writings he has referred to the Leadville district, and has shown that notwithstanding all the secretion that has taken place there still about four per cent. of the representative rock is mineralized? A. Yes.

Q. What kind of rock is it at Leadville? A. That is a gray porphyry. 5

Q. I suppose you would class limestone as sedimentary? A. Yes, sir.

Q. How far out in that cross-cut tunnel did you go? Did you walk all the way out? A. Only as a means of exit; I never examined it beyond 50 feet. 10

Q. You haven't any notes then, shewing the number of planes that you found there? A. I found no plane parallel with the Centre Star.

Q. Did you find any planes which you think would correspond with the planes of the so-called flat fault? A. No, sir; I did not. 15

Q. You did not look for them specially, I suppose? A. I did not look for them specially, but I saw the general shattering of that rock

The Court: Do both of those tunnels open out into a gulch? 20

Mr. Davis: Yes, my Lord, both No. 1 and No. 2.

The Court: Do I understand you to say, Mr. King, that the Centre Star vein No. 2 is a shear-zone vein? A. Yes.

The Court: With defined walls, hanging and foot? A. With correlative walls, with a series of parallel fractures, the exterior ones of which I consider to be the walls. 25

The Court: And without knowing where these exterior ones are in some cases? A. Because the work would not permit the seeing of the foot wall country. 30

The Court: These are what are sometimes called the superior walls? A. The inferior walls in that foot country. The superior and inferior walls, yes. 35

The Court: The inner walls are the inferior and the superior the outside walls? A. No, I would confine the use of inferior to the foot wall.

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TWELFTH DAY.

Rosslund, B. C., May 1st, 1899.
10:30 o'clock a. m.

Trial resumed.

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Present: The Court and the same counsel as before.

Waldemar Lindgren—Sworn on behalf of the defendants:

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DIRECT EXAMINATION.

By MR. DAVIS—

15

Q. You live where, Mr. Lindgren? A. I live in the City of Washington, District of Columbia.

Q. What is your business or profession? A. My profession is that of a mining engineer. I am a geologist in the United States Geological Survey.

Q. You were born in Sweden, I believe? A. I was born in Sweden, yes.

The Court: Geologist in the United States Survey? A. In the United States Geological Survey. There are several other surveys, your Lordship.

Q. I believe you are also at the present time professor of mining geology

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in the Leland Stanford University of California? A. Yes, I hold that appointment.

Q. Where did you receive your scientific education? A. My technical education was begun and finished in Freiburg, Germany, in the Mining School of Freiburg. 5

Q. How many years did you spend there? A. I came there in 1878 and I left there five years later, in 1883, after having taken the degree of mining engineer and also the special degree of mining surveyor. 10

Q. You came then, I believe, to the United States? A. I did.

Q. What were you engaged in when you came first, and where? A. During the first eight months I was engaged by the Northern Pacific, which was then building its road, to prospect coal lands in Eastern Montana chiefly. I was engaged in that until January or February, 1884. 15

Q. And you then went where? A. I then went to Montana and held the position of assayer and chemist at the Gregory Smelting Works, near Helena, for about eight months I think. 20

Q. And when did you enter the United States Geological Survey? A. I was appointed assistant geologist of the United States Geological Survey, I think, in December, 1884, and I was stationed in San Francisco for the first few years. 25

Q. What is your position in the Survey now? A. My position is that of a geologist. I have been continually employed by the United States Geological Survey since that time.

Q. What branch of the United States Geological Survey have you been more especially connected with? A. With mining geology exclusively, and more especially the vein geology. 30

Q. Outside of the United States in what countries have you examined mines? A. I have examined mines in Sweden and Norway and Germany quite extensively, and Austria and the United States, and to some extent in Mexico. 35

Q. In what states in the United States? A. Practically all of the Western states, except Colorado and Utah. 40

Q. I believe there are certain disputes respecting mining lands which have to be settled by your department, the Geological Department. Is that correct? A. Yes, very often, or sometimes, requests for experts come to the United States Geological Survey in case of lawsuits of the government against—I

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should say disputes of the Department of the Interior or the Land Office, and in the Department of Justice. In such cases involving questions in the Western states I have generally been appointed expert by the government.

Q. Those matters have been referred to you for decision? A. Yes, sir. 5

Q. When did you commence your examination of the veins and ground in dispute in this action? A. I think it was in the first of April. I came here on the 31st of March, and I immediately began. I think on the following day. 10

Q. You have been continuously at work since that time? A. I have been continuously at work in this vicinity since that time.

Q. You have examined the apex, I believe, of the vein in dispute, Centre Star No. 2 vein? A. I have. 15

Q. From where to where? You might point it out on the large map? A. (Referring to the map). I have examined it from a point a short distance west of No. 3 shaft to No. 2 shaft and from there on to some distance east.

The Court: That is, examined the croppings? A. Examined the croppings. 20

Q. What kind of croppings or apex do you find that to be Mr. Lindgren? A. I find along that cropping a practically continuous streak, sometimes two parallel streaks of solid sulphides, and I have followed that—it is continuous, practically continuous from shaft to shaft except for the short interruption of the railroad track. Besides that, I find a number of planes dipping in at an angle of, I should say, from 35 to 60 degrees, generally 45 degrees along those croppings. I have examined it more especially where the railroad cuts the croppings, at which place the cut offers very good opportunities for looking into the same. 30

Q. What do you find there? A. I find a streak of solid pyrrhotite, a little chalcopyrite, of about a foot in thickness. Above that are two or three walls separated by country rock, perhaps a foot or a foot and a half apart, giving it a distance in the hanging from this one foot streak of about 3 or 4 feet. I should say. 35

Q. Three or four feet of what? A. Three or four feet of country rock separated by two and three planes dipping 45 degrees north. On the south from this solid streak I find some altered country rock for about two or three feet, that is, going south towards the foot, in the foot really. 40

The Court: Is all this in the railroad cut? A. At the railroad cut, yes. I simply mention it because it shows really better there than any other place along the croppings. Then there are a few inches of solid sulphides again—

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Q. When you say sulphides, what do you mean, Mr. Lindgren? A. In this case I mean chalcopyrite and pyrrhotite. Those being the only primary sulphides of importance which occur here. Of course, there is also arsenite sulphide and others. There is also at this point about three feet in the foot from the streak—which is one foot thick, as I mentioned first—another streak of solid sulphide, and chalcopyrite two or three inches thick. And going in the foot of that again you find two or three walls several feet distant—perhaps two and three, the first one about three feet distant from this second seam, and the last ones perhaps five or six feet; so that you have only exposed a width of, I should say, perhaps 12 or 13 feet of rock which is penetrated by a number of these shear-planes, walls dipping north; and two streaks of solid sulphides.

Q. Is there any question as to that outcropping being the apex of a vein? A. No, sir, there is not. The whole apex forms an absolutely characteristic cropping of the vein, in my opinion. It is as typically a vein cropping as I have seen.

Q. Can you ascertain from the apex as you have seen it, the whole apex of that vein? A. Well, no, not the top places. Generally there is only about three feet exposed, perhaps. At this place at the railroad cut I would be of the opinion that the whole vein is exposed. I think that its total width is about 12 or 13 feet at that place and that practically the whole is exposed.

The Court: Is that 12 or 13 feet all vein matter? A. It is more or less altered. The outer part, of course, is not quite as much altered as the space between the two seams of solid ore.

Q. Are veins always of the same width throughout their length and breadth? A. No, they vary very greatly. Sometimes they pinch to the thickness of a few inches and then again they are liable to swell out to a thickness of very many feet. That is exceedingly common; that is in fact, the rule, you might say.

Q. Of what vein is this the apex; that is, do you find this vein in other places? A. Yes, I find it at a number of places. I find it exposed in the No. 3 incline, in No. 2 incline and I also find it exposed in various places in the ground.

Q. It is the vein that has been spoken of here, then, as the Centre Star vein? A. It is.

Q. From the study you have given that vein what description would you give of it so far as structure goes? A. As far as its structure goes it is what is commonly called, what is called a composite vein, or sometimes a shear-zone vein consisting of a number, two or three, five, six or more planes situated at a

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distance apart varying from a few inches to a few feet, and together constituting what is called a shear-zone or composite vein.

Q. Is it a fissure vein? It is.

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Q. Have you had experience in veins of this kind before? A. Yes, I have.

Q. Is it a very rare vein or a common vein, or what? A. No, it is a very common type. In fact, I should say it is the more common type. The vein in its most simple form, the simplest type of the vein, consists of a clean break, we will say, in the hard rock along which some movement has taken place, the various walls stripping each other have produced more or less open spaces, which open spaces have been subsequently filled in by vein material, ores and so on, forming a filling entirely distinct from the walls and sharply separated from them. The walls in this case are simply unaltered rock. This type of a vein is a very rare one so far as my experience goes, even in such places.

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The Court: These shear-zone veins? A. No, this type, this single or simple vein.

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The Court: This that you are just speaking of? A. That I was just speaking of; it is a very rare type. It is much more common to find two or three walls enclosing a space of say, in three, four or six feet between these walls; and between the limit of the exterior of these walls you will find the ore following down, sometimes along the foot wall, then pinching out there, perhaps, and by a cross seam traversing to another parallel plane a foot or so apart, and then continuing it on that. That is really the most common type of fissure veins.

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The Court: Let me ask: is there any ore matter generally speaking? You are referring now to this type of vein—is there any ore matter or is there always ore matter between the several planes? A. It varies. But it is proper to make a distinction between solid ores, solid sulphides, and ore on one hand, and later vein matter on the other hand; that is, in the case of these veins. The distance between the walls is nearly always filled with greatly altered rock, generally altered rock mineralized. But besides this general mineralization there is a more intense mineralization which has produced what is extracted and used as ore, and which carries the highest values. That is the part which I have referred to as occupying a small space between the inside of these walls and even changing from one side to the other.

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Q. In what other districts have you been familiar with this type of vein? I am speaking now as to structure only?

The Court: You are still referring to the shear-zone veins?

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Mr. Davis: Yes, as to veins of that type, as to structure only. I am not saying anything now about the filling or anything of that sort. A. I have seen them in a number of places. I have seen some in California; I have seen a great many in Idaho and also some in Arizona.

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The Court: You say you saw a great many in Idaho? A. Yes.

The Court: And some in California? A. Some in California and Arizona. It is a type which one might say is especially common in Rocky Mountain regions, say from Idaho and as I know from reports, in Colorado and Montana.

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Q. What is the nature of the country rock in the disputed territory, roughly speaking? A. The rock is of an igneous character, a crystalline igneous rock of granular structure, and I should designate it as an augite-diorite. I would explain in this connection, I have a specimen of the rock, a hand section, a thin specimen, but that for a complete determination of the rock it is necessary to have a chemical analysis of it, down to its minute details, you might say. Such an analysis I have not made.

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Q. Mr. King spoke of it, I think, as monzonite? A. Yes.

Q. What is the difference between the two or how are they comparatively used? A. I think this rock is in all probability a monzonite. That is a peculiar sub-group which is characterized by the appearance of orthoclase, feldspar, together with plagioclase, besides augite. I should think that it is very likely monzonite; anyway, it stands between that and the augite-diorite.

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Q. What have you to say as to the filling of these veins, the formation of them so far as their filling goes? If I said these veins, I mean this vein, the Centre Star No. 2? A. The ore minerals—the sulphide minerals—are pyrrhotite and chalcopyrite. These occur in more or less irregular streaks within the walls. Besides these, there is a great deal of altered country rock, forming what is commonly known as vein matter. The vein matter results from the country rock by the introduction or formation of minerals which are foreign to this country rock. In this case these minerals are quartz, calcite, pyrrhotite, chalcopyrite and a certain kind of a brown mica. These may occur altogether, or each mineral by itself, and their appearance gives to the country rock that aspect when it is usually termed vein matter. This vein matter usually fills the space between the walls. I should say that besides these minerals I mentioned there is also finely divided chalcopyrite and pyrrhotite—I don't know whether I mentioned that—sprinkled in the rock. And this vein matter fills the space between the walls, and is as a rule characteristic of the vein. That is to say, outside of the walls you do not find very much of it, although you may find finely divided sulphides occasionally.

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Q. What is the process by which the country rock is changed called? You may just describe it? A. The process is called replacement. It is changed, it is evidently caused by the introduction of solutions bearing different minerals, gold, copper, iron and a great many other salts. This solution evidently acted on the country rock introducing some minerals and forming others from the constituents which were already there. In fact more or less completely changing the whole aspect and composition of the rock. In favorable places the change to pyrrhotite and chalcopyrite went on more intensely. The minerals of the country rock were more or less completely replaced by those minerals; their substance was dissolved out—leached out, you might say—and instead of the original substance, the chalcopyrite and pyrrhotite were deposited.

The Court: The vein was deposited? A. The vein was deposited.

Q. In place of the other? A. Yes, in place of the other. These places where complete replacement has prevailed are very generally quite irregular, depending on a number of factors, so that usually you will find the masses of pyrrhotite and chalcopyrite to have no regular outline, sometimes stopping quite suddenly again fading out gradually into the country rock.

Q. I understand a piece of petrified wood is an ideal example of replacement. Is that correct? A. Yes, it is. Of course, it is not of the same character as replacement in the rock, but it conveys the idea very nicely. In that, the substance of the wood is carried away, the structure is largely retained, but the silica replaces the fibre of the wood.

Q. What is the difference between replacement and impregnation of the veins? A. Impregnation is usually employed to signify a filling of minute pores in the rock. Sandstone, which is a porous rock, might be filled by cinnabar, such as happens at New Idria. This impregnation took place in the case of the Centre Star vein also to a certain extent probably; it probably always takes place, but it is subordinate to the main process of replacement which I have already outlined. I would also like to say that a third process is filling; that is to say, the accumulation of metallic and other minerals, along in open spaces which were formed during the shearing action which produced the fissures. Such minerals as accumulate along open fissures by filling are evidently not very common in the case of—you are referring to Centre Star No. 2?

Q. In the case of Centre Star No. 2 vein? A. In the case of Centre Star No. 2 vein they might have existed to some extent; that is to say, there may have been cracks an eighth or a quarter or perhaps half an inch thick which were filled; but as a whole the process is one of replacement.

The Court: What produced this shearing process? A. What will produce the shearing planes?

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The Court: Yes. A. A compressive stress acting on a certain block of ground, on a certain mass of rock, generally produces one or more planes dipping at a certain angle, and which forms either a simple vein or a shear-zone. In fact, the compressive stress is usually the cause or origin of fissures before they are filled. 5

The Court: You mean the fissure really forms from the compression? A. From the compression, yes. The compression acts on a certain block of ground and as the result of that the particles will slide over each other along a certain plane or a number of planes, and that is what causes the fissure which then is afterwards filled by solutions. 10

Q. Are you familiar with replacement veins in other districts, and if so, what? A. Replacement which is a process which nearly always accompanies veins. It is very rare to find a vein without some evidence of replacement. It is, however, more or less common. I have seen certain veins which were nearly entirely formed by that process. I have seen some at Meadow Lake, for instance, in California; I have seen others at Wood River in Idaho; I would especially mention one mine there which is called Creosuss mine, because of its great similarity in structure and ores with this occurrence. 15 20

Q. With this present Centre Star No. 2 vein? A. Yes.

Q. Did you find much of what they call selvage in this Centre Star No. 2 vein? A. No, very little. 25

Q. What is the explanation of that? A. It is not common to find selvage in replacement veins, simply because the selvage is produced by—the selvage is more common in fissure veins having open spaces. 30

The Court: Contact veins? A. Yes, might say contact veins, in which the material has accumulated, and after accumulation has formed a solid metal body on the walls. In the case of replacement veins the selvage is much more likely to be absent, because the solutions eat in the rock from the planes both ways and cause a gradual fading out rather than an abrupt change in constitution. 35

Q. By selvage is really meant placed in? A. Placed in, following along the vein, filled, yes. 40

Q. Caused by attrition? A. Caused by attrition, yes.

The Court: You speak of replacement. What does it replace? A. The ores replace the minerals of the country rock.

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Q. What are they in this case? A. They are feldspars, plagioclase, orthoclase; those are the feldspars. They are augite and to some extent hornblende. These minerals are dissolved out and the ores deposited in their stead.

The Court: It is not an actual replacement according to the literal meaning of the word, is it? A. Yes, in some places it is an actual replacement. That is to say, a cubic inch of space formerly occupied by rock is now occupied by ore. 5

The Court: Replacement strictly speaking means to replace back again.

Mr. Davis: That is not the meaning here. Possibly the word "substitution" would be nearer. What happens here is, one body is taken out and another put in its place, substituted for it. 10

The Witness: Substitution is a word that is very much used in connection with that same process; some authors prefer the word replacement and some prefer substitution. 15

Q. How much of an examination have you made of the No. 2 shaft, Mr. Lindgren? A. I have examined it very carefully at different times, I think on three occasions from top to bottom, on both sides. 20

Q. How closely? A. I have examined it, you might say, inch for inch.

Q. Do you find any vein there? A. I do. 25

Q. What are your reasons for saying that? A. I find a continuous streak of solid sulphides beginning at the top and——

Q. Only go down at the present time to the mud-seam, Mr. Lindgren, and take it from that on afterward? A. Practically continuous from the collar to the mud-seam, with the exception of places where drifts have been cut in, of course. 30

Q. With the exception of what? A. Where drifts have been cut. 35

Q. That merely means—— A. Continuous, yes. And the width of these solid sulphides practically ranges from two or three feet down to a few inches. I should say that it would average perhaps 12 inches of practically solid sulphides. 40

The Court: Sulphides, I understand, are minerals impregnated with sulphur? A. No, sulphide is pyrrhotite and chalcopyrite. I mean in this case, of solid pyrrhotite and chalcopyrite; of solid ore, you might say. The

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limits of this body of solid body of ore are as a rule very clearly defined; and for a large part of the distance there is a little seam of calcite which clearly indicates its upper limit, and in some places also a similar seam indicating its lower limit.

Q. That is the ore body? A. The ore body.

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Q. Of the sulphides? A. Yes.

Q. You may state what are the components parts of these sulphides you speak of, that is, chalcopyrite and pyrrhotite? A. The pyrrhotite consists of iron and sulphur; chalcopyrite consists of copper, iron and sulphur.

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Q. Now, I interrupted you. You were just stating that you find these walls or streaks, whatever you call them, above and below the ore body, and were going on with something else. A. Yes. Two or three feet above the upper limit of the ore body there is a well-defined wall, sometimes broken into by the miners in working in sinking the shaft, but it is very well defined in a number of places. I took its strike and dip.

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The Court. What is well-defined. A. The wall and upper wall in the roof of the incline.

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Q. What did you find the strike and dip of that wall to be? A. I found it to be very nearly north 85 east. I think from the average determinations; and the dip ranges from 38 to 48 or 45.

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Q. Speaking of different strikes of veins, are they uniform in any vein? A. No. In fact, nature never follows mathematical planes and a vein is sometimes a quite irregular plane, changing in dip quite considerable at different portions of its extent; it also changes in strike. It is exceedingly common; in fact, it is the most common thing. Of course, it is not very common to find the veins change at right angles, but minor changes, 10, 20 or 30 degrees, is very common indeed.

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Q. This wall you speak of which you say is clearly defined in the hanging wall of the shaft, is that or is it not, or can you tell whether it is, the ultimate hanging wall of the vein? A. No, I can not. As shown by the exposure along the railroad cut—to give an example—there are three hanging walls, I think, a short distance apart, and it would be impossible to be sure that what I have seen in the shaft was the ultimate hanging wall. There might very well be another beyond. I should, perhaps, say in this connection, that I found in the shaft, along the shaft, the space between the solid ore body and the wall to be quite altered: it is mineralized, in other words. It is not mineralized to such an extent as to form a solid body at all, but it is full of secondary minerals and is characteristic vein matter.

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Q. How would you know when you get to the ultimate hanging wall of the vein proper? A. You would find the mineralization gradually decreasing; that is the only thing.

Q. The limit of the vein, even if there were shearings beyond, would be the limit of mineralization? A. The limit of mineralization, yes. 5

Q. What about the foot of the drift? Was the shaft in such shape that you can follow the foot wall there? A. No, the foot wall is not well exposed. In a few cases, as I said before, you see the foot wall of the ore seam, that is to say of the solid ore; but it is not sufficiently down in the foot to enable you to see any foot wall planes. There are very likely—in fact, I am quite sure there must be—some foot wall planes below there which are not exposed by the present shaft. 10

Q. I think you say you saw foot wall planes in the railway cutting? A. I did, several of them. 15

Q. Have you workings that have been made there which will show the limit beyond which the vein does not go? A. Yes, in the so-called brown crosscut which starts from Iron Mask stopes and goes back until it strikes the vein; the whole hanging part of the vein is very well exposed. It shows, I should say, four or five feet of what is practically the solid ore—chalcopyrite and pyrrhotite. Above that there are two walls, I should say about four feet apart. Between these walls, to the limit of the outer wall, the country rock is strongly mineralized, beyond that wall it is very much less so. That wall forms the limit of the vein, in my opinion, in the hanging at that place. 20 25

The Court. Where would the hanging wall be on the drift? A. (Referring to model) That would be about here; I think about 15 feet from the face of the drift back.

The Court. Which way would it dip? A. It would dip north. I took the strike and dip there. 30

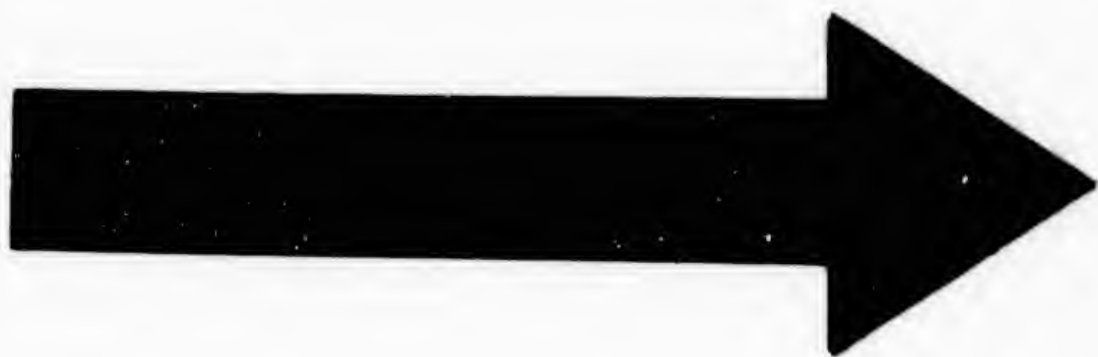
Q. You say you took the strike and dip there. A. I did.

Q. What do you find the strike and dip to be there? A. (Referring to memorandum). I find it to be south S3 east. 35

The Court: What is that? A. The strike of the wall.

Mr. Davis: You gave the other north; perhaps it would be well to give this north too. A. Well, that would be north S3 west. The dip of this wall is 36 degrees. 40

Q. About how far is the face of that brown drift from the No. 3 shaft at the corresponding point? A. You mean in a horizontal direction?



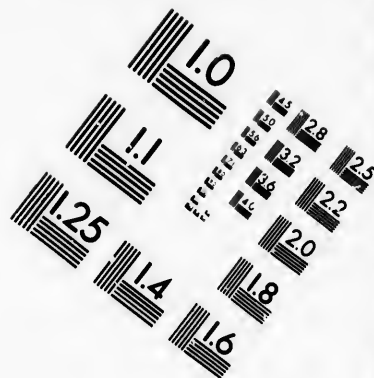
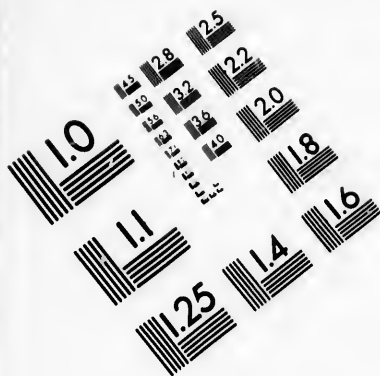
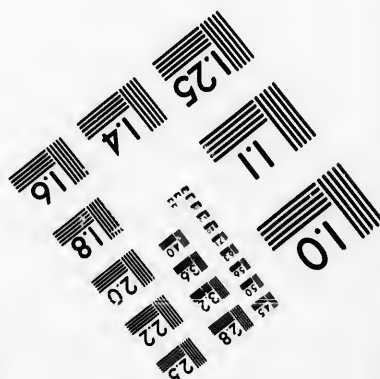
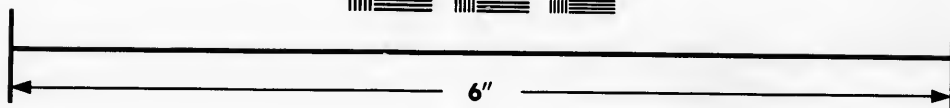
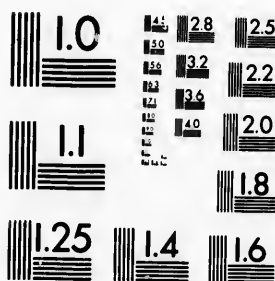


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Q. Yes. A. It is about 50 feet. You mean the distance from the end of the brown drift to the shaft; that is its horizontal distance.

Q. Yes, but it would not be 50 feet, would it? A. Oh, this map is 20 feet to the inch, and I was thinking of 30 feet. It would make the distance about 30 feet. 5

Q. What vein is that you find in the face of the brown drift? A. That is in Centre Star No. 2. Its position indicates that it is that vein, as well as its composition.

The Court : Do I understand you to say that the vein matter begins to show a few feet from the face or does it, from the stope inwards? From the stope right through to the face? A. There is no vein matter showing from the stope, practically speaking, from the stope to a point practically 13 feet from the face of the drift. 10 15

The Court : There is no vein matter? A. No.

The Court : That is what I understood you to say; I am right in my understanding of it? A. Yes. 20

The Court : Is that the reason you say it is the Centre Star vein, from the character of it? A. No; my reasons for saying this is the Centre Star vein are, first, that it is in the position where you will be expecting to find it from the dip which I have ascertained at other points, and, secondly, I think it is that vein because it has the characteristics of that vein as to the walls, and as to the filling which I have found it in other places to possess. 25

Q. And in the workings disclosed have you found anything which would lead you to suppose for a moment that there was any other vein of which it could form a part? A. No sir. 30

Q. So that you have both negative and positive testimony on that point? A. Yes, sir.

Mr. Bodwell : My friend draws the conclusion which he would only be justified in when commenting on the evidence, and puts that in the question, and the witness says yes to it. I do not think he ought to do it. 35

Mr. Davis : I will try to avoid anything of that kind that my learned friend objects to. 40

The Court : Yes, the objection is well founded.

Q. Now, what about the foot wall of that vein. Have you been through any workings which would show you a place beyond which at any rate, there is

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no foot wall; that is, so that you can give some limits within which the foot wall must fall? A. Yes, I have seen what I consider the foot wall exposed in the short crossect running back from the bottom level, this blue level; and the vein is exposed very nicely.

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The Court: This Iron Mask level? A. This Iron Mask bottom level, running south from the Iron Mask east drift No. 71. I find at that place what I consider to be the foot wall of the vein. Beyond that in the drift there does not seem to be any further mineralization, or at least, there does not seem to be any mineralization which would indicate that the vein extended any further in that direction.

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The Court: Of course, I have to form some opinion from your evidence; that is the reason I am interfering at all by asking questions. Do I understand you to say you found the foot wall in what I call the spur or drift? A. I do.

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The Court: Then where is the hanging wall? A. The hanging wall is in the vicinity of the end of the blue drift.

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The Court: But would there not be a hanging wall? A. Yes.

The Court: Did I understand you to say that there was no more vein matter north— A. I mean south, your Lordship. I meant south if I said north.

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Q. Where would the hanging wall be? A. The hanging wall would be a little north of the hanging wall side of this Iron Mask drift.

The Court: It would be at the mouth of the small drift? A. Well, there is a wall there, but I am not sure that it is the ultimate hanging wall. The ore shows and the wall shows from here on to the end of this Iron Mask drift No. 71.

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Q. East end? A. The east end of 71 Iron Mask east drift. But I am not positive that it is the ultimate hanging wall, because there may very well be another wall just beyond that.

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Q. Do you know this yellow crossect from the No. 1 Centre Star tunnel? A. Yes, sir.

Q. To station 38, is it not? A. Station 38.

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Q. Do you find any foot wall of that vein in the crossect from No. 1 tunnel running to station 38?

The Court: (Referring to the model). I want to see exactly what you

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are speaking of there, Mr. Davis. You better call that the long crosscut, running northwest from Centre Star tunnel No. 1. Now, what was your question?

Q. (Question read). A. No, I have not, not as far as I have examined it. I have examined it from station 38, a distance of—I would be unable to say exactly—perhaps 40 or 50 feet back, southeast, without finding anything which I consider a wall. 5

Q. What conclusion do you draw from that as to the limits of the foot wall of that vein? A. Naturally, that the foot wall of the vein lies to the north of station 38. 10

The Court: The footwall of the vein lies to the north? A. To the north of station 38; that is to say, the foot wall is on this side, but at some point north of there.

Q. You stated that you examined No. 3 shaft. I think the expression you used was "inch by inch." Is there any place there down to the mud-seam where there was any continuous sulphides, pyrrhotite and chalcopyrite? A. No, sir. The solid chalcopyrite and pyrrhotite are continuous practically down to the mud-seam. 15 20

Q. When you say practically, just explain what you mean? A. I mean that there is a place a few feet below station 59 at which the ore for two or three feet is thin, but still it is a thin streak, and you can follow it perfectly well; and two or three feet below that station it immediately widens out again. 25

Q. It is thin, but it is there? A. Oh, certainly. So that the solid pyrrhotite and chalcopyrite are continuous down to the mud-seam.

Q. You have examined, I believe, Centre Star east drift No. 59, this green drift (indicating on model). A. I have. 30

Q. Do you find any vein in there? A. I do. I find a continuation of the same vein which is exposed in the incline shaft No. 3, shewing all along from station 59, which is at the shaft, eastward to the end of the drift a continuous vein of solid pyrrhotite and chalcopyrite, along with large quartz, so that the vein here consists of solid chalcopyrite and pyrrhotite and a considerable amount of quartz. The width of this is about from 2 to 3 feet anyway, the width of this that might be termed ore. 35

Q. Now, when you spoke of the ore being continuous in that drift, as I think you said, what do you mean by "continuous?" Are you speaking of it literally or otherwise? A. I am speaking of it literally. 40

Q. You are speaking of it literally? A. Literally, continuous, yes, sir.

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Q. Now, what are the reasons for your saying that the vein in the 59 east drift is the same vein as the vein in the No. 3 shaft? A. Because I can trace the ore and the vein matter continuously from along the No. 3 shaft into this drift, without break or interruption, and following the same plane.

Q. And what other reasons? A. And because it is similar in character, entirely similar in character, to the vein as shewn in the shaft and at other places.

Q. And what about strike and dip? A. I measured the strike and dip of the walls at several places, or at at least one place that I recall distinctly, about half ways in, I think, from the shaft to the end of the drift. I measured a foot wall there and a hanging wall, both quite well defined, and perhaps six feet apart. The dip and strike of those were that of the normal vein as shewn in the shaft and along the croppings.

Q. That is, No. 3 shaft? A. Yes. I can give you the figures if you wish.

Q. Well, they correspond? A. They do.

Q. Now, you spoke of walls in that No. 59 east drift. So you found walls there, did you? A. I did.

Q. Just describe those walls. A. I found a hanging wall which shews on the north side of the drift, shews very plainly in places, and I found a foot wall which shews very plainly in at least one place. Now, in driving a drift it is very rarely that the walls shew absolutely right along, it is broken into, and during the excavation of the drift its continuation was more or less broken.

Q. The drift is square, as it were? A. Yes.

Q. Can you tell whether or not those are the ultimate walls of the vein in the drift? A. No, I cannot.

Q. That can only be told by what? A. By cross-cutting the hanging walls and foot walls and so on.

Q. By cross-cutting and ascertaining? A. Exactly.

Q. Now, have you made an examination of the winze which is sunk from the east end of the 59 drift? A. I have.

Q. Do you find a vein in that winze? A. I do. The vein continues down the winze which is about—

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Q. What vein is it, I will ask you first? A. The Centre Star vein, the very same vein which I followed down the main No. 3 shaft and out through the 59 east drift, then continued on in the winze.

Q. Well, it is seen in the winze at the present time to the bottom? A. Exactly, shewing along the sides of the winze a continuous body of solid pyrrhotite, about a foot thick, I think. 5

Q. Any chalcopyrite? A. Yes; there is chalcopyrite along with it always; more or less suddenly widening out towards the bottom of the winze, on the west side, to a thickness of perhaps three feet just above the mud-seam. But I should explain, of these three feet right above the mud-seam, there is only a part which is solid, solid ore. 10

Q. About how much is the solid part? A. There is some of the country rock which begins to come in this solid body just before it reaches the mud-seam. 15

Q. About what is the width of the solid part?

The Court: You mean of the three feet immediately above the mud-seam only a part— A. Only a part is solid. 20

The Court: Solid what? A. Solid ore.

Q. About what is the width of the solid part? A. Just above the mud-seam I think the solid part would only be about a foot and a-half wide, possibly two feet. 25

The Court: Immediately above the mud-seam? A. Immediately above the mud-seam. That is to say, there is a small mass of country rock coming in, as it always does in solid masses, just above the mud-seam, occupying some of the space which is just above occupied by solid pyrrhotite. 30

Q. You spoke about the ore being continuous in the winze there. Again are you using the word continuous in its literal sense? A. I do. 35

Q. And what about walls in the winze? A. The hanging wall which I mentioned before, as shewing in the drift, is very well defined in the roof of the winze, and shews that characteristic dip and strike, about two feet or thereabouts, three feet, above the solid ore referred to before.

Q. Why do you say the vein in the winze is the same vein as the vein in the east drift and the No. 3 tunnel? A. Because I have followed it continuously and without break from the shaft, through the 59 drift, down to the bottom of the winze, it maintaining its strike and dip and the other characteristics. 40

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Q. There is, I believe, a small dyke in the east end of that winze? A. There is.

Q. Is that a dyke, by the way? A. A dyke?

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Q. Yes, is it a dyke? A. Yes, certainly it is a dyke.

Q. What do you mean by a dyke? A. Well, a dyke is a sheet of igneous material which is included along a crack or fissure in the rock.

Q. So that the filling is different from the country rock? A. Totally different, as a rule—a sheet of molten material.

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Q. Do you find any other dykes in that disputed territory? A. Yes, I find a great number.

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Q. Now, about what size is this dyke in the east end? A. This dyke is about 15 inches wide, as I remember it.

The Court: Did you say it was to the east of the winze? A. Yes, sir.

The Court: Feet or inches?

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Q. Just tell his Lordship where you found that? A. I found it first at the end of the 59 drift there, it cuts the ore, and the ore shews again a little east of this dyke: the ~~to say~~—

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The Court: On the other side of it? A. On the other side of it, not very far, but it shews again. Then I find it again on the sides of the winze; I see it in a few places, and I find it again at the bottom of the winze at the east side of it, showing very plainly the same width—about 15 inches. It is here broken through and for an extent of about a square foot or two the ore, mineralized matter, shews to the east of it again.

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Q. Does that dyke have any effect on the vein? A. Not that I can see—no effect.

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Q. Do you see that dyke anywheres else? A. Yes. You see it in a number of places; you see it in the outcropping, crossing the outcrop.

Q. You see it in the outcrop? A. Yes.

Q. I will only take that first. A. It is seen in a great many other places.

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Q. What effect does it have on the vein at the outcrop? A. None that I can see except interrupting it, breaking it to the extent of its thickness.

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Q. Do you find it in vein matter, in other words, in vein matter on both sides? A. I do. In other words, it goes through the vein without any interruption or fault in the vein, along the dyke fissure.

Q. Now, the brown drift you have already described. A. Yes, sir. 5

Q. Now, taking No. 2 shaft next. Do you find any vein in No. 2 shaft? A. I do.

Q. What vein is that? A. It is the Centre Star vein No. 2.

Q. Why do you say it is the Centre Star vein No. 2? A. Because it 10 is the same vein which I have examined in Centre Star No. 3 incline. I know that because I have followed it continuously along its outcrop, and furthermore I followed it even beyond No. 2 to a certain extent—40 or 50 feet anyway.

Q. And what other reasons, if any? A. The character of the vein is 15 similar to the character of the vein I have observed in other places; its strike and dip are also similar.

Q. Now, will you describe the vein which you find in the No. 2 shaft itself down, to, we will say again, the mud-seam? A. At the collar of the 20 shaft a very heavy body of solid ore shews, chalcopyrite and pyrrhotite, and this same body of ore which is from one to three feet thick is exposed along the shaft, to a depth of about 50 feet, I should say from my recollection, and at that place this body narrows and becomes thinner—smaller; it continues, however, as one well defined plane—

The Court: Do you mean downward? A. Down in the shaft, along 25 the incline, as one well defined plane, along which, on both sides of which, there is a great amount of mineralization, a great amount of pyrrhotite—scattered pyrrhotite, chalcopyrite, calcite and quartz—in fact it continues as a very well defined, though narrow, vein. This continues down to a distance of about 30 feet from the bottom; at this place the solid sulphides or ore—solid ore, I might say, widens out again and appears to be, in fact is, 3 or 4 feet thick. It is not absolutely solid, it is mixed with some quartz and country rock. At about 80 feet, or 75 feet, I should say, or 70 feet, from the bottom a different rock begins 35 to come in in the hanging; it is a coarse grained rock, which I have identified as a gabbro; and the shaft continues, principally in that rock, down to its bottom.

Q. What is your explanation of the different rock being in that position? A. That body of coarse grained rock, which is very much tougher, harder, 40 than the rest of the material, may be a dyke or it may be a segregation from the igneous rock while the same was in a condition of molten magna.

The Court: Intrusion? A. Intrusion, yes, my Lord. I am not quite sure as to what it owes its origin.

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Q. What kind of rock is it as far as toughness is concerned? A. As I said before, it is an exceedingly tough rock. It is composed of feldspar and large crystals of augite, and the large crystals of augite gives it a great tenacity, toughness, so it breaks with difficulty.

Q. You may as well go to the bottom of No. 2 shaft with your description here? I think it will be better. A. This coarse rock begins to come in on the hanging wall in the roof of the shaft going down; now, as this coarse rock begins to occupy the whole of the shaft, the solid sulphides, solid ore begins to disappear and disappears and instead for about 20 or 25 feet there is simply an impregnation, a scattering, of bunches of pyrrhotite and chalcopyrite in this coarse rock to indicate that the vein is there. It has, however a very strong mineralization. Now, within about 25 feet, or about 50 feet, perhaps, from the bottom of the shaft, several seams begin again; seams filled with chalcopyrite. These seams, which are 2 to 3 inches thick, or from 1 to 3 inches thick, I should say, continue down unbrokenly, or at least with small interruption, to the mud seam. The rock surrounding the seam is, as before, strongly mineralized, and filled with minerals indicating vein material. Below the mud seam down to the bottom of the shaft bunches of pyrrhotite occur again, scattered bunches; they are especially plentiful in the little recess which is cut back from the main drift at the bottom of No. 2, cut back for a distance of about 4 or 5 feet in a southerly direction; on that recess, over which the water flows, the solid ore is very nicely exposed. The continuation of these seams which I mentioned before as showing just above the mud seam, are not seen below for the reason that they come down at the place—come down against the floor of the shaft, so to speak. There is a recess again put in there and their continuation below could not very well be seen.

Q. That is, they pass into the footwall of the shaft, is that what you mean? A. Pass into the footwall of the shaft, especially if there has been a slight, a very slight fault, they would be completely carried into the footwall; a few inches would be sufficient for that purpose.

Q. Now, what about walls in the No. 2 shaft? A. The walls show at the top very plainly for the whole distance down, until at a place 75 feet from the bottom; the walls are exceedingly well defined at first and they are indicated by the limits of the ore body—of the heavy ore body I mentioned before.

Q. 75 feet from the bottom? A. Yes, sir.

Q. That is the point you mentioned that the gabbro rock came in? A. Yes. From the distance of 75 to 125 feet from the bottom the walls are also very well defined, consisting first of that central fissure which I mentioned be-

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fore, filled with calcite and other minerals, and by another wall above that, a distance of about 2 or 3 feet, showing in the roof of the incline. This wall is very well defined in several places, but in several places it is less well defined. I took its strike and dip and they correspond well with the dip and strike of the vein.

Q. What about below that? A. Below that point for a distance of about 25 feet the walls are not well defined; they do not show, in fact; that is, in this coarse rock, but— 5

Q. What is your explanation of that? A. Well, it is very common to find—in fact, it is the rule to find, that whenever a fracture and fissure crosses a material of different composition from that which it has been traversing before, its character changes, from a clean cut fissure it may change into a splintered up set of fractures and vice versa; the sudden change of the rock influences the fissure very decidedly and very strongly. In this case the fissure passed from a rather fine grained rock, of even, close texture, where it could make a good clean fissure, into a coarse grained, tough rock, and the natural effect of that would be to change its character, to break it up into a number of seams, and cracks more or less irregular. 10 15

Q. Have you seen that sort of thing elsewhere? A. Yes, I have seen it in a very great number of places. I have seen it, and there are some instances I have specially described and mentioned from Idaho, from the Boise Basin, but in fact it is such a common phenomenon it is to be noted in every mining district where there are veins and changes in the country. 20

Q. The one you have mentioned in Boise Basin as one that you have described, that description would be in one of your reports, I suppose? A. That would be in one of my reports, I believe published last year. 25

Q. What did you say as to the continuity or otherwise as to the minerals in No. 2 shaft? A. I should say there was continuous mineralization from top to bottom. The mineralization, of course, as far down until the coarse rock is reached, is exceedingly well defined and clear to anybody. Below it is also exceedingly clear, but the fact that the rock is very coarse renders the mineralization a trifle less easy to see. In a coarse rock the mineralization may have gone on to a considerable extent and still it would be difficult to realize it from a casual look at it. In the fine grained rock it is very much easier to see, and as illustrating this, I might say that at the bottom of No. 2, where that little recess is cut back in the foot, part of that recess is in the coarse rock and the other part, the western part, is in the finer grained rock. The finer grained rock, which shows on the western side, is exceedingly strongly mineralized, as can be seen by the most casual inspection; the eastern side which consists of the coarse rock, is much less easy, although they lie in the same plane and should be 30 35 40

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mineralized to the same extent, the same thing occurs just above the mud seam there, the two rocks adjoining really, appear one on each side of the incline, and the same difference in mineralization is shown.

Q. Is there any other cause for this difference in mineralization than the intrusion of this tough rock that you have mentioned, that you can see? A. No. The tough rock has caused the change in the character. 5

Q. I know, but it is the rock which is the cause of the difference in character? A. The rock is the cause of the difference. Of course there are variations in any vein from place to place. 10

Q. I understand that. A. (Continued.) Mineralization is a thing that changes from foot to foot.

Q. Is there any doubt in your mind as to the continuous mineralization from top to bottom, in No. 2 shaft? A. No, sir, there is not. 15

Q. To where, from the foot of No. 2 shaft, do you trace, if anywhere, that Centre Star No. 2 vein? I will ask you another question first about the No. 2 shaft. How do you find the dip in No. 2 shaft? Does it vary or is it uniform? A. The No. 2 shaft from top to bottom, shows a very fairly constant dip. I should say it is, perhaps, a degree or two steeper than shown in shaft No. 3, may average a little above 40 or 45. 20

Q. What is the dip at the top of it, the first 20 feet or so? A. The dip at the top of it, I believe, is steeper. 25

Q. I am now asking as to the dip of the shaft, and not the dip of the vein. I asked you before as to the dip of the vein. I am now asking as to the dip of the shaft, from the top of it, say down 20 or 30 feet? A. The top of the shaft is steeper at that point. 30

Q. What is the explanation of that? A. It is not sunk right on the outcrop, the outcrop is not right at the collar.

Q. Just explain what you mean. That is, say where the collar of the shaft is, as compared with the hanging wall of the vein, we will say at the collar, and where it is as compared to it 20 or 30 feet down? A. Well, the hanging wall lies a little to the north of the collar in No. 2 shaft, at about the top, and from there on it dips down in a direction about, perhaps, at first, 55 or 60 degrees and then flattening out below. 35 40

Q. You do not exactly see what I mean, I think. I want you to explain how the dip of a shaft which was supposed to follow along a vein, might be different from the vein itself in that shaft, or in a portion of it? A. The

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shaft may not follow the vein, and sometimes it may be in the foot and sometimes in the hanging.

Q. That is what I mean. A. Consequently the dip of the shaft is in no way indicative of the dip of the vein.

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Q. Is that so in No. 2? A. The dip of the shaft and the dip of the vein varies; it is not the same, that is, at the collar. Just how that is I will have to look up my notes to see.

Q. You might look at your notes. (Witness consults a memorandum book.) A. I find this in my notes: That at 10 feet below the collar of the shaft, there is a heavy, 2 foot wide, body of pyrrhotite and chalcopyrite, dipping 52 degrees. The dip of the vein is a little steeper at the collar of the shaft than the dip of the shaft itself right there; that changes immediately below and the vein dips parallel with the shaft.

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Q. Now, Mr. Lindgren, I wish to repeat that question which I asked you a moment ago when I branched off on the question of the dip of the vein in the No. 2 shaft. That is, the question as to what point, if any, you could follow the vein in this No. 2 shaft? A. At the foot of No. 2 shaft?

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Q. Yes? A. I have seen the vein from the foot of No. 2 shaft extending westward to about a point close by Station No. 53; I have seen it extending eastward of the up-raise No. 4 to a point 20 feet east of Station 49, which would be about in here some place (indicating on model.) At this place it cuts into the foot and is no more seen. I measured the strike and dip at various places along in here (indicating on model), along near station 49 and also near station 52, and the average dip I obtained, in fact, it was constant, was 56 or 55 degrees. The strike is very plainly indicated by the course of the drift.

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The Court: By the course of the drift west from No. 4 upraise? A. West of No. 4 up-raise, Yes, your Lordship.

Q. And east, I suppose too? A. And east—well, in both places. The strike being about north 75 degrees west, approximately. The vein at both places, to the east and to the west of No. 4 raise and No. 2 incline, shows very clearly and is indicated by from one to two feet of solid ore, solid pyrrhotite and solid chalcopyrite.

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Q. Is that ore or is it not continuous between those points? A. That ore is without any doubt continuous from No. 2 raise to No. 2 incline. It is furthermore continuous from here (indicating on model), being the foot of No. 2 incline a point a few feet beyond 59.

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Q. What vein is that? A. That, in my opinion is Centre Star No. 2, which I have traced all round from the outcrop down the No. 2 incline and down the No. 3 incline.

Q. Now, have you examined No. 2 raise? A. Yes, I have.

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Q. Do you find any vein there? A. I do. The No. 2 raise starts on a very well defined vein, carrying, as far as I remember, about a foot of solid ore.

Q. What vein is that that it starts from? A. That vein starts, in my opinion, on the same vein that is shown in the drift here, that is, the Centre Star No. 2. The dip at the bottom of No. 2 raise is about 56 or 55, to the best of my recollection—very nearly that; going up it flattens out very soon, as shown, indeed, by this model, and near the top I find a well defined vein, with 1 foot of solid sulphides and with the characteristic dip and strike; the dip and strike is characteristic of the Centre Star vein. I measured it at the time, and if you wish it, I will give it.

Q. You might give it? A. (Consulting memorandum book.) No, I was mistaken. At the bottom of No. 2 raise, the dip is 60 degrees north.

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Q. And it flattens out to about what? A. It flattens out to 40 degrees, a strike very nearly east and west. That is to say, at the top of the raise I found a vein dipping 40 degrees north and striking east and west—very nearly east and west.

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Q. Now what conclusion do you come to from that dip and strike, as to that being or not being the Centre Star No. 2 vein? A. In my opinion it is the same vein as I have followed coming down the No. 2 shaft and along the drift and up again in No. 2 raise; it is unquestionably the same vein. The change in dip, the local change in dip there, is a thing that is very apt to happen in any vein. I think the probabilities are, if you went down on it, the vein would be found to resume its normal dip. Such local occurrences are a matter of very common occurrence in fissure veins.

Q. Now what about the vein in No. 2 raise as to continuity? A. At the bottom there is a well defined vein shewing five inches of solid ore and walls about five feet apart.

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The Court: Hanging and foot wall? A. Hanging and foot wall, yes.

The Court: Well defined? A. Well defined. A short distance up from the bottom this seam of solid ore grows very thin, and for some distance above and below the mud-seam there are only bunches of pyrrhotite scattered through the rock. The rock is heavily mineralized but for some distance it is

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poor. Going up again, the solid ore appears at a point about 60 feet up from bottom, or 30 feet down from the place the solid ore appears again, and continues to the face, about a foot thick.

Q. Is there anything unusual in ore becoming thin in spots, in that way? 5
A. No, that is an exceedingly common occurrence. In fact, there is no fissure vein in the world that I know of in which local pinches and impoverishment of the ore does not take place.

Q. Now were you up the No. 4 raise? A. Yes, sir. 10

Q. Do you find a vein in there? A. I found a strong vein, about two feet wide, of solid pyrrhotite and chalcopirite, going up that raise, and it was very steep dip.

Q. What would you say about that vein? A. I do not know enough 15
about its extent to be able to venture a definite opinion about it. It is only shewn in this raise and it may simply be an offshoot of this Centre Star vein No. 2, or it may possibly be an independent vein; I could not say; the exposures are not sufficient to enable me to tell.

Q. Now, you know the mud-seam that has been referred to in this action?
A. I do.

Q. Commonly called the flat fault? A. Yes, sir.

Q. Have you made an examination, thorough examination of that? A. 25
I think at all points where it is exposed.

Q. At all the points where it is exposed. There are something like a dozen of them, I believe A. I should say so, something like that, I don't 30
know exactly.

Q. Is it the same mud-seam that you see exposed at these various points?
A. It is, to the best of my judgment it is the same mud-seam. It is a persistent seam, and there are no others apparently, and it is always encountered in the same place where you would expect it, so I judge from that it is one and the 35
same.

Q. Well, have you any doubt about it yourself? A. I have not.

Q. About what is the general dip and strike of that mud-seam? A. 40
The average dip I should say was about 35 degrees north, and the average strike is north 70 degrees.

Q. And the dip was what, did you say? A. Thirty-five degrees north.

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Q. It dips to the south? A. It dips to the south—of course, it does, 35 degrees south.

Q. You might just give his Lordship an idea with this piece of blotting paper what the dip and strike of that is. A. The strike is before shewn along the Iron Mask drift from point marked "X" to a point marked "107." It is practically exposed for the whole distance, or almost the whole distance. 5

Q. About 300 feet, is it not, or over? A. I should say it is about 300 feet; I don't know exactly, and it dips down in this manner, like this, dipping (illustrating) down southward, and in this instance cutting the bottom of the winze at the end of 50 drift as shewn here in this place, and coming above this yellow drift Centre Star No. 1, I believe. 10

Q. Centre Star No. 2 it is called. A. Centre Star north drift. 15

Q. Between stations 40 and 41.

The Court: Does that mud-seam appear at the top at all in any place?

A. At the surface?

The Court: Yes. A. No, it does not. 20

The Court: Anywhere? A. No, not where I have seen. On the surface it would appear somewhere away over there, but it would be unlikely to shew on the surface. There is no characteristics of it except crushed rock, and that would not be apt to shew on the surface at all. 25

The Court: There was nothing to crush it? A. No. Shall I describe the mud-seam?

Q. Yes, take the various points where you find the mud-seam and describe them carefully, speaking of the effect, if any, the mud-seam has at various points, and especially at these points where it intersects the vein. Mention first, without saying anything about it at all, at what points you find this mud-seam. 30

A. Do you wish me to give them in any order?

Q. Take the order that you will take it up afterwards in describing it. 35

A. Very well.

The Court: Go from east to west, would you not?

Mr. Davis: Well, probably the same way that he has them down in his note book; that he will remember most easily. 40

The Court: It would be easier for me to remember them from east to west or west to east, because it is quite easy for him to find that out.

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Q. From east to west say. And you want to take the red level first.

The Court: Let him do as he likes about that, but from east to west.

Q. Give the points where the mud-seam is seen, and then you may describe them afterwards. A. At point marked "X" in Iron Mask tunnel; from there on continuously to a point approximately 20 feet west of 47 in the same tunnel.

The Court: Just on the lower level now you are talking about. A. On the lower level.

The Court: That is on the lower level of the Centre Star. A. On the lower level of the Centre Star, and in No. 1 crosscut south. In Centre Star No. 2 tunnel; in No. 4 upraise.

The Court: Whereabouts, at the foot of it? A. About 20 feet above the bottom; in No. 2 incline about 16 feet above the bottom; in No. 2 raise, about 40 feet above the bottom; in Centre Star north drift at 47 and 48; in the same drift at No. 3 raise, this locality (illustrating on model); in the same drift at 37 and 38; in the Iron Mask winze 25 feet; in the Iron Mask winze 40 feet.

Mr. Bodwell: You said 25 feet. Are you mentioning two places? A. Did I say 25 feet just now?

Mr. Bodwell: Yes. A. I meant 25 feet below the Iron Mask level.

The Court: Then 25 feet below the Iron Mask level, you find it in the Iron Mask winze? A. In the Iron Mask winze, yes your Lordship.

The Court: And that is west of the Iron Mask drift No. 57, is it not? A. West of the Iron Mask drift No. 69; finally in the bottom of No. 3 incline, and in the bottom of the winze leading down from 59 drift Centre Star.

The Court: In the bottom of Centre Star winze? A. In the bottom of 59 drift; in the winze leading down from the Centre Star No. 59 drift. Those are all of the localities as far as I remember.

Q. Now, will you take them one by one, Mr. Lindgren, and say how you find the mud-seam there and its different characteristics and what effect it has, if any, upon the different veins it encounters. The first point you took up is what? A. The point "X". At the point "X" I find the mud-seam faulted about 8 or 9 feet south by a fissure parallel to a dyke which shows about 10 feet from the point marked "X".

The Court: That would be a vertical fissure? A. A vertical fissure, yes. Ten feet from the point marked "X" and there are two dykes, each per-

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laps five feet in thickness, as far as I can remember. Between those two dykes is a vertical fissure. At that vertical fissure the mud-seam appears again and continues unbrokenly westward for a distance of about 300 feet.

The Court: Eastward, do you mean, or westward? A. Westward in this direction. In the dyke the mud-seam traverses— 5

The Court: That is near point "X." A. Near point "X" the mud-seam traverses westerly of those two adjoining dykes, and in that dyke it is a comparatively narrow fissure and a couple of inches wide, I should say. 10

The Court: Does the dyke cut the mud-seam or the mud-seam cut the dyke? A. The mud-seam cuts the first dyke, and going eastward it also cuts the second one, but the cutting, I think, is thrown back to this point. Immediately westward of the point where it meets this vertical fissure, it continues increasing in width. 15

The Court: Westward from point "X." A. Westward from point "X," and reaches perhaps 6 or 7 inches in thickness.

The Court: You did not say what was the thickness; you did not start with any thickness. What thickness was it when you started the mud-seam? A. At this place, point "X," in going through this drift—I had better consult my notes, because the number of the measurements are different, remember. (Referring to book.) The thickness of the mud-seam where I first encountered it, the point "X," is only a few inches, 4 or 5 inches, and the thickness of the mud-seam at the next place I find it, to the west of the fault, that is at this place about 20 feet. 20 25

The Court: To the west of the dyke you mean. A. To the west of the dyke, is only about an inch or two, that is while it traverses westwardly of the two dykes. 30

The Court: The place between the two dykes,—where it traverses the place between the two dykes. A. No, the fissure lies between the two dykes, and the mud-seam goes through one of them, and one of them comes through the— 35

The Court: There are two dykes and an intervening fissure? A. Yes, sir.

The Court: Parallel to them? A. Parallel to them. 40

The Court: You say the mud-seam cuts the dyke, but it does not cut the fissure—the fissure cuts it. A. The fissure cuts the mud-seam, yes, sir, at a point 10 feet east of station 45, that would be about this place (illustrating on

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model), the mud-seam dips 39 degrees and shews a thickness of five inches of finely ground-up material.

Q. Does that mud-seam cut both of those dykes, Mr. Lindgren? A. Yes, it does, but the cutting of the second one I think was at this place (illustrating on model); it comes through the first of them and comes through and strikes this fissure; it throws it back to this place. 5

Q. That is the eastward dyke? A. That is the eastward dyke. 10

Q. Is it earlier or later than the mud-seam, or have you seen it? A. Both of the dykes are earlier than the mud-seam. Then at the next place, station 46.

Q. You might, before you go to another point, Mr. Lindgren, state what effect, if any, the mud-seam has upon the rock above and below it, whether there is any particular point of shattering or crushing of the rock, or not, and in each case you might speak of that. A. As far as I go along. At station 46 the mud-seam dips 45 degrees, its thickness is four inches, and below it— 15

The Court: Forty-six is over here (illustrating). A. Forty-six is this place (illustrating on model). 20

Mr. Davis: The numbers are duplicated in some cases.

Q. Forty-six, on which level? A. On the Iron Mask level. 25

Q. The red level? A. Yes, sir; and immediately below it there are some indications of sheeting, that is to say, the rock for a foot or two or a few feet below it is finished up roughly into parallel sheets, which very often takes place along the sides of a fracture, both sides of a fracture. 30

Q. Co-ordinating fractures? A. Co-ordinating fractures, but the rock is solid and hard, and there is no dislocation except at the actual mud-seam.

Q. How was the rock at the first points that you have mentioned, "X," above and below the mud-seam? A. I have no special notes of it here. As far as my recollection goes, I think there was a little sheeting of the same kind; there certainly was not much, because there was solid rock immediately below and above. The next place would be at station 104, that is here (indicating on model). 35

The Court: On the Iron Mask drift? A. On the Iron Mask drift, and the mud-seam here dips 42 degrees south, and is eight inches wide; it carries a little calcite and shews some fracture, as before, below, at 47 it is displaced here (illustrating on the model). 40

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Q. East of the big vertical dyke? A. Yes, on the Iron Mask drift, the dip is 33 south and the thickness is here 14 inches.

The Court: The thickness of the mud-seam? A. The thickness of the mud-seam.

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The Court: Fourteen inches? A. Fourteen inches, and the rock above and below is sheeted, roughly sheeted to the extent of a foot or two I guess, to the best of my recollection. This sheeting, as I say, appears in a great many places, but nowhere is there any indication of any movement along it; that is to say, that is of any importance, except as indicating that the force which created the mud-seam also acted to some slight extent on the rock immediately adjoining it above and below.

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The Court: The next point you took was the Iron Mask winze, wasn't it? A. Yes.

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Mr. Bodwell: The next point is the No. 1 Centre Star. A. I will also mention that a short distance west of 47 the mud-seam encounters a large dyke.

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The Court: In the Iron Mask drift? A. In the Iron Mask drift, the mud-seam encounters a large dyke, perhaps 10 or 11 feet wide. It goes through part of it, but in about the middle of this dyke it strikes a fissure, strikes a vertical fissure running north and south—and from there on westward I have not seen it in this drift. It indicates to my mind clearly that the mud-seam has been faulted along this vertical fissure in a similar manner.

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The Court: Now, the large dyke is the well known large dyke that runs here from this elbow west to the No. 3 of the Centre Star? A. The top is the same, but the fissure does not necessarily follow the same place in the dyke.

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Q. That dyke that you speak of is only one of the two dykes. A. I know, but it is in the larger one.

Q. This is the first of those dykes, is it? A. Yes, sir.

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Q. The most easterly one? A. Westward.

Q. Was there something more you want to say? A. No, it proved to my mind the mud-seam westward, the continuation of the mud-seam has been faulted.

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The Court: Interrupted. A. Interrupted, yes, and carried on down to some other place. I have not been able to find it in this drift from this point.

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The Court: In the Iron Mask drift westward to what point have you not been able to find it? A. Westward of a point 20 feet west of 47.

Mr. Davis: There are one or two general questions I want to ask you before you leave the Iron Mask water-course and mud-seam.

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The Witness: I think that is all in regard to this drift.

Mr. Davis: I want to ask the witness two or three questions.

Q. The mud-seam you stated evidently varies considerably, as you have stated, from 3 to 4 inches to, I think, the widest place you mentioned is about 14 inches? A. The widest place so far is about 14 inches which I have described.

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Q. There is another place where it is wider than that? A. Yes, it goes up to two feet.

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Q. What sort of a thing is this mud-seam, what is its geological explanation? A. It is a fracture in the rock; it is a plane along which a fracture has taken place.

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Q. If it had been filled with mineral it would be, I suppose, a vein? A. Yes.

Q. Then it is the same kind of a fracture that you find in a vein? A. Exactly.

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Q. Only the filling is different? A. Exactly.

Q. No mineral matter.

The Court: Similar to a vein fissure? A. Similar to a vein fissure, exactly similar to it, only it is not mineralized.

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Q. Now, what is the nature of the filling that you find in the mud-seam; what is the source of that filling? A. The filling in the mud-seam is an attrition product.

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Q. Explain what you mean by that? A. Simply the rock of the immediate vicinity ground up by the compressing force which produced this plane. Any stress, shearing stress of this kind, producing fissures is necessarily accompanied by a great deal of breaking and shattering. Sometimes this shattered zone will be wider and sometimes it will be narrower. In this case the shattered material is from a few inches up to a few feet thick, and it follows the fissure or seam pretty continuously; it consists of ground-up rock from the immediate vicinity simply.

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Q. When you say immediate vicinity, what do you mean by that? A. I mean from the vicinity, that the rock for a distance of about from a few inches to a foot has been ground up in place.

Q. That is, it is what was country rock? A. What was the country rock? 5

Q. Between hanging and foot wall of the fissure? A. Ground-up.

Q. So it is not foreign matter. A. Oh, not at all; it is simply a rock from the adjoining space. 10

Q. And then, it has a course, that water flows over? A. Yes, evidently, because it carries water in a number of places and the filling has been reduced to a sort of mud in places which we can easily pick with your hammer, and it indicates that the water has been percolating it, and that it has formed a close water-course from which the water could not very well spread out below, but it was closely confined to this seam or opening. 15

Q. Now, then, is the water-course co-terminous with what you have spoken of as the mud-seam? A. Yes, it is the same thing, only two different names for the same thing. 20

Q. Now, does any of the water flowing in that mud-seam, or which has flowed in the mud-seam at any of the places where you have examined this, has it passed below what you speak of as the mud-seam, that is the seam containing this attrition mass? A. I should not think it would have; it is solid rock. 25

Q. Where would the mud-seam necessarily be? A. I don't know that I quite understand the question. 30

Q. It is a little indefinite but it has been said that the mud-seam is at the top of the flat fault, and by flat fault has been defined to be the mud-seam, and several feet of rock on either side of the mud-seam? A. Yes, sir.

Q. Now, must the mud-seam or water-course necessarily be? A. If there is a wide zone of broken material which is open to the circulation of water, the water would necessarily course through it from top to bottom. If there is an open passage way in this fault and below and above this solid rock, only sheared to some extent, the water could not naturally pass in any other place but along the seam. 35 40

Q. So that the water would be bounded at the bottom by the solid rock. I suppose that is a thing that it is not necessary to ask about, but is that correct, that the water at the bottom would be bounded by solid rock? A. Oh, yes, certainly. If the rock were not solid it would not hold the water.

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Q. What is the size of the attrition mass which you say varies at different times from 2 to 3 inches to two feet, to what is the size of that attrition mass due? A. It is primarily due, I should say, to the inequalities of the surface along which the principal break was made; the first break, as the force was applied, was naturally formed, in more or less irregular surfaces, little joints and little rocks. As the force continued its friction, these rocks ground one against each other, as the slight movements which have evidently taken place, under the influence of the movements which have suddenly taken place, and the attrition mass is the result of this grinding of the uneven surfaces. There are also other causes which might contribute to its thickness, such as the hardness of the rock, the local concentration of the force, and several other factors like that, but the principal factor is no doubt the inequalities of the surface.

Q. Can you say whether or not there has been a very great movement, or what movement along this fractured plane constituting the mud-seam? A. I have some definite information on that point and it clearly points to the fact that there has been an overthrust, a reverse fault I should say, amounting to about a foot and a-half or something like that. The evidence of that comes from many places, and is very convincing.

The Court: What do you call a reverse fault? A. A vein is cut, we will say, by a fault plane. Now, if the hanging wall slides down along that fault plane, a normal fault is said to have occurred. If the hanging wall on the other hand slides up, or is pushed up—because it could not slide up of itself—a reverse fault is said to have occurred.

The Court: The expression "overthrust fault" is a synonym for "reverse fault"? A. Yes.

The Court: If the foot wall slides into the hanging wall, or is lifted up, it is called reverse? A. Yes, it simply refers to the relative movements, because we can never be quite sure which wall did actually move.

Q. Does that mud-seam cause a reverse fault at either point where you see it? A. There is one place at which it seems to have caused the normal fault of a slight throw of a few inches. Shall I mention the place?

Q. You may mention it. A. I mean at station 48. There are also two places at which the movement along the mud-seam seems to have been very slight, not perceptible. Those places are the south cross-cut No. 1, south in the Centre Star No. 2 tunnel, and at No. 3 raise in Centre Star north drift. From station 42 (referring to model) Centre Star north drift westward in a general direction, the evidence seems to be very good that the movement has been in the nature of a reversed fault.

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Q. How would you explain, or what is the explanation of the fault being different at different places; it might be a normal fault at one place, and a reverse fault at another? A. When you have a fault, a very slight throw like this, when the movement only approximates a few inches, or at most a couple of feet, the different parts of a fault may be thrown in different directions by a sort of rotating movement, so that in some places we may have a flat fault and other places we may have a slight normal fault, and in several other places we may have a slight reverse fault. 5

The Court: Would it depend at all on the character of the rock it passed through, whether hard or soft? A. No, I don't think it would depend on that very much; it would depend entirely on the character and direction and the force which moved the vein on this fault. 10

The Court: If you find, for instance, a vein above the seam, the vein above the seam is higher up than the vein below the seam, no matter which was moved up, the other moved down, you would call it a reverse fault, do I understand you to say? If you could not say it was moved up or down, as I understand you, you would call it a reverse fault, if the upper part of the vein above the seam was any distance above the vein that was cut off? A. The vein in hanging? 15

The Court: By the mud-seam? A. Yes, sir. 20

The Court: You would call it then a reverse fault, would you? A. Yes, sir, if the hanging wall has moved relatively to the foot wall.

The Court: Now, in looking at the relative positions of the vein as cut, and the ore above the seam is above, the other below the seam, would you call that a reverse fault? A. Yes, if you will permit me to illustrate it a moment (illustrating on blackboard). If this is the fault plane and if a vein comes down here, and if you find the continuation of this vein here (indicating), then it is a reverse fault. 25 30

The Court: So it does not matter whether the movement occurred above or below? A. Exactly.

Q. And if it appears on its side, then it is a normal fault? A. And if on the other hand you find the hanging wall down here, it is a normal fault because this upper part has then slid down by a movement in that direction. Of course, if this may have been accomplished by the foot wall moving up in that direction, it is only a relative movement. 35

Q. In this Iron Mask drift or water-course, the flat fault meets no veins, I believe? A. It does not. 40

Thereupon an adjournment was taken to 2:30 o'clock p.m.

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AFTERNOON SESSION.

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2:30 o'clock p.m.

WALDEMAR LINDGREN—A witness for defendants, on the stand.

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DIRECT EXAMINATION RESUMED.

By MR. DAVIS—

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Q. Before we go on with the flat fault, Mr. Lindgren, you have some slides that I want to prove by you, although they will not be used until later, perhaps not at all. They were got chiefly for the purpose of shewing there were a number of dykes through this disputed territory and I wish merely to prove them now. This box you have handed me contains what? A. Fourteen thin sections or thin slices of rocks. 30

Q. From what were they taken? A. They were taken from fourteen samples which were sent to me by Mr. Ferrier of this place. 35

Q. Had you anything to do with the taking of them? A. I had not, no.

Q. When and where did you first see them? A. I received a package addressed to me. 40

Q. How did it come, post or express? A. It came by express and was delivered to me by the agent, directly to me by the express agent.

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Q. How were they done up? A. They were in a small wooden box sealed with the seal of the express company.

Q. What was that seal, do you remember? A. Great Northern Express Company, I think.

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Q. At any rate, it was the regular express company's seal? A. It was the Great Northern Express Company's seal.

Q. Where was it you received these? A. I received these specimens at my office in the City of Washington.

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Q. What did you do with them? A. I kept them under lock and key a couple of days and then brought them down to have sections made of them by a firm in Washington—microscopical sections.

Q. Were you present while they were being made? A. I was from beginning to end.

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Q. Did they ever pass out of your possession? A. They did not.

Q. After the sections were made, what did you do with them? A. I put them in a box and sealed them and kept them under lock and key until I arrived here.

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Q. You brought them up here with you? A. I brought them here with me.

Q. And these are the ones? A. Those are the ones.

Q. The box of sections was marked Defendants' Exhibit 139.

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Q. Now, in going over the points at which you saw the mud-seam you had arrived at Iron Mask drift and the water-course and had finished that. What is the next point where you saw it? A. (Referring to the model.) The next point is in No. 1 cross-cut south, Centre Star No. 2 tunnel. I found it there a distance of 50 feet from the mouth of the cross-cut, from the beginning of the crosscut. It forms a small fissure about three or four inches thick filled by the usual fine aggregate of small particles, mud, practically.

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The Court: Is there a number at the mouth of that small cross-cut? A. It is No. 51, yes.

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Q. (By the Court): Then, from the start of the cross-cut No. 51. A. Yes, 50 feet from it. At that place I do not remember any particular shattering or sheeting of the country rock in the vicinity. It has its normal dip of 30 degrees, as I remember it; and cuts at that place a vein shewing some—

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Q. Allow me to interrupt you one moment. When you speak of shattering anywhere in connection with this flat fault as you have spoken of, do you mean anything more than shearing, and if so, what? A. No, I mean a jointing or breaking up of the rock in the vicinity so as to show that it has been broken by some force.

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Q. Broken up in what way? Can you explain it on the blackboard so we will get a clear idea of what it is? A. The ordinary condition of the mud-seam—and that applies to the majority of instances which I have seen—is a fissure dipping down this way, perhaps a little more than I have indicated it, about 30 on the average, which is from two to three up to six and even 12 inches, in one or two places more, thick, in this manner. This is filled with what is generally called mud, that is, the finely ground-up country rock. Below it and above it sometimes appears in a number of places—not always but often—small fissures like this (illustrating on the blackboard), jointing, showing a slight jointing of the country rock, and sheeting, without diminishing the solidity of the rock, the rock is perfectly solid and would not permit the water to percolate through it; but it is enough to show to the eye that some sheeting, some disturbance of the rock, has taken place in the immediate vicinity.

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Q. I interrupted you when you were describing the flat fault as it occurs in the No. 1 cross-cut south? A. (Referring to the model.) At this place it cuts across a small vein which has a dip of 40 degrees, as I remember it, north, and which has a strike carrying it in the direction of the point 49. The vein is not dislocated or thrown by the mud-seam in any appreciable way that I could determine.

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Q. What vein do you take that to be which you have just mentioned? A. It is in the position of the Centre Star No. 2; that is to say, it is about in the place where you would expect to find the vein between raise No. 2 and incline No. 2 if it were prolonged in that direction.

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Q. And you say it has a corresponding dip and strike? A. Corresponds in dip and strike, yes, sir, approximately, closely.

Q. Are there any other reasons why you would suppose it to be that vein, and are there any reasons why you would suppose it not to be that vein? A. In that particular place that is about the only reason, except that the ore is very similar to that found along that plane; in fact, very similar. The next place where I found the mud-seam—

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Q. One moment, before you leave that place, Mr. Lindgren.—You say that you can not find any displacement of the vein by the mud-seam there? A. No.

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Q. Has the mud-seam had any effect upon the vein at that point that you could discover? A. No. It shows no effect whatever; that is to say, the vein shews above as thick and as much solid ore as it does below.

Q. Does it appear immediately above and below? A. Yes.

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The Court: In this cross-cut? A. In this cross-cut. There was a little drift run in here when I was there, for a distance of 15 feet, I believe it was then, in a westerly direction. And that drift shows the mud-seam and the vein very well indeed.

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Q. The next point is what? A. The next point is in Centre Star No. 2 incline. At that place the mud-seam cuts across the vein 16 feet, I should say, from the bottom of the Centre Star No. 2 tunnel.

The Court: Not Centre Star No. 2 shaft? A. It cuts across Centre Star No. 2 shaft or incline at this place, 16 feet above the bottom of Centre Star No. 2 tunnel at about this place (indicating on the model). At that place the mud-seam is well-defined, has a dip of—I will have to refer to my note book. It has a strike approximately east and west and a dip of 28 degrees to the south. The thickness of the mud or ground-up material in it is from 5 to 10 inches. And there is no extensive shattering or sheeting of the rock, as far as I remember. The rock below the mud-seam—from the mud-seam to the bottom of the drift—contains a good many joints, however, but is firm and solid. The mud-seam does not seem to have—there does not seem to be any change in the vein above and below the mud-seam.

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The Court: Where is that? A. At this place, No. 2 shaft. The vein is poor above and below; it shews bunches and little streaks of pyrrhotite and chalcopyrite above and below the mud-seam. It is poor above and below.

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Q. What displacement, if any, did you notice there? A. I could not determine any displacement. There is simply a wide, heavy mineralization shewn at that place, and there is nothing—no definite points by which to determine displacement if any such took place. The next point is before No. 4 raise. The mud-seam which cuts across the No. 2 incline at this place continues and necessarily connects with this dyke as shewn by this triangle, and necessarily cuts No. 4 raise at this point.

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The Court: At a corresponding height on the No. 2 raise? A. The corresponding height on No. 2 raise, yes. I examined it at No. 4 raise. The vein shews above and below. It is rather heavy below, I think two feet of more or less solid pyrrhotite. Above it is somewhat poorer, but the vein is still there. I could not find any dislocation, at least, I could not prove any dislocation at that place, and I do not believe that any dislocation of any importance has taken

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place. The next locality is in No. 2 raise where I find it at a distance of 40 feet from the bottom and dipping down as usual in a southerly direction so as to carry it just a short distance above the Centre Star north drift.

The Court: At number what? A. At No. 44, I should say (referring to the model). At No. 2 raise I will give you the dip as I took it. (After referring to memoranda). I find I did not measure the dip, but I made an actual sketch of the place from which it appears the dip is about 30 degrees. The thickness of the attrition material in the mud-seam is one foot, and there is a slight movement of sheeting above and below.

The Court: At which particular place? A. At No. 2 raise, about this locality right there.

The Court: And downwards? A. And downwards, yes. Three feet above the actual mud-seam at this locality is another seam, very small, but still pretty distinct, which is somewhat flatter; it can not be confounded with the mud-seam, however, it is very distinct. I only mention it to place it on record.

The Court: Does it cut the No. 2 upraise at all? A. Yes, the mud-seam here cuts the little seam above it, cuts the No. 2 raise and cuts the vein. The vein, however, here is poor.

The Court: You mean below? A. The vein is poor above and below.

The Court: You mean the vein above the main seam above and below is poor? A. Yes, sir. The small seam above has nothing to do with the main seam. The vein is somewhat characterized by bunches and streaks of pyrrhotite and chalcopyrite. That, I believe, is all.

Q. What about displacement at that point? A. There is no displacement that I could measure, and had there been a slight displacement I would probably have been unable to determine it, because there is no data from which to measure it.

Q. At this place the same as at the other places you mention here there was no apparent displacement; could there have been any large amount of displacement without your noticing it? A. Oh, no, I should think not; it is impossible in fact, because it would have thrown the vein so that you would find a distinct break; you would find vein material coming up below and you would find barren country rock above if there had been a large throw. Certainly there has not been any such throw as that.

Q. At that point does the mud-seam have any effect on the vein that you could see? A. No, it does not. As I said, the vein is poor above and below.

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The Court: The displacement of the vein would be, I suppose, either north or south?

Mr. Davis: Yes, either toward the foot wall or hanging wall.

A. (Continuing.) The next point at which I found the mud-seam is at station 48 Centre Star north drift. That is in the direct continuation of the mud-seam as exposed above in inclination No. 2. It comes down just like this triangle which I hold. At station 48 it measured a dip of 29 degrees and the thickness of the mud-seam is from two to four inches. At this place I should say there is no great sheeting that I could observe above or below; the rock is solid above and below this mud-seam. At this place, namely, station 48, it cuts a vein which extends nearly vertical, which is narrow, only from 2 to 6 inches, I think, of solid ore, of solid pyrrhotite.

The Court: A separate vein? A. Yes, a separate vein.

Q. What vein is this that is cut? A. That is a vein that I take to be the Iron Mask vein. At the place where it cuts this vein the vein shews a slight displacement apparently in the way of the normal fault. It is only, however, a few inches, or a foot, possibly.

The Court: That is in Centre Star ground as you are shewing it? A. Yes, but it is the continuation of the Iron Mask vein, the Iron Mask vein being indicated in that direction into Centre Star ground. The mud-seam shews from 48 to 47 for a short distance, and beyond that going westward it is not seen for a long distance, passing evidently in the hanging above, in the roof, I should say, above the drift. This would about represent the actual plane of the mud-seam.

Q. The point 48 you refer to is on Centre Star tunnel No. 2? A. Yes.

Q. At 48 you say there is a slight displacement, normal? A. Yes.

Q. Outside of that slight displacement, has the mud-seam had any effect, or the flat fault as it is called, any effect upon the vein which it cuts? A. No, it has not. The vein is very narrow, and I should say the only difference is that above the mud-seam it is rather narrow—it is two or three inches—and below the mud-seam it is pretty thick, about six inches. But otherwise, that might happen at any displacement. Now going westward the next place I find it is in No. 3 raise. At that place it appears between sections 42 and 43.

The Court: Near the dividing line of the Centre Star and Iron Mask?

A. At this place the mud-seam appears as a tight seam in the foot wall on the

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south side of the drift and about 12 feet above the bottom of the drift there is a little bit of raise there as indicated here, coming up about 18 feet.

Q. When you say "tight seam" you mean there is no mud shewing there?

A. There is no mud shewing there.

The Court: No. 3 raise then (I want to get it in the notes) is about 18 feet? A. No. 3 raise is about 18 feet high, yes. But on the north side of the north side of the same raise the mud-seam increases in thickness to about 3 or 4 inches. I mention this simply because I was in slight doubt whether it was the mud-seam and in following it up around the raise to the north side, it widened out and presented the usual characteristics of the mud-seam.

Q. When you say 18 feet—No. 2 raise is 18 feet—do you mean from the bottom of the tunnel? A. From the bottom of the tunnel.

Q. Now, what about shearing at that point where you saw the mud-seam? A. There is no shearing that I can remember at all. I don't remember any.

Q. It cuts no vein there, does it? A. Yes, it does; it cuts the vein which I have reason to believe is the continuation of the Iron Mask vein as shewn in the Centre Star north drift.

The Court: Then the Iron Mask vein does appear, you say, in the Centre Star north drift? A. I do, yes; that is, the Iron Mask vein in my belief. But it shews no dislocation that I can observe. The vein is very small there; in fact, only a seam as far as I can observe there is no dislocation.

The Court: Is it admitted that that is the Iron Mask vein there?

Mr. Davis: I do not know, my Lord.

Mr. Bodwell: No, it is denied.

A. (Continuing.) This is the only place for some distance in which the mud-seam appears as both east and west of No. 3 raise. It necessarily would come above the roof of the Centre Star north drift.

Q. Where do you see it next? A. The next place you see it—I believe the next place I gave was in Iron Mask winze 25 feet from the collar; the Iron Mask east winze 25 feet from the collar of the winze. At that place the dip is 31 degrees to the south and the thickness of attrition material is 10 inches.

Q. What about shearing? A. I have noted no shearing, and I can not remember any taking place at that place. Here it cuts a vein which I believe to be the Iron Mask vein. The strike of which follows this red drift.

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Q. The Iron Mask east drift? A. The Iron Mask east drift.

The Court: Just below the stope? A. Just below the stope. In fact, it is the Iron Mask vein; it is admitted, I believe. The vein can be followed down 20 or 25 feet in the winze until it strikes this mud-seam. At that place where it strikes the mud-seam it is in the hanging of the winze; that is, in the extreme north side, in fact, on the northeastern corner and from there downward, the Iron Mask vein is not visible any more. 5

The Court: Down the winze? A. Yes, down the winze, for some distance anyway. And I believe that the Iron Mask vein there goes into the hanging of the winze so that it would not be visible. I think a slight reverse fault has taken place—I mean to say a slight fault has taken place, by means of which the Iron Mask vein below the mud-seam has been thrown a few inches in the hanging. That would suffice to carry it from observation. 10

The Court: That is below the mud-seam? A. Yes. 15

Q. Did you pick in below the mud-seam at that point? Was it in there that you picked in? A. I picked in just above the mud-seam, and I found ore.

The Court: In the Iron Mask winze? A. In the northeast corner of the Iron Mask winze. I found ore there, shewing that the Iron Mask vein goes down to the mud-seam. 20

Q. Below the mud-seam did you find it? A. I did not find it until I came down in the Iron Mask drift 69. The reason for that is that the winze is not exactly as shewn here. The wall is curved this way, southward, so that the winze is temporarily obscured from the view. 25

The Court: Bent? A. No, the vein is not bent, but the wall is bent.

Q. Did you find any ore in the Iron Mask winze below the mud-seam above 69 east drift? A. I found quite a good deal of ore at a place 10 feet above station 16, which would be about in here where I hold my pointer. (Referring to model.) 30

Q. What I want to get at is, how far below the mud-seam do you find that ore? You say you found some ore in the Iron Mask winze below the mud-seam. How far below the mud-seam is it? A. I do not remember exactly. (It is 25 feet from the collar down to the mud-seam; the total depth is 60 feet, I believe; that would give 35, and then from that bottom of this drift up there is 10—)well, I should say for about 16 or 18 feet. 35 40

Q. Have you your notes on that, Mr. Lindgren? A. This thing is shewn much better on a section here.

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Q. Well, take a section then. A. (Referring to section G-II.) This is a perpendicular section through the winze. (Exhibit 21.) I stated that I could trace the Iron Mask vein down to the mud-seam. This indicates the mud-seam, and from here on——

The Court: From the mud-seam on? A. From the mud-seam on down to the Iron Mask No. 69 east drift the Iron Mask vein would lie in the hanging of the winze. 5

Q. Was it seen there? A. (Continuing.) So that it would not be seen I picked in under the mud-seam there, and I found some ore. 10

Q. That is what I wanted to get at? A. Yes.

The Court: Then you made that little sag that has been spoken of there? That place has been spoken of as a sag? A. Yes. 15

Q. Then you found ore both above and below the winze? A. I found ore there. What I mean to say by above: you can trace it continuously to the level of the Iron Mask drift and below I could not trace it continuously from the mud-seam down to the 69 east drift. 20

Q. What about shearing above and below the mud-seam in the Iron Mask winze? A. There is not any shearing in that locality that I can remember at all.

Q. Where do you see it next? A. The next place I think would be in the bottom of Centre Star No. 3 shaft. 25

Q. Describe the conditions there and of the bottom of Centre Star No. 3 shaft? A. At the bottom of the Centre Star No. 3 shaft the mud-seam cuts across about 8 or 10 feet from the actual bottom of the shaft itself. It is perhaps best exposed under the eastern side of the shaft—the eastern side of the pit of the shaft I might say. And it has at this place a dip of from 33 to 35 degrees, and a thickness of—— 30

The Court: What height did you say it was from the bottom of the shaft? A. (Referring to notes.) Eight feet above the bottom. The mud-seam is about a foot wide, I should say, and consists of the usual soft attrition material. It is shewn across the shaft and the sides, and can be traced up towards the dyke on the west side of the shaft. However, the mud-seam is a little bent at this place; that is to say, it does not quite preserve its strike and dip, but as it approaches the dyke it is bent upward a little. 35 40

Q. Flattened, do you mean? A. No, bent upward as you look at it facing north. And this is undoubtedly due to the dislocation which has taken

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place parallel to a plane lying near the western side of the No. 3 shaft. And the same influence is shewn in the hanging wall of the Centre Star No. 3 which at this place also bends upward a little.

The Court: Has that been caused by the dyke? A. That, in my opinion, has not been caused by the dyke, but by a subsequent dislocation which has taken place along the dyke. 5

Q. Just explain what you mean by that, Mr. Lindgren? A. The dyke itself did not cause any very great dislocation, in my opinion; but a dislocation has evidently taken place, a dislocation of some moment along a plane which was subsequently opened in this dyke. 10

The Court: By a splitting of the dyke? A. By a splitting, as it were, of the dyke. 15

The Court: And then dividing the main dyke into two dykes? A. Dividing the main dykes into two, really; and as this new movement took place along this splitting, this motion has probably caused this slight irregularity in the dip of the mud-scan, and the walls of the Centre Star No. 2. 20

The Court: After all, the bend upwards is due to the presence of the dyke there? A. Yes, it is.

Q. It does not matter how the dyke was treated by nature afterwards? A. Yes. 25

Q. This consists of two dykes? A. Yes.

Q. A double dyke with country between? A. Yes. 30

Q. Do you mean from what you said a moment ago that the dyke was originally one dyke? A. Oh, no; there are two distinct dykes; I have only referred to one of them. I have never distinctly and explicitly referred to the western dyke yet; but of course, it is there. 35

Q. Then there is a line of fissuring between those two dykes, is there? A. Well, the actual fissure and the place where it is perhaps best exposed, near point 47 in Iron Mask drift, is really in the easterly dyke; but it does not follow that it always will occupy that position. The fissure may pass out of that dyke and pass between the two dykes; that is possible. 40

Q. When you used the words "Iron Mask drift" in your answer, you meant the Iron Mask tunnel, did you not? A. Yes, the Iron Mask tunnel, I beg your pardon.

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Q. This change which you have mentioned you think is due, the same as the vein in the incline shaft itself, to this dislocation? A. This disturbing influence of this dislocation of the fault. At this eastern side of the bottom of No. 3 Centre Star incline a mass of ore, an ore streak of solid pyrrhotite, comes down to the mud-seam. It is perhaps a foot or two wide, a foot and a half, perhaps. Immediately below the mud-seam, which is here about a foot thick, you will find the continuation.

The Court: What place are you speaking of now? A. I am speaking of the east side, your Lordship, of the No. 3 Centre Star incline at the very bottom—not at the very bottom, but eight feet above the bottom. At that place that solid pyrrhotite is found immediately below the mud-seam again exposed on the east side of the shaft. It here forms a body about three feet long and about 18 inches thick.

Q. What do you mean by long? Up and down the shaft? A. Extending up and down the shaft, and about 18 inches wide and running out to a point at that distance about three feet below the mud-seam. It is simply a natural closing up, the natural ending of that particular body of solid ore.

The Court: It goes down to a point towards the bottom of the shaft? A. It is not a point hardly; it is rather of a rounded form, rather a rounded point.

Q. What displacement of that ore by the mud-seam is there, if any? A. By comparing the solid pyrrhotite above and below the mud-seam it is quite apparent that a reverse fault has taken place.

Q. About how much? A. About a foot and a half, a dislocation of about a foot and a-half; so that below the mud-seam you find the solid pyrrhotite about that distance, a foot and a-half further to the south than you would expect it if no dislocation had taken place.

Q. Has the mud-seam had any other effect on the vein at that point than the dislocation you have mentioned? A. No, it has not that I can see.

Q. What about the extreme bottom of the shaft itself now? What have you to say about that? A. After examining the bottom of the shaft below this mass of solid pyrrhotite which itself is below the mud-seam I found small masses of pyrrhotite and chalcopyrite. I found these two minerals accompanied by quartz and forming typical ore in the very northeast corner of the bottom of the shaft, and practically at a little below, I should say, the drill hole which united the bottom of the shaft with the Centre Star No. 2 tunnel.

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Q. That is, in this little cross cut here? A. In this little cross-cut here near station 68; the distance is only a few feet, and a drill hole has been bored from the yellow drift near 68 into the pit of the shaft.

The Court: That is in the Centre Star tunnel?

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Mr. Davis: The Centre Star north drift, it is called, at station 68.

Q. What do you say as to the continuity and otherwise of mineralization from the bottom of the flat fault down to the bottom of the No. 3 incline shaft?

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A. There is continuous mineralization, and from there on I mentioned that point in the northeast corner where I found the solid pyrrhotite and chalcopyrite. Now, then, tracing out the rock on the same level on the north side of the shaft—

The Court: Of No. 3 shaft? A. Yes. I found a width of about 2 and 3 feet of exceedingly highly mineralized rock.

The Court: Where is that? Near the bottom of what? A. That is below the mud-seam, and across the north side of the shaft.

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Q. Where is the next place you find it? A. There are two other points I would like to mention right here.

Q. Well, go on, Mr. Lindgren. A. Below the mud-seam there is some sheeting shewn in this locality, in the pit of the shaft; in fact, it is quite well marked, but the rock is absolutely solid; there is no dislocation whatever of it; it is simply sheeting such as is shewn in many other places. But as to the mineralized rock, it extends from a place near the drill hole below the mud-seam right up alongside the shaft. I wanted to say that I traced that ore continuously—that heavily mineralized rock, rather, I should say—until it was abruptly cut off by the dyke on the west side. The mineralization at that place is very plainly indicated by abundant quartz, secondary mica and pyrite.

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Q. What is the next place where you saw the mud-seam? A. The next place—and perhaps I should have mentioned that before—is at station 37, between 37 and 38.

Q. That is on the yellow level? A. On the yellow level. It is from here to there. That is, of course, a little below the mud-seam shewn in the bottom of the shaft, because the mud-seam naturally dips down to the south.

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Q. What is the condition of affairs there? A. Well, at the point 15 feet west of station 38 I find the mud-seam dipping 37 degrees and indicated by a few inches of attrition material; 15 feet west of 38, 38 being there (indicating

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on model) would be about this place (indicating). And I think I should mention there, too, that there is a little calcite occnrring along the mud-seam at that place besides the usual——

The Court: That is down here, is it, and it cuts through here to there (indicating on model)? A. Yes, your Lordship, right at that place, and then appears in the lower part here (indicating). 5

Q. In the roof of the lower level? A. Yes, sir.

Q. At point 38? A. At point 38. This continues out a short distance eastward, at a point 10 feet west of 39 which would be about in there (indicating on model), would be a little further on on the same level, perhaps about there (indicating). I found a mud-seam about a foot thick and dipping 30 degrees to the south. 10

Q. In the yellow level? A. In the yellow level. At this place it intersects a seam of ore, an ore seam which dips about 45 degrees to the north. 15

The Court: I suppose it appears that No. 39 east drift is away above the mud-seam and clears it? A. That clears it entirely. 20

Q. And only appears in the winze here? A. That only appears in the very bottom of the winze. At that place the mud-seam cuts a seam of solid pyrrhotite.

Q. What dislocation does it cause there? A. It shews an exceedingly well marked dislocation of 22 inches, I believe I measured it. 25

Q. Normal or reverse? A. Reverse. The ore above, in the very roof, is about three feet thick and solid pyrrhotite, but very rapidly narrows, as the mud-seam is approached, and below the mud-seam, or just above the mud-seam, rather, it is about two feet wide; immediately below the mud-seam that same solid ore appears, about 10 inches wide, shewing continuing narrowing. 30

Q. How wide is the mud-seam at that point? A. The mud-seam at that exact place that I refer to now (consulting memorandum book) is three inches wide, there is three inches of attrition material; below it the rock is solid; practically absolutely solid; above it, for a distance of two feet, the rock is considerably broken, until you come two feet above this mud-seam to a solid roof, which has a somewhat flatter dip than the mud-seam itself. 35 40

Q. Now, that body of pyrrhotite above that you speak of, does that come right down to the hanging wall of the mud-seam? A. That comes right down to the hanging wall of the mud-seam.

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Q. And where does this ore body begin again below? A. It begins a distance of eight inches below it, measured from the exterior outlines of the ore body.

Q. That is, you mean, there is eight inches between the upper and lower ore bodies? A. Yes, sir. 5

The Court: That eight inches being represented by the mud-seam, is it? A. Yes, that is right, your Lordship; it is represented by the mud-seam. The character of the ore is exactly the same above and below; the only difference is that above it is wider, it widens out; below, of course, it is only 10 inches wide; at some other places that same seam is a little over a foot wide—some other places below. 10

Q. Now, what is the next place you found it? A. The next place I found it is in the bottom of the winze, leading down from the Centre Star 59 east drift. 15

Q. Just describe the condition of affairs there, please, and the condition of affairs in the bottom of the winze below the mud-seam also? A. I believe I mentioned this morning that the ore follows down the winze continuously, that is to say, that is a continuous seam of solid ore, solid pyrrhotite and chalcopyrite, accompanied by more or less quartz and other vein matter. 20

The Court: You mean to say down to or down below the mud-seam? A. Down to the mud-seam. Immediately above the mud seam, 2 or 3 feet above the mud-seam, that ore streak, which is perhaps one foot thick there, widens out and shews, perhaps, 2 or 3 feet of solid pyrrhotite. When it comes down to the mud-seam, however, some country rock appears in this solid mass again, so that just at the mud-seam the total width of the pyrrhotite is altogether only about, perhaps, a foot and a-half or two feet. What I mean by this is, that just exactly as the seam widens out above so it contracts below by the appearance of masses of rocks which have not been altered or changed. 30

The Court: This is breadth you are talking about? A. That is in breadth, yes.

The Court: On the dip to the north? A. On the dip to the north, yes. 35

Q. How wide is the mud-seam there?

The Court: You mean to say, Mr. Davis, how thick or what? 40

Mr. Davis: Yes, my Lord, how thick.

A. At this place the mud-seam is nearly two feet thick; it is made up of attrition material, which can be easily picked out with a hammer, with a pick,

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and it is stained dark red, dark brown, and very evidently largely consists of ground-up vein matter, rusty colored. At this place, that is, at the western side of the bottom of the winze, the mud-seam is quite near the actual bottom. Below it, however——

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The Court: Do you mean the actual bottom of the winze? A. The actual bottom of the winze, yes. Below it, however, ore appears——

Q. When you are speaking of the actual bottom of the winze, Mr. Lindgren, you are speaking, I suppose, as the winze was on Saturday? A. I was. 10

Q. You have not seen the winze since any work has been done on it? A. I have not. And below the mud-seam solid ore and bunches of chalcopyrite and pyrrhotite again appear at this place——

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The Court: You had better give the number of feet, so I will have the same idea of it in the future; otherwise, it may be mixed up with the other evidence. How many feet is that below the mud-seam? A. Immediately below the mud-seam and at the bottom of the winze, very nearly, I am speaking of.

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The Court: Well, how far in feet or inches? A. Half a foot, maybe.

The Court: Half a foot immediately below the mud-seam? A. Immediately below the mud-seam. The ore begins again and is exposed at that particular corner about six inches or whatever it was.

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The Court: Until it reaches the bottom of the winze as it was on Saturday? A. As it was on Saturday.

The Court: That is, last Saturday, two days ago? A. Yes. Now then, I traced this ore below the mud-seam, across the bottom of the winze; I traced it along the north side to the bottom of the winze and on the south side to the bottom of the winze, and I found continuous ore, with plentiful solid pyrrhotite and chalcopyrite, in the bottom of the winze. What I mean by solid ore is, that it was firm, it was not shattered, it was solid.

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Q. By the way, when you were speaking this morning about three feet of pyrrhotite above the mud-seam in the winze, you said it was not solid pyrrhotite, that there was some country rock. How was that country rock? A. I explained that just a moment ago, Mr. Davis. I explained, that just as the ore widened a few feet above, just the same, on coming down to the mud-seam, it contracted, by reason of some foreign material appearing in it, and just as it is liable to any place. 40

Q. And above it was wider, and below, the foreign material being out it was narrower? A. Exactly; although the foreign material being below, it

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brought in some sulphides belonging to and included in the mass, which often happens.

Q. You say the bottom of the winze, as it was on Saturday, was in ore?
A. In ore, yes, sir, very decidedly.

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Q. What displacement was there in the vein by the mud-seam in the bottom of the winze? A. The displacement, measured by the appearance of the ore along the western side of the bottom of the winze, was, I should judge, about 18 inches. The measurement there is, however, subject to some little uncertainty, because the mud-seam is very wide; it is two feet wide, and ore bodies, of course, rapidly change their outlines; but it appears very probable that the dislocation was about 18 inches, in the sense of a reversed fault; but a much better way of measuring the dislocation is afforded by the hanging wall of the winze. The winze all the way down has a very well marked hanging wall, with the ordinary dip and strike. When you come to the bottom of the winze, this same wall appears again below the mud-seam; but, instead of having its normal position, which would, of course, coincide with the position it has above, it is thrown about 15 inches or a foot and a-half southward, shewing that the hanging wall at that place has been subjected to a reversed fault.

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Q. Have you more than one plane there that you can gauge that displacement by? A. No. There is only one hanging wall, as I remember it. It is a very distinct one, however. I have described the mud-seam on the western side. If you wish me to, I will now take up the eastern side.

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Q. Yes, if you please? A. The mud-seam continues across the bottom of the winze, and to the eastern side it raises a little, so that the bottom of the winze is further below the bottom of the mud-seam at that place than it is at the western side; the mud-seam is here not quite as thick as it was on the other side; about a foot thick, I should say, something like that, when it comes to a dyke which I described this morning, and which appears on the eastern side of the bottom of the winze, where it becomes much narrower; and the seam, the mud-seam, goes through the dyke, showing that the mud-seam is a later dislocation—a later fissure, and goes through it.

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Q. Is it dislocated? A. I could not measure any dislocation.

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The Court: You mean the dyke?

Mr. Davis: Yes, sir.

Q. That would shew there was not horizontal displacement, at any rate, would it not? A. That would shew there was no horizontal displacement east or west, but there might very easily have been that displacement I measured before north and south. And there is, where the mud-seam strikes the

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dyke, a little branch of it bends down and seems to follow the dyke down for some distance. The dyke is broken there, I do not know whether I mentioned it this morning, at this place, and the ore is exposed to the east of it.

Q. You stated that this morning? A. I believe I did.

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Q. And you also stated that it did not seem to be affected by the dyke. Now, is the ore that you found in the bottom of the winze below the mud-seam a part of the vein which you found above the mud-seam in the winze? A. It is.

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Q. Why do you say so? A. Because it shows the same—the ore here shows the same characteristics as the ore above. You have the hanging wall here the same as you have it above; in fact, you have the vein, to all intents and purposes, identical with the vein above the mud-seam.

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Q. How about the dip of the planes below, or the hanging wall as you saw it below? A. The dip of the hanging wall is the same. I measured it, I think, about 40 degrees.

Q. Now, you have seen the body of ore that is exposed at the east end of the Iron Mask east drift 69, have you not? A. I have.

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Q. There is a body there, I believe, having a dip corresponding to the dip of the Centre Star vein? A. Having a dip of 45 degrees, yes, sir.

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Q. Is that, or is it not, in your opinion, a part of the same vein that is seen above the mud-seam? A. It is, in my opinion, a part of the same vein without any doubt whatever.

Q. That is where the work is being done now? A. That is what I understand.

30

Q. Now, that is all, I think, you have to say about the bottom of the winze, is it not, Mr. Lindgren? A. I believe that is all, but I might mention that I took several specimens from there and carried them up and examined them so as to be in no doubt as to the actual character of the ore.

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Q. Examined them in daylight, you mean, brought them up above? A. Yes, sir.

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Q. Now, did you find any intersections of the Centre Star No. 2 vein with the Iron Mask vein in these workings? A. I have found several of them, two of them—three of them.

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Q. Wherenabouts are they, first, and then you can describe them? A. The first intersection of the two veins is at the end or near the end of the Iron Mask upper drift. I believe that is the way to put it.

Q. Near station 105 that would be? A. Near station 105. The second intersection is in the Iron Mask drift. 5

Q. Iron Mask east drift 69? A. Iron Mask east drift 69. The third intersection would be near the bottom of, or at, Iron Mask 71 east drift.

Q. Now, I notice as you go westward, those intersections get lower. You might just explain to his Lordship why that is. A. That is a necessary consequence, if two planes intersect. 10

The Court: That is what they were talking about the other day; if they were parallel, they would intersect in a parallel way; if they are not parallel, like building a boat; that the bows, if it was not a flat bottom boat, of course, the planks get higher up here at the bow than they are below. 15

Witness: That is it exactly.

Q. Take those intersections and mention them in the order that you find them. A. Those intersections form a straight line really. Here is one intersection at the end of the Iron Mask drift, and here is a second one at the end of the Iron Mask drift 69, and here is a third (illustrating on model). They are three sections formed in a line as they in fact should be if two planes intersect. 20 25

The Court: If they are not parallel they must intersect at different levels? A. They must intersect at different levels, yes, sir.

The Court: And the more they diverge, the deeper the intersection? A. The steeper the intersection line would be. 30

Q. You might describe those intersections in the order in which they occur. A. The Iron Mask vein is clearly exposed along the Iron Mask drift from the collar of the Iron Mask east winze to a point about 40 feet west of point 105. The Iron Mask vein passes right along this drift, the very marked characteristics which ordinarily characterize it; it has a steep dip; it has a comparatively narrow vein, with well defined walls, and is not very wide, generally quite narrow; at the widest place along this drift I believe I found to be near the collar of the winze, about 2 or 3 feet. 35 40

The Court: Is that the vein or ore body? A. The ore body. Now, when this Iron Mask vein, marked by its well defined steep and smooth wall comes to a point about 40 feet west of station 105, it is

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met by a number of planes, number of walls—by 2 or 3 walls, between which there is an exceedingly strongly mineralized rock; these walls come in at an angle of about 45 degrees, and thus form a sharp intersection with the Iron Mask vein.

Q. What walls are those, in your opinion? A. Those walls are without doubt in my opinion, those belonging to the Centre Star No. 2 vein. 5

The Court: Now there are the stipes of the Iron Mask. A. Yes.

Q. The Court: And there will be no vein from there more than likely. 10
A. There will be no vein.

Q. You answered this once before, but what you have said here on a former occasion was that that vein is probably down to there (illustrating on model). A. It is not continuously exposed from here down to there (illustrating on model). 15

Q. No, but you draw a deduction that is the Iron Mask vein. A. If that is the Iron Mask vein.

Q. That is its dip then, is it? A. Yes, sir. 20

Q. What dip has it? A. Seventy degrees.

The Court: There is a difference between the two dips there? A. Yes, 35 to 45, and the lowest I have noticed of the Iron Mask is 63 degrees and the highest 90 degrees. 25

The Court: Ninety degrees? A. Yes, sir.

Q. And this dip is about what? A. (Illustrating on model.) I should say about 70 degrees in that yellow level. This vein, which I consider the Iron Mask vein, only follows its drift to a point between 41, that is here; there it leaves in the country on the north side of the drift until it joins and strikes— 30

The Court: I have nothing to do with that, only I wanted that explanation. I suppose that is the explanation really of it, but it did not strike me before, and I was not told so. But if you run this incline down, it will naturally give the exact dip there. A. Of the Iron Mask vein, yes sir. This Centre Star vein as shewn at this intersection is about five feet wide. It consists of a hanging seam at the top, a hanging seam of calcite, pretty pure calcite, white calcite, about five inches wide, then it follows below that about five feet of very highly mineralized matter, consisting largely of pyrrhotite and chalcopyrite. 40

The Court: What are you speaking of now? A. That is at the end of Iron Mask upper drift.

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Q. The intersection? A. Where the first intersection takes place.

The Court: Of course the Centre Star vein runs out this way (illustrating); it commences here at the top. A. And then comes down here, and runs down from there (illustrating). At this place the Centre Star is characterized by a hanging seam of calcite about five inches thick, and five feet of vein matter, consisting very largely of solid pyrrhotite and chalcopyrite, mixed with mineralized rock. Then below that follows again a seam of one inch thickness of calcite. That section is exposed, shews at the very end of the Iron Mask upper drift, at point 105. It also shews at the point where the actual intersection takes place, which is 30 feet back westward from point 105. Also the Centre Star No. 2 vein is exposed in a very excellent way by a little winze, which is indicated on the map at this place, near 105, and which is sunk below the level of the drift to a depth of about five feet.

Q. Is this the raise here opposite the winze? A. That is a little bit of a raise, yes.

Q. Does that shew the Centre Star vein? A. Yes it does; it is a little bit of a raise that has been made on the Centre Star vein, on the planes of the Centre Star, following the planes of the Centre Star vein.

Q. About what height is that raise, the raise opposite the winze near point 105 on the Iron Mask east drift? A. It is not very high; I should think about 10 feet above the level of the drift, 12 feet, possibly.

Q. Ten or 12 feet on the south side, and you have a sinking of the winze of 5 or 6 feet on the north side. A. When I say 5 or 6 feet I mean perpendicularly, down on the bottom.

Q. Five or six feet? A. Five or six feet.

Q. Then you have the height of the drift which would be about seven feet, I suppose? A. Seven feet.

Q. So that you have a vein exposed for over 20 feet? A. Fully that, I should say.

Q. What is the next place where you see a section that you mention, in the Iron Mask east drift 69? A. In the Iron Mask east drift 69.

Q. Now, before taking that up, you might trace the vein from the bottom of the No. 3 incline shaft down the Iron Mask winze and then you can go across and take that intersection. A. The Centre Star vein and bottom of the drift around about points No. 68 and 16, that is to say, along in here to the 69 drift back in here (illustrating on model).

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The Court: Do you say that that Centre Star vein, according to your belief, runs into the Iron Mask winze? A. Yes, it runs into the Iron Mask winze partly to a distance—well, I will come to that presently. As you go along this short diagonal cross-cut of the Centre Star.

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The Court: That is from the Iron Mask winze to the bottom of the No. 3 shaft. A. The bottom of the No. 3 shaft to the Iron Mask winze, you see near the bored hole, which unites this drift with the bottom of the shaft, a little bit back from this bored hole, you see a flat seam dipping about 20 or 30 degrees, of solid pyrrhotite, on the west side of that drift, that is, right under and 10 corresponding with the ore body which is shewn at the end of the shaft. It is, so to speak, the elongation of that ore body.

The Court: Could you see anything through that bore hole? A. No, you cannot see anything through that.

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The Court: It is too small? A. You can just see the light through it, that is all. From this place, which is 15 or 20 feet southeast of station 68, from this point on to station 16, which is at the Iron Mask winze the country rock is very much mineralized, and all of it is without doubt in my opinion clearly vein 20 matter. It contains bunches of pyrrhotite in places, but throughout it is exceedingly altered, filled with secondary quartz, pyrite and brown mica; in fact it is a typical vein matter, a distance from the bottom of the winze to a little back of station 68. At station 16 considerable bunches of solid pyrrhotite make their appearance. The ore shews up very handsomely—to the eye, I mean to 25 say, there is any amount of solid pyrrhotite and chalcopyrite in it. From 16 up to 10 feet above 16 this same ore, which I consider part of the Centre Star No. 2 vein, is very clearly shewn. At 16 there is, 10 feet above 16, a plane, I said, which to my mind becomes the hanging wall of the Centre Star vein. It has the normal strike and dips about 40 degrees or 38 degrees, I have forgotten 30 which exactly, to the north. So that along that plane, to my mind, is the hanging wall of the Centre Star vein. As you pass the point No. 16 and turn into the 69 east drift you follow along ore on the right hand side of the drift going in all of the way, and in this ore are emphasized planes dipping 45 degrees as the Centre Star should be. At the same time, there appears on the north side 35 of the 69 east drift a very prominent wall, carrying a few inches of ore, very smooth, well defined, dipping 70 degrees north. This wall is clearly in the position of and identical with the Iron Mask vein. As you go in 30 feet or so in the 69 drift the ore of the Centre Star and that of the Iron Mask approach, and at one place in the roof of the raise there is exposed up to a height of 20 feet, 40 perhaps, the planes of the Iron Mask and those of the Centre Star actually intersect, forming an exceedingly well marked "V" shaped figure, which can be seen for some distance by ordinary light, and which is emphasized by an upper wall, the hanging wall of the Centre Star and the main Iron Mask vein.

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The Court: And the foot wall of the other? A. Well, two walls of the Iron Mask there are very close together, the walls are only a few inches apart; the Iron Mask at this point is very narrow.

The Court: Pinches? A. Pinches. Above the junction there is comparatively unaltered fresh country rock. Below the junction in the Centre Star vein there are large bunches of pyrrhotite, and in fact a large part of it is solid pyrrhotite. Now, this Centre Star vein which at this place, at the junction, is about, as exposed, 7 or 8 feet wide, I should say from my recollection, continues across the Iron Mask vein. The Iron Mask vein is broken into a little; the plane is broken into a little by the Centre Star. 5 10

The Court: It is broken into by the dip of the Centre Star? A. It is broken into by the mining operations; so that the planes of the Centre Star are seen to continue across the Iron Mask, beyond the other side. 15

The Court: Across and beyond? A. Yes, sir.

The Court: That is to say the Iron Mask does not cut the Centre Star, but the Centre Star cuts the Iron Mask? A. That is a question. 20

The Court: I am only asking you. A. That involves the question which vein is the older one, and I am not able to decide that from the data we have. .

Mr. Davis: He does not mean to say anything with reference to which cuts the other. 25

The Court: I took it that way, and I wanted to know whether it was so, because it is very important to both sides.

Mr. Davis: He does not mean that. 30

The Witness: It would not be easy to say which one actually intersected the other. They come together and both of them continue beyond the intersection; that is the most I can say.

The Court: And in the place where they intersect you cannot tell one from the other? A. No. 35

The Court: As to vein matter. A. No, the evidence is not conclusive on that point.

The Court: That is exactly what I wanted to know, because there is law applicable to a matter of that kind. 40

Q. Now, you find another intersection, I think you have mentioned. A. Well, the intersection along the bottom level is—

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Q. Just describe what you find as leading up to that, what you find coming down the Iron Mask winze 69. A. From the Iron Mask winze on the 69 east drift down nearly to the bottom of the winze—

Q. East drift 71. A. East drift 71, I find the vein shewn in the winze 5
very nearly continuously; we find the vein which corresponds to the Centre
Star vein as shewn at station 16 continuing down the winze.

The Court: The same dip? A. The same dip of the winze shewn
very clearly, and at the bottom of the winze you have evidently 10
arrived near the foot wall of that vein. In running out, in going out
to the westward in what is 71 east drift you meet at station 75 planes which are
evidently to my mind, planes of the Centre Star vein, and you find considerable
altered vein matter. In going to the end of 71 east drift, you find a vein shew-
ing solid pyrrhotite. 15

Q. West end you are speaking of. A. I beg your pardon, this is the
west end. I was mistaken. At the end of that drift you find a solid pyrrhotite,
quite a good many inches of it, and very many planes, about parallel to those of
the Centre Star and at the very end of this west drift you find those planes 20
coming up against the dyke.

Q. West drift or south drift. You mean this south cross-cut from the
east drift, or north cross-cut. A. I mean the north cross-cut from the Iron
Mask No. 71 drift. In going eastward along that same drift, Iron Mask drift, 25
you find pretty nearly a continuous streak of solid pyrrhotite from about 10 or
20 feet east of the foot of the winze to the end, and shewing at the end and
elsewhere distinctly dips of about 45 degrees to the north. In going back into
the little cross-cut to the south from this 71 drift, there is a quite distinct foot
wall which seemed to form the southward boundary of the Centre Star vein. 30

The Court: That is it has the same dip, you mean. A. It has the same
dip, and beyond it there is no mineralization to speak of; I consider that place
south as the foot wall, as the actual foot wall of the Centre Star vein.

The Court: Is there any vein along there? A. No. 35

Q. So that the vein matter is confined to this and stopping here. A.
Yes.

Q. Were you through with your description of that point, Mr. Lind-
gren? A. Yes, sir. 40

Q. A moment ago, when you were speaking about the intersection in the
69 east drift Iron Mask, you spoke of the intersection some distance back from
the east end of that drift. What did you find at the intersection in the extreme

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cast end itself? A. At the extreme east end of the 69 drift, you find about five feet of vein matter, and largely of solid pyrrhotite which has the north dip of 45 degrees and characterizing the Centre Star No. 2, and which are practically identified with the vein exposed at the first intersection, at the actual intersection which I mentioned, half way between the end of the drift and the winze. 5

The Court: The drift I referred to a few moments ago is the Centre Star drift on the water-course. There is no vein in it. A. There is no vein along that. At the bottom of the winze in No. 71 drift—Iron Mask 71 drift—I find a small vein which first appears near point 75 and is traceable from there to the bottom of the winze. This vein has a steep dip. 10

Q. A dip of about what? A. I don't remember; I will have to look it up (referring to memoranda); I have not got it in my notes. It is referred to as "steep." It does not shew very well except in the roof of the drift, and it is a little difficult to take the exact dip of it. It extends from near point 75 to the bottom of the winze, and has the strike of the Iron Mask, and I believe is the extension of the Iron Mask vein downward. If you take the average dip following the stopes, it has naturally cut down in that vicinity. 15

The Court: And this vein would run over it? A. This vein would run over it. 20

Q. That is the Centre Star vein? A. The Centre Star vein. Of course, the line of intersection between the two veins runs on. 25

Q. Which was here and there.

Q. "Here" being the east Iron Mask, and "there" being the Iron Mask east drift. A. Yes, and continued down to somewhere near the bottom of the shaft, bottom of the incline. 30

Q. That Iron Mask winze you mean. A. Somewhere near the bottom of the Iron Mask winze, yes.

The Court: The intersection must take place about here some place (illustrating on model). A. The intersection does actually take place here (illustrating), and from there on, I say, the intersection lies further down. 35

Q. Mr. Lindgren, I believe you examined that westerly ore body at station 66—at least, the place from which the ore was taken by Mr. Durant? A. I did. 40

The Court: And came to the conclusion that that belonged to the Iron Mask vein? A. I did; it is within the planes of the Iron Mask vein.

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The Court: Whereabouts is that marked on the map? A. Station 66.

The Court: That ore body then was formerly claimed by the Centre Star Company, was it? 5

Mr. Davis: Yes.

The Witness: That lies within the planes of the Iron Mask, then dipping down following the ⁷ down by the slopes. 10

The Court: That is an Iron Mask winze there. A. They referred to it as Iron Mask west winze.

The Court: Is that marked on the fact of it? A. No, I don't think it is. 15

Mr. Davis: The only question that I have left to ask this witness is one to which the answer will be pretty long, the general summing up of his evidence.

Thereupon an adjournment was taken to to-morrow morning, May 2, 1899, at 11 o'clock a.m. 20



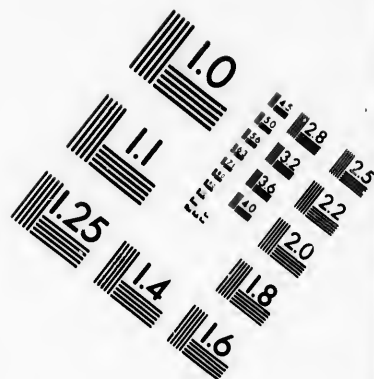
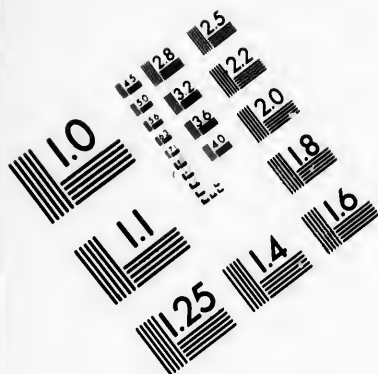
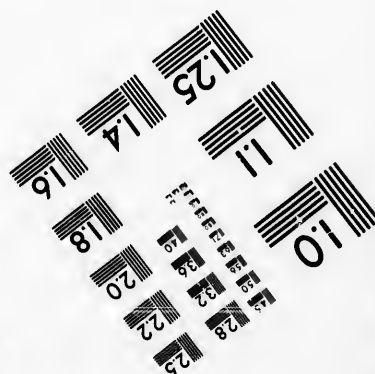
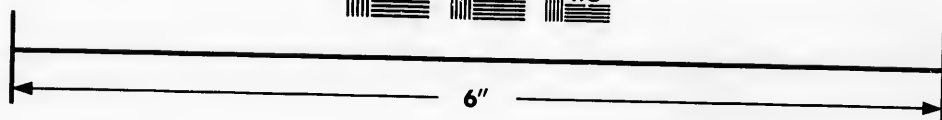
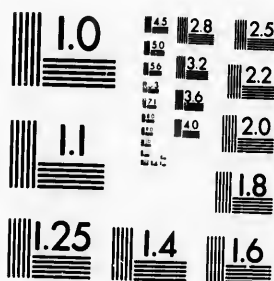


IMAGE EVALUATION TEST TARGET (MT-3)



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THIRTEENTH DAY.

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Rossland, B. C., May 2nd, 1899.

Trial resumed at 11 o'clock, a.m.

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Present: The Court and same counsel as heretofore.

WALDEMAR LINDGREN—A witness for defendants, on the stand.

25

DIRECT EXAMINATION RESUMED.

By Mr. Davis—

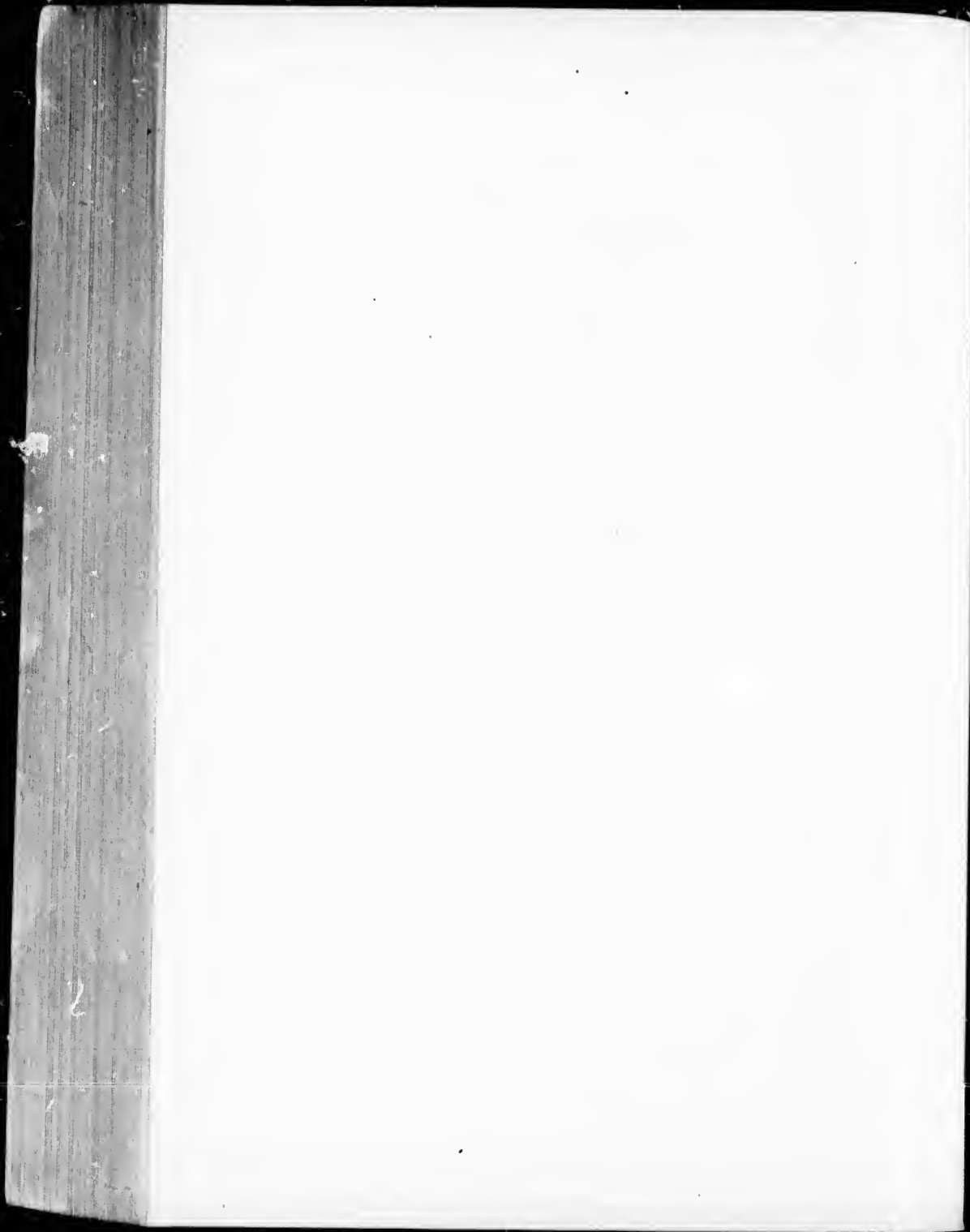
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Q. Mr. Lindgren, you did not go very fully into the condition of things in the Iron Mask winze yesterday, and I believe you were examining that point again last night? A. I did.

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Q. Will you just give a little further account of affairs there. A. The Iron Mask east winze extends from the upper drift of the Iron Mask 71 drift, which is the bottom level, and is marked in blue on the model; at the collar, at station 106 in the Iron Mask upper drift (indicating on section G-II, Exhibit 21), the Iron Mask vein shews plainly in the roof of the drift, which is about 12 feet above the collar; it shews as a vein about two feet thick, with a considerable amount of solid pyrrhotite and chalcopyrite. The vein shews from 106 down for 25 feet in the winze, its wall closely hugging the hanging of the winze

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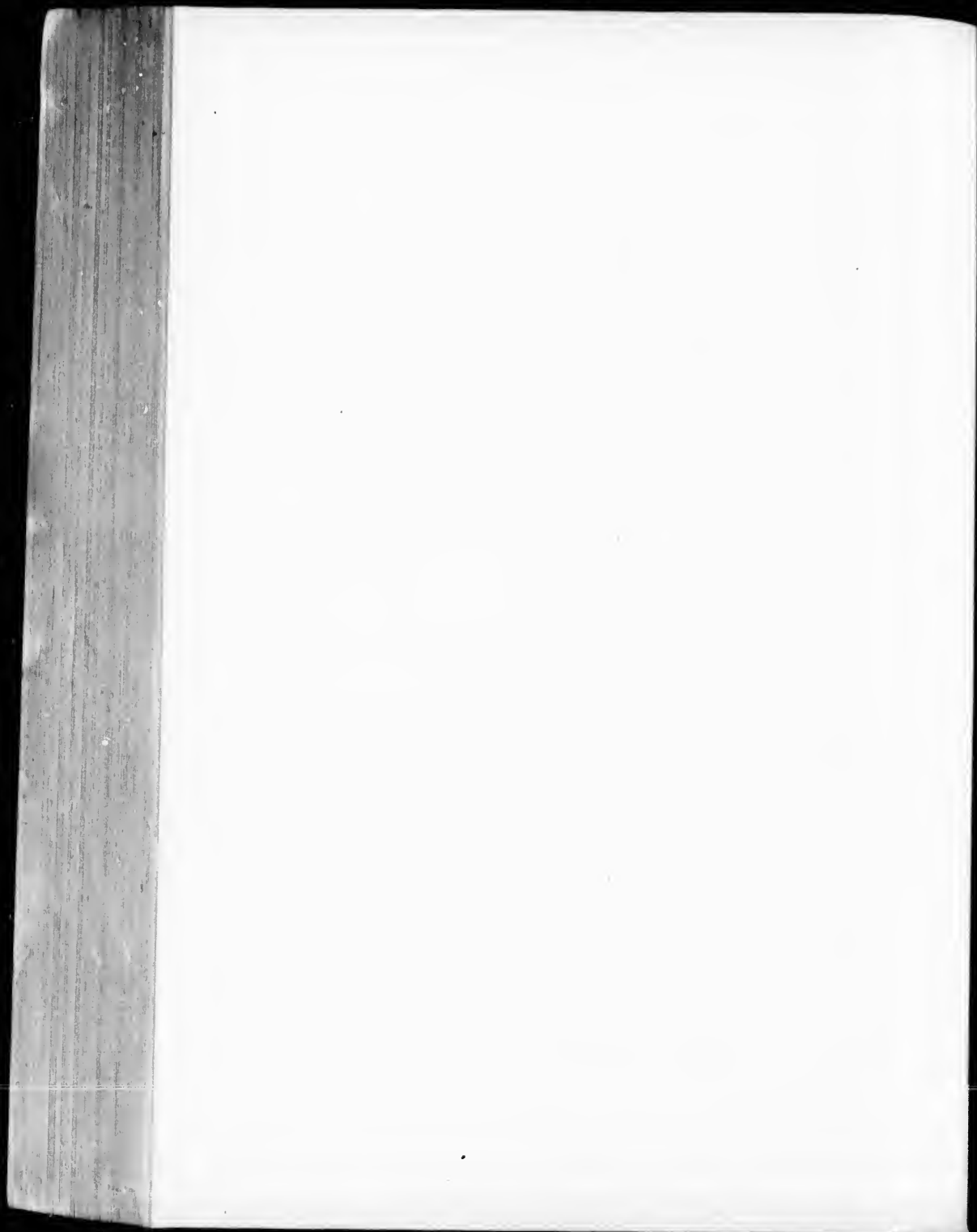
until it strikes the mud-seam. At that place there is, immediately above the mud-seam there is ore, and the Iron Mask vein shows its wall quite plainly. Immediately below the mud-seam, which is here, perhaps, 6 or 8 inches thick, as I remember, it, there is also some heavily mineralized ore—heavily mineralized rock I should say, but there are no very well defined planes that can be referred to the Iron Mask except at the place, perhaps 10 feet below the mud-seam, where there are some indications of such planes. That is caused, in my opinion, by the fact that the Iron Mask winze is not quite straight, so that the Iron Mask vein would go slightly in the hanging at this place, from which hanging it does not emerge in the Iron Mask No. 69 east drift.

The Court: Below? A. Below. The upper drift, that is, the drift with red stripes on the model (indicating on model); in this drift the Iron Mask vein appears somewhat indistinctly in the place where it should be from lining it up with the excellent Iron Mask wall which appears some 20 feet further east in the same drift. Going down the Iron Mask winze, below the 69 east drift, I again found what I consider the Iron Mask vein, at a point, say, 20 or 16 feet below the bottom of the 69 drift; here it is in the foot, and I can follow it from here (indicating) continuously down to the bottom of the winze, following the foot wall pretty closely all the time and marked plainly by—oh, from 2 to 4 or 5 inches of solid pyrrhotite and chalcopyrite; at near the bottom of the Iron Mask winze, what I consider the Iron Mask vein, shews in the roof of the tunnel, immediately at the bottom of the winze; in other words, where the winze breaks into the drift.

The Court: In the tunnel marked blue. A. In the tunnel marked blue. At the roof of the tunnel, Iron Mask No. 71 east drift, and at the winze, I measured the strike and dip and found it to be the normal strike of the Iron Mask vein and the normal dip of 65 to 70 degrees, which dip it maintains for the whole distance as far as it is visible in this winze. I refer to that expressly because in my notes before I did not have the exact dip at that place. The Centre Star vein in the Iron Mask winze shews, at the place 10 feet above station 16; at this place I found what I consider to be the hanging wall of the Centre Star vein. It is marked by a well defined plane, below it there is a large amount of heavily mineralized rock, and a considerable amount of solid pyrrhotite and chalcopyrite. The winze continues in the Centre Star vein No. 2.

The Court: The winze continues in Centre Star vein No. 2? A. The winze continues in Centre Star vein No. 2.

The Court: You mean the vein continues in the winze. A. The vein continues in the winze down past station 69, and it is visible from station 69 and down for 30 feet, I should say, with a well defined dip of 45 degrees, shewing as a seam of ore about from six inches to a foot wide. The lowest point at which



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I observed the Centre Star No. 2 vein in the Iron Mask winze is at a place, say, 30 feet above the bottom of the Iron Mask No. 71 east drift. At that place I found a well defined plane, dipping 45 degrees and having the normal strike of the Centre Star No. 2 vein. At this place (indicating), 30 feet above the bottom of the Iron Mask No. 71 east drift I should be inclined to put the foot wall of the Centre Star vein. 5

The Court: What is that, the east or the west side? A. In the winze.

The Court: Yes, but what is it; that is, is it on the lower side of the winze? I want to get it in the record so as to be able to understand it afterwards. I know where it is now. A. (Indicating on model.) The plane is about here. 10

The Court: I know, but upon this side or that side (indicating)? A. It shews right across; I measured it in the roof.

The Court: It shews right across here (indicating). A. In the hanging, right here (indicating) in the hanging, I measured it, and it shews about the place where the winze on the model makes the curve. 15

The Court: Here is the Iron Mask ledge, or whatever you choose to call it, down this way (indicating). Now, do you mean to say, that those cross, that the Centre Star comes down here as you say it does— A. Yes. 20

The Court: And crosses down here (indicating). A. And goes out near the bottom of the shaft, near the hanging. 25

The Court: Well, have the veins intersected one another? A. The veins have apparently intersected one another at this place, about 30 feet above the bottom of the Iron Mask No. 71 east drift.

The Court: And where did you say the Centre Star vein is traceable below, or is it traceable below? A. The Centre Star vein, the foot wall of the Centre Star vein, goes a little in the hanging of the winze. 30

The Court: Above the figures No. 75? A. Above the figures 75.

The Court: On the plane section G-II? A. On the plane section G-II. And this is better illustrated in the section A-B (Exhibit No. 18), which is better adapted for the purpose, because it is cut perpendicularly to the Centre Star vein No. 2. 35

The Court: Well, is not this all imaginary (referring to Exhibit 18)? A. That is imaginary, yes, but the foot wall—

The Court: What you are stating is not imaginary. A. No. The foot wall is, at this place, at the place about 30 feet above the bottom.

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The Court: The foot wall is the line which is shewn to intersect the Iron Mask vein in this particular plane. A. Yes.

The Court: And that foot wall, you say, is the foot wall of the Centre Star, which we see. A. I do. 5

The Court: Excuse me for asking these questions, Mr. Davis, but he is explaining to me, and I want to understand it.

Mr. Davis: Certainly, my Lord. 10

The Witness: That is about all regarding the Iron Mask winze.

Q. I believe you examined the new work which has been done in the Centre Star winze this morning? A. I did. 15

Q. Would you just describe to his Lordship what you found in this new work, the appearance of the vein and ore?

The Court: Now, that is in the Centre Star winze, at the end of the east drift No. 59 or 69? 20

Mr. Davis: It is at the bottom of the Centre Star winze as it goes towards the 59 east drift, where the new work is being done.

A. I find that the work has progressed to a depth of 10 feet below the mud-seam, measured along the dip of the vein. 25

Q. That would be about eight feet, I suppose, below the former bottom of the winze. A. Hardly that much.

Q. Hardly that much? A. More like 7, 6 or 7, vertically. A hole has been blasted through shewing the conditions near the foot wall. The rest of the winze has not been sunk to that depth. The rest of the winze, I should say, has only been sunk to a depth of four feet below its former depth. Now, at this deepest pit, I find a well marked wall, dipping about 45 degrees north; immediately below that I find a vein of solid pyrrhotite nearly a foot wide; that is near the hanging; below that again there is about two feet or two feet and a-half of altered country rock, and below that a smaller seam of pyrrhotite, perhaps three or four inches wide; that is what is shewn in the deepest pit. Over the rest of the area exposed by the new work there is heavy mineralization shewn, strongly mineralized rock, full of quartz, copper pyrite and pyrrhotite—or pyrite, I should say, rather; I did not actually observe any copper-pyrite, because I did not look for it very closely. The rock is very solid and there are no indications of any other planes that I could see except those of the Centre Star, dipping 45 degrees north. 30
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Q. Is it a vein down there? A. It is.

Q. What vein is it? A. Centre Star vein No. 2.

Q. What do you say about continuity of ore from the former bottom of the winze down to the present bottom of the winze? A. It is absolutely continuous. 5

Q. Now, will you tell his Lordship, please, what, in your opinion, is the extent of this Centre Star No. 2 vein, and what is its relationship to the Iron Mask vein and to the mud-seam, and your reasons for it. That is, give a general summing up, Mr. Lindgren, of the various points in the case. A. In the disputed ground I find that there exists two well defined veins. I shall first refer to the Iron Mask vein. This is a clearly defined fissure, with walls from a few inches to perhaps 6 or 7 feet, as far as I have seen it, apart. Over a large part of its course, the walls are only a few inches apart; the walls of the Iron Mask are smooth as a rule, as a rule they are smooth, and the ore which is contained between those walls is generally quite solid, perhaps more so than is usual in the Centre Star vein No. 2. I mean to say, wherever there is ore developed, it is as a solid sheet. From this I should consider that there possibly has been more actual open spaces between the fissures than has been the case in other veins in the vicinity. The filling of the Iron Mask vein I thus regard as, possibly, partly a filling of open spaces, but besides that there is abundant indications of the same purposes of replacement which I found in all the other veins of the district, as far as I have examined them. There is shown in this vein chalcopyrite, pyrrhotite, some calcite, quartz and occasionally some secondary biotite. Now, I have found in this Iron Mask vein, I have seen, the place where it should outcrop on the surface. I have not actually seen its croppings; it is a relatively small vein and the croppings are not very plain. I have further found the Iron Mask vein along the Iron Mask upper drift, from station 106, which is here (indicating on model), continuously exposed to near station 105, at the eastern end of the same drift. I have also seen the vein exposed in the old stopes, which show above this level, and where it attains a considerable thickness, of five or six feet at least, in some places. I have further seen the Iron Mask vein in the Iron Mask winze from this collar down to the Iron Mask drift No. 69, for some distance of that winze anyway. 10 15 20 25 30 35

The Court: The blue drift? A. No, the winze. 40

Q. Down to the bottom? A. Well, yes. I may say, bottom; but I only went as far as the Iron Mask drift No. 69. I have further seen it in the Iron Mask drift 69, exposed in the winze to the eastern end of the same drift. I have further seen it in the Iron Mask winze from the Iron Mask drift No. 69 down to the Iron Mask drift No. 71, which forms the bottom level. I have seen

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it exposed for some distance westward of the winze, in this blue level. I have
firmly seen the Iron Mask, what I consider to be the Iron Mask vein, exposed in
the Centre Star north drift, from a point half ways between stations 41 and 42,
to No. 3 raise.

The Court: Eastward. A. Eastward. And from a point a short distance
east of the No. 3 raise, continuously exposed to station 48, eastward in the
same drift. From all these exposures of the Iron Mask vein I draw the con-
clusion, that the Iron Mask vein is a very well defined fissure vein, that it is of
exceptionally straight course and constant dip, and that it is generally, or nearly
always found at the place where, constructing it geometrically, it ought to be
found. The strike of the vein is, taking it on the average, 24 degrees south of
east.

The Court: Would you let me ask you this, Mr. Lindgren, I am sorry to
interrupt you, but I wish to know this because I understand there is some point
about it. You pointed to the Iron Mask vein in the Centre Star north drift;
that is where? A. Near the raise here (indicating on model).

The Court: Now, do I understand you to say that you find it where you
would, mathematically speaking, expect to find it? A. I do.

Q. (By the Court.) So that is the point. I understand there is some
point about it, I do not know what it is, but I wanted to know that fact. A.
I said there was some interval between the No. 3 raise and station 43 or there-
abouts, where we do not find it, and that is caused by the slip along the vertical
fault which I explained before. Now, I further find another vein, entirely dis-
tinct, and separate from the Iron Mask and of some different character; that
vein is the Centre Star No. 2. The Centre Star No. 2 has a strike which varies
somewhat in the western part of the ground in dispute; its direction is about east
15 degrees north; that is to say, 15 degrees north of east. In the eastern part of
the ground in dispute its direction is some degrees, has plane spaces as much as
15 degrees, south of east.

The Court: What do you call "the ground in dispute?" That is not very
clear. A. I beg pardon, it is not. I mean the ground involved. Perhaps
the ground to the east of Centre Star incline No. 3, I should say. So that the
Centre Star vein No. 2 makes a certain bend of from 10 to 20 or 25 degrees in
its dip; the Centre Star vein No. 2 is fairly constant; its average dip may be said
to be 42 degrees; deviations from that average dip are found in places near the
bottom, or I should say, perhaps, near the Iron Mask drift No. 69, its dip ap-
pears to be a little less, perhaps to be a flattening out. At other places, such as
in the Centre Star shaft No. 2 and in the drifts connecting the raise No. 2 with
the shaft No. 2 of the Centre Star, it is a little steeper, perhaps in places

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degrees. The Centre Star No. 2 is what might be termed, or what should be termed properly, a composite vein, a vein showing several flat planes situated within a certain distance. I draw that distinction to distinguish it from a simple vein a comparatively simple vein, such as the Iron Mask is. A composite vein may also be referred to as a shear-zone vein; in fact, one of the authorities on mineral deposits, Professor Kent, makes a special division of fissure veins, calling them shear-zone veins; but I say, so far as I have shewn in my former examination, there is no sharp and distinct line separating these two classes of veins; they simply run over into each other by the appearance of one or more additional planes, by which a certain strip of ground, say, 5, 10, or 20 feet wide, is subdivided by means of a number of walls between which the ore is found. 10

The Court: Between some of which the ore is found? A. Between some of which the ore may be found. It may be found between all of them.

The Court: Between some or all of them the ore will be found. A. 15 Now, this difference between the two veins, this difference in the structure, is only, perhaps caused by the different dip which the veins exhibit. A straight vein dip, nearly vertical, is very much more apt to be clear cut and well defined than a vein dipping at a lower angle, as a vein dipping at a lower angle, we may much more confidently expect changes in dip and appearance to the shear-zone veins. Now then, I come to the filling. The filling of the Centre Star vein No. 2 consists, as far as its valuable ore is concerned, of chalcopyrite and pyrrhotite, associated with those are other gangue material, such as quartz and calcite, and also finely divided brown mica. From the character of filling I should draw the conclusion that the process by which the ore has been deposited has been nearly exclusively a process of replacement. In other words, that there have been but small amounts of open spaces between these walls, that the deposition has been caused by the solution following those walls and eating into them, and depositing, instead of the dissolved rock, more or less pyrrhotite and chalcopyrite. I would also say that I find no radical difference, in fact, no difference at all, in the minerals of the Iron Mask and the Centre Star veins. The same minerals appear in both—the same products of minerals. The only difference would be that when certain processes, that of filling in open spaces might have occurred to a greater extent along the Iron Mask vein than has taken place along the Centre Star vein. But I do believe, from the general appearance of the ore and the great similarity of the ore in the two veins, that they have been formed in substantially the same manner, and very possibly at the same period. The Centre Star No. 2 vein I found exposed continuously, exposed in the crop from Centre Star shaft No. 3 to some 40 feet eastward of Centre Star shaft No. 2. I found it exposed along the entire length of the Centre Star shaft No. 3, and along the entire length of Centre Star shaft No. 2. I have also found it along the whole length of Centre Star drift No. 59. I have also 40

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found it in the cross-cut running from point 38 to point 69 in Centre Star north drift, especially exposed between points 68 and 16 on the same level. I have also found it exposed in the Iron Mask drift No. 69, nearly along its whole length. I have also found it exposed in the Iron Mask east winze from the Iron Mask drift No. 69 to the Iron Mask drift No. 71.

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The Court: Downwards? A. Downward to near the bottom of said winze. I have finally found it exposed in the bottom level of the Iron Mask drift No. 71, at several places, notably from near the foot of the shaft to the easterly end of the said drift. In other words, to sum it up, I have found the Centre Star vein exposed underground by the workings, I have found it at all places where I should expect it to be, construing the plane geometrically from the croppings down, with some slight deviations. Now, then, I have two well defined fissure veins, two typical fissure veins, the Iron Mask and the Centre Star, which, on the average, differ in their strike to an extent of 24 or 25 degrees, perhaps in their dip differing, also, to an extent of 25 degrees; they dip in the same direction. These two planes must necessarily intersect if prolonged in depth. I actually do find intersections at the places where such intersections should be expected to be found. If the Iron Mask croppings were traced on the surface continuously I should expect to find an intersection on the surface, somewhere in the vicinity of Centre Star shaft No. 2. I do not know they have, really.

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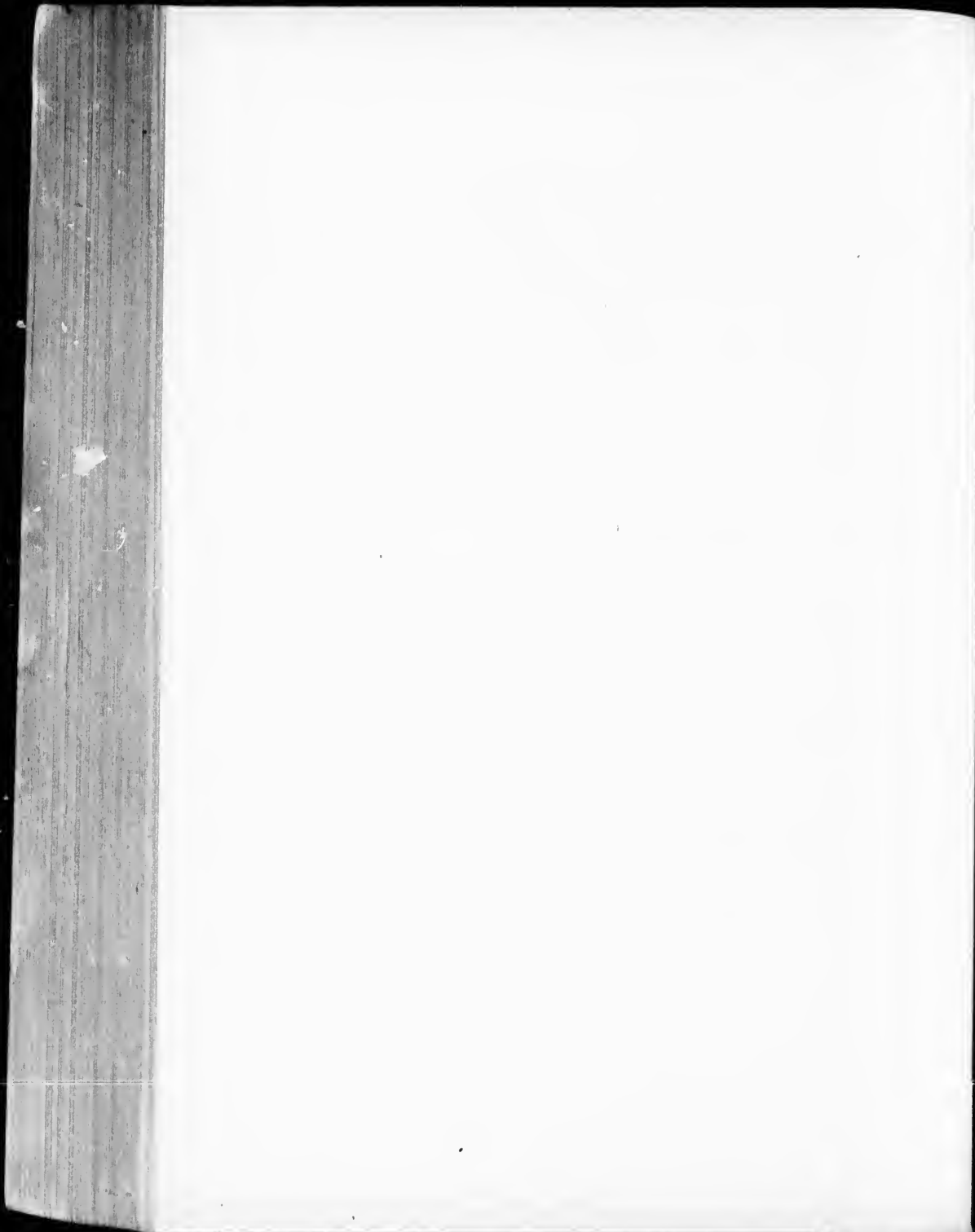
The Court: That is, an intersection of the Centre Star croppings? A. Of the Centre Star croppings, yes, sir. Such an intersection I have not found for the reason, that I can not continuously trace on the surface the Iron Mask vein, as I can the Centre Star No. 2. However, near the point 105 in the Iron Mask upper dip, I do find an intersection. I find both veins crossing each other, each one continuing in its proper strike and dip without any change, after having crossed each other. I finally find an intersection at or near the end of the Iron Mask drift 69, which is exactly similar in its appearance and its conditions to the crossing at the intersection I first described. I finally find in the bottom, or near the bottom of the Iron Mask east winze, about 30 feet above the Iron Mask drift 71, what I consider to be an intersection of the same planes. At this place the Iron Mask plane intersects what I consider to be the foot wall of the Centre Star vein; and those, in all places where the two planes have been exposed, have fulfilled the conditions which would be expected from their general strike and dip, and especially are found to be intersected wherever they, according to those conditions, should be found to intersect. Now, there remains to indicate, with a few words, the mud-seam or water-course, so-called. The water-course forms an entirely separate plane, which has an average dip of east 15 degrees south, perhaps, or 15 degrees south of east, and which dips, on the average, 35 degrees to the south. It is a well-marked fissure filled with attrition products, ground-up rock, and continues with very well defined strike and dip

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over the entire area which I have examined, as far as I have seen it; along with the ground-up material which it contains, there is also in some places a little calcite, and in some places a little quartz; where it has crossed any of the veins it has a rusty appearance and is clearly full of vein material, derived from the crushing of those veins at the point where it has been crossed. Now, the mud-seam, which is simply a place with the characteristics I have just mentioned, dipping to the south, must necessarily cross the Centre Star vein No. 2 and the Iron Mask vein. It does so, and I have examined the crossings at a number of places. At perhaps five places where it crosses the Centre Star No. 2, and three or four places where it crosses the Iron Mask vein, I find at those crossings, as a rule, a slight throw, generally in the nature of a reversed fault, but nowhere exceeding two feet, and generally from one foot to a foot and a-half. At some places this dislocation is very clearly marked—clearly and unmistakably marked. So far as any influence on the vein is concerned, the mud-seam is absolutely of no importance; it simply cuts the two veins at the places where it so happens from the conditions given of its geometrical position. In some places where it cuts the veins the veins are heavily mineralized above and heavily mineralized below; in other places they are poor above and poor below; in still other places it is a little better looking above and a little poorer looking below. It is simply a subsequent fracture, which has no bearing whatever on the richness and the continuation of the veins, except so far as the slight throw which I have already mentioned.

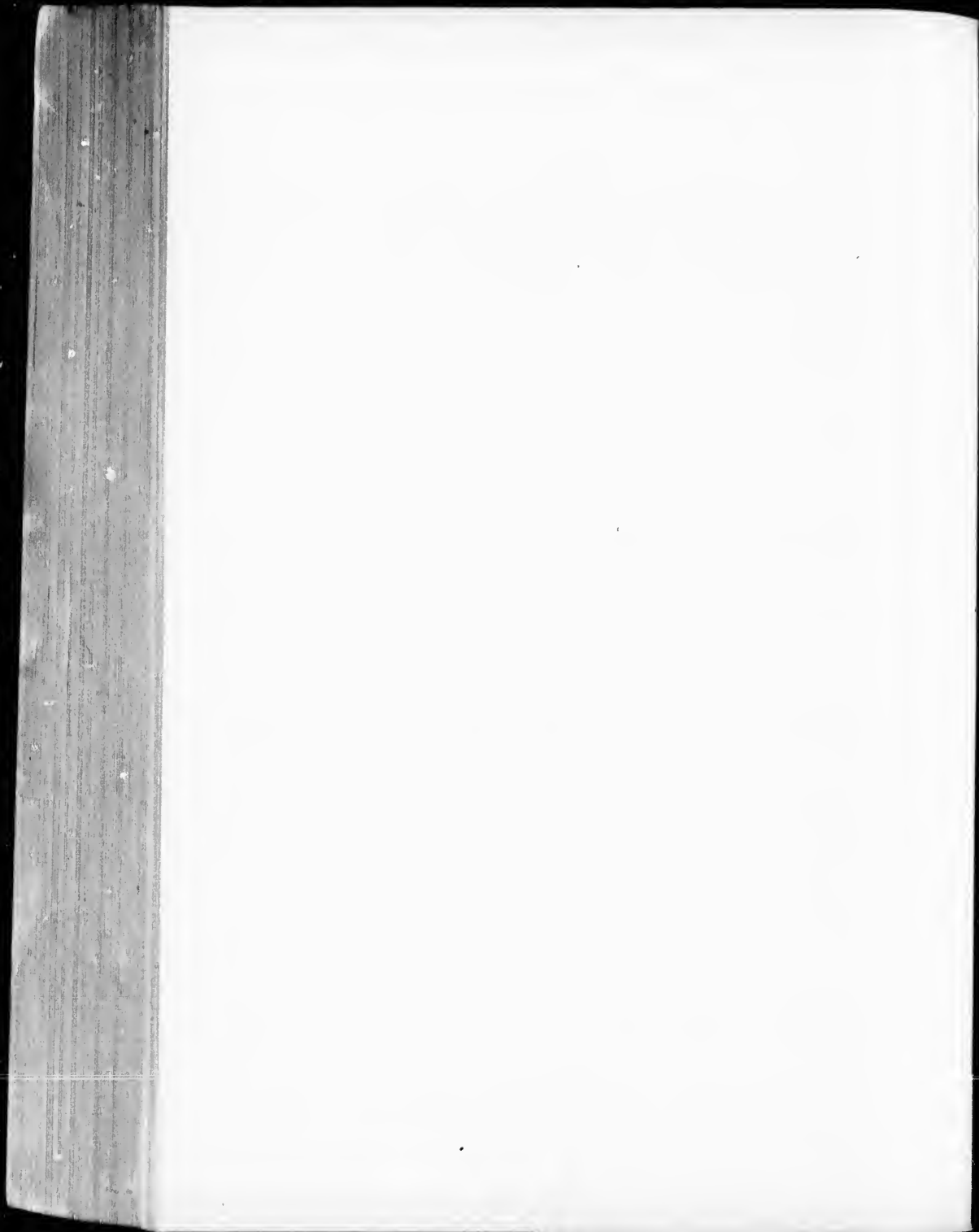
Q. I think you made a mistake there, Mr. Lindgren, as I understood you, in speaking of some places, you said it was better above and poorer below, and in some places it was better looking above and poorer looking below. I suppose you mean the opposite. A. Did I say that? I did not mean that. I meant just the reverse. That is, I believe, all I have to say in answer to that question.

Mr. Davis: That is all.

CROSS EXAMINATION.

By Mr. Bodwell—

Q. You say that the ore in the Centre Star and Iron Mask veins was probably formed the same time and under the same conditions. A. I said probably.



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Q. It is the same character of ore? A. It is the same character of ore.

Q. Therefore, when you have intersections you have planes crossing, have you? A. Yes.

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Q. Two planes crossing? A. Yes.

Q. Both filled with ore formed at the same time and probably under the same conditions? A. Both probably filled at the same time and probably under the same conditions.

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Q. So far as you have been able to observe there is no distinction between the filling of the veins of the Centre Star and the Iron Mask— A. Yes, there is this distinction, which I have already emphasized; that the ore in the Iron Mask is more in the nature of a filling—more in the nature of a filling of open spaces.

Q. I know, but you do find vein filling in the Iron Mask vein, do you not? A. I find what I think is vein filling.

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Q. And you find calcite? A. I have found a little calcite; I have not found very much of it.

Q. And in the Centre Star you found calcite? A. I did find calcite.

Q. And you found quartz? A. I found quartz in some places.

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Q. Do you make any point on the brown mica you found in the Centre Star filling? A. You find it in both veins; you find it in all veins of this district so far as I have noticed them.

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Q. Then, speaking as to the quantity of vein filling you do not distinguish between the vein filling of the Centre Star and the Iron Mask? A. Yes, I do distinguish as to its occurrence. The iron ore of the Iron Mask vein contains—

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The Court: You mean the ore of the Iron Mask vein? A. The ore of the Iron Mask vein is more solid and compact wherever it occurs.

Q. But speaking of vein filling, you found more vein filling in what you call the Centre Star vein than in the Iron Mask? A. I find vein filling extending over a broader space as a rule.

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Q. That is to say, it is more in quantity? A. I should say in absolute quantity I should think it would be more, yes, sir.

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Q. But in its essential qualities it is practically the same? A. As to their component minerals it is the same.

Q. Is not that the essential quality of vein filling, the minerals of which it is composed? A. The essential quality of the vein filling is indicated by the assay. 5

Q. I do not appreciate the distinction. Will you kindly explain it? A. I simply mean to say that you can not tell from a simple inspection which is the best filling, which has the highest value. 10

Q. No, but I was referring to its mineral character and speaking of the vein filling? A. The same minerals are in both veins.

Q. But there is more in quantity in the Centre Star than in the Iron Mask? A. I should be inclined to think there was, although that involves a comparison which— 15

Q. Which you have not made? A. Which I would not like to answer finally without examining in detail all the workings of the old stopes. 20

Q. Then I will take it this way: that you have not made that comparison in your examination as to the comparative quantity of vein filling in the Centre Star and Iron Mask? A. I have made that comparison, but it is impossible to give such comparison down to its most minute details without a quantitative comparison, which would be a work of great importance, of great— 25

Q. (Interrupting.) Speaking from your observation and relying upon your experience, I am willing to take your answer as to the comparative quantity of vein filling in each vein? A. Well, I should think there would be more filling in the Centre Star vein; it is a wider vein, shews a wider mineralization. 30

Q. Then when you come to the intersection, Mr. Lindgren, you have two planes crossing each other, one at a 45 degree dip and the other—what do you place the dip of the Iron Mask at on an average? A. Sixty-five to 70. 35

Q. And you have these veins filled with ore, which, so far as its character is concerned, is practically the same in both veins? A. It is not the same in both veins, because there is a difference in its mineralization, which I have explained before. 40

Q. What is the difference in the mineralization? A. The difference in the mineralization is that the Iron Mask vein, so far as I have seen it, carries one seam, rather narrow, confined between two planes with solid pyrrhotite be-



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tween it, and chalcopryite between it. In the Centre Star vein the mineralization is scattered over a larger width than it is in the Iron Mask.

Q. This is because there is more width in the Centre Star vein than the Iron Mask vein? A. I should think that is correct.

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Q. Let us take a point. Say the crossing which you find in the Iron Mask winze below station 69, in one of those crossings at station 69 you find a crossing, do you not? A. At station 69 the Iron Mask vein is not very well defined.

Q. Let us take another. Take the crossing near Iron Mask No. 69 east drift. A. Yes, sir.

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Q. Is there any distinctive characteristic at that point between the ore of the Centre Star and the ore in the Iron Mask vein? A. The ore of the Iron Mask vein at that locality is a small seam filled with a few inches of practically solid sulphides, solid pyrrhotite and chalcopryite. The ore of the Centre Star shews here six feet wide, I should say, and consists of altered country rock with large bunches of pyrrhotite in it.

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Q. But leave the altered country rock out, which is a space lying between the two solid bodies of ore. Referring to the solid bodies of ore in the two veins what distinction do you make? A. I could not do that because the ore which I just referred to consists of a mass of intimately mixed altered country rock and solid pyrrhotite.

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Q. You took the plane of the Iron Mask vein? A. Yes.

Q. Then don't you find a block of ore there, a block of rock which you call altered country rock intersected with planes, and then you come to the plane of the Centre Star vein. Is not that so? A. No, I do not believe I quite—it is not quite in that way.

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Q. Let me put it this way. The Centre Star vein and Iron Mask vein form at that point roughly, what you might call a "V"? A. Yes.

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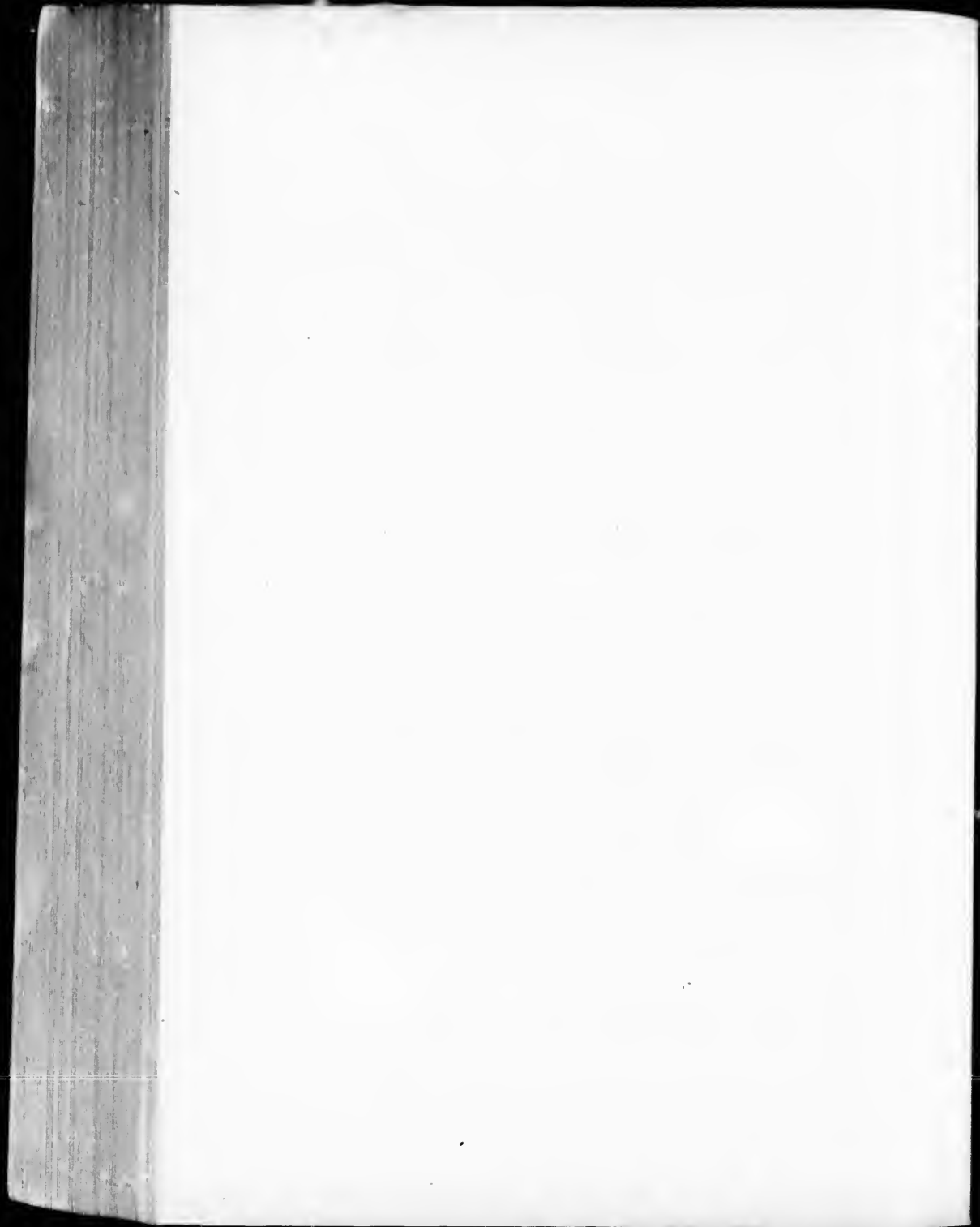
Q. Between the two parts of the "V" you find altered country rock, don't you? A. Between the two parts of the "V?"

Q. Yes. A. In the space of the two forks of the "V," so to speak?

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Q. Yes, comes down like that and like that, doesn't it? A. Which is which?

Q. Call this the Centre Star and that the Iron Mask. A. Very well.



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Q. Now, you find a space in there, don't you? A. Find a space in there, yes.

Q. Which is seened across like that and altered country rock? A. Again I must ask you to indicate which is the Centre Star No. 2. 5

Q. (Referring to the diagram drawn on the paper.) That is what I call the plane of Centre Star No. 2. A. That is one plane of Centre Star No. 2.

Q. And the other would be down here? A. Yes, that is right. 10

Q. And the other plane of the Iron Mask would be there? A. Yes, the other plane of the Iron Mask.

Q. What I want to get at is, what distinctive characteristic do you make between the ore in that plane and the ore in this plane? A. Well, in taking it simply in small specimens there is no difference; taking the two veins as a whole there is a difference. 15

Q. I know, but if you take pyrrhotite ore there and pyrrhotite ore here you make no distinction, do you? A. Taking a piece of pyrrhotite that I can hold in my hand from the Iron Mask, and a piece of pyrrhotite from the Centre Star, and there is no difference.

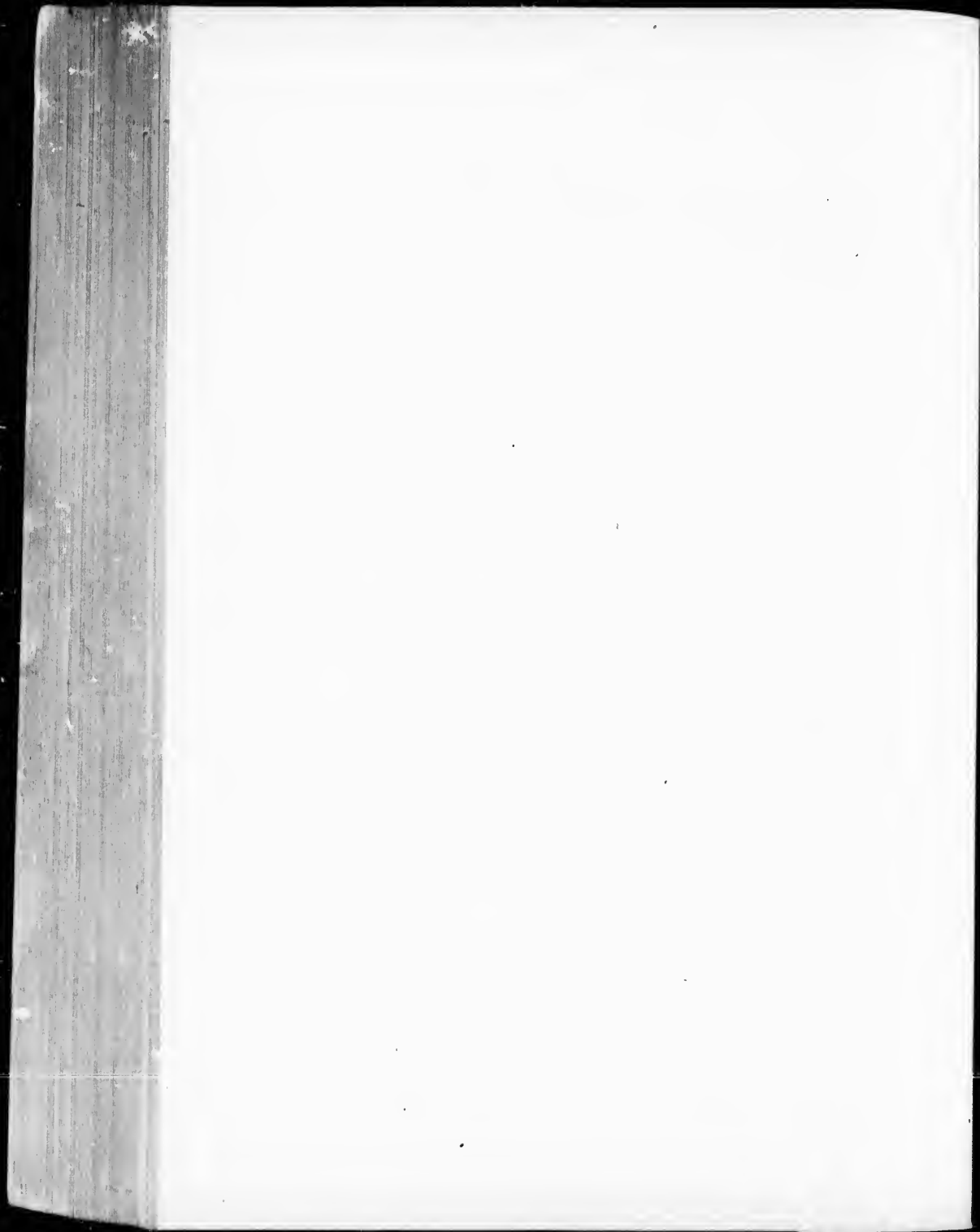
Q. And if you find altered country rock in here and altered country rock in there, do you make any distinction between the altered country rock in the two places? A. The process is practically the same. 25

Q. But you may find more altered country rock here in the Centre Star plane than you do in the Iron Mask plane. A. You ordinarily do.

Q. Do you remember whether you do at that point? A. Well, you necessarily do, because the width of the Centre Star vein at this place is 6 or 7 feet, which comprises much altered country rock. 30

Q. You have two planes—four planes, rather, I suppose I might say—two a short distance apart and two a considerable distance apart, one dipping at 60 and the other at 45, and between these planes you find in each place ore of the same quality, and where there is altered country rock, altered country rock of similar quality, is it not a fact then, that you must depend for your crossing upon the intersection of two planes dipping at different angles? A. You do practically. 40

Q. And will not that, speaking generally, apply to all the other intersections of the veins which you have referred to in your evidence? A. You do not depend upon that alone; you depend upon that in part



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Q. I think I understand you, Mr. Lindgren. I am speaking—suppose for the minute, you confine yourself to what you actually see at the crossing without any reference to any other part of the mine. A. Yes.

Q. Will not the answer which you just gave to my last question apply to the crossings at all the places? That is to say, that at each place you will find planes dipping at different angles, at each place you will find ore which is characteristically the same, at each place you will probably, or may probably, find altered rock which is characteristically the same, but you may find more rock in one place than in the other. Won't that do for a general description of these intersections? A. No, it would not do for a general description, because, although each piece of pyrrhotite and each piece of altered country rock may be identical, the two veins are not identical. 5 10

Q. I do not ask you to say that the two veins are identical. A. I mean identical in appearance. 15

Q. They are identical in appearance? A. They are not identical in appearance, I say.

Q. Well, let me get it piece by piece. In each place you will find planes dipping at those different angles, don't you? A. Yes. 20

Q. At each place you find ore characteristically the same? A. In the two veins.

Q. And at each place if you find country rock it is characteristically altered? A. As I said before, the individual parts of the filling are identical, but there is a very marked difference between the veins as a whole. 25

Q. I am just taking it by pieces. So far you agree with me, do you not, Mr. Lindgren? A. I agree with you so far as the answers indicate, yes. 30

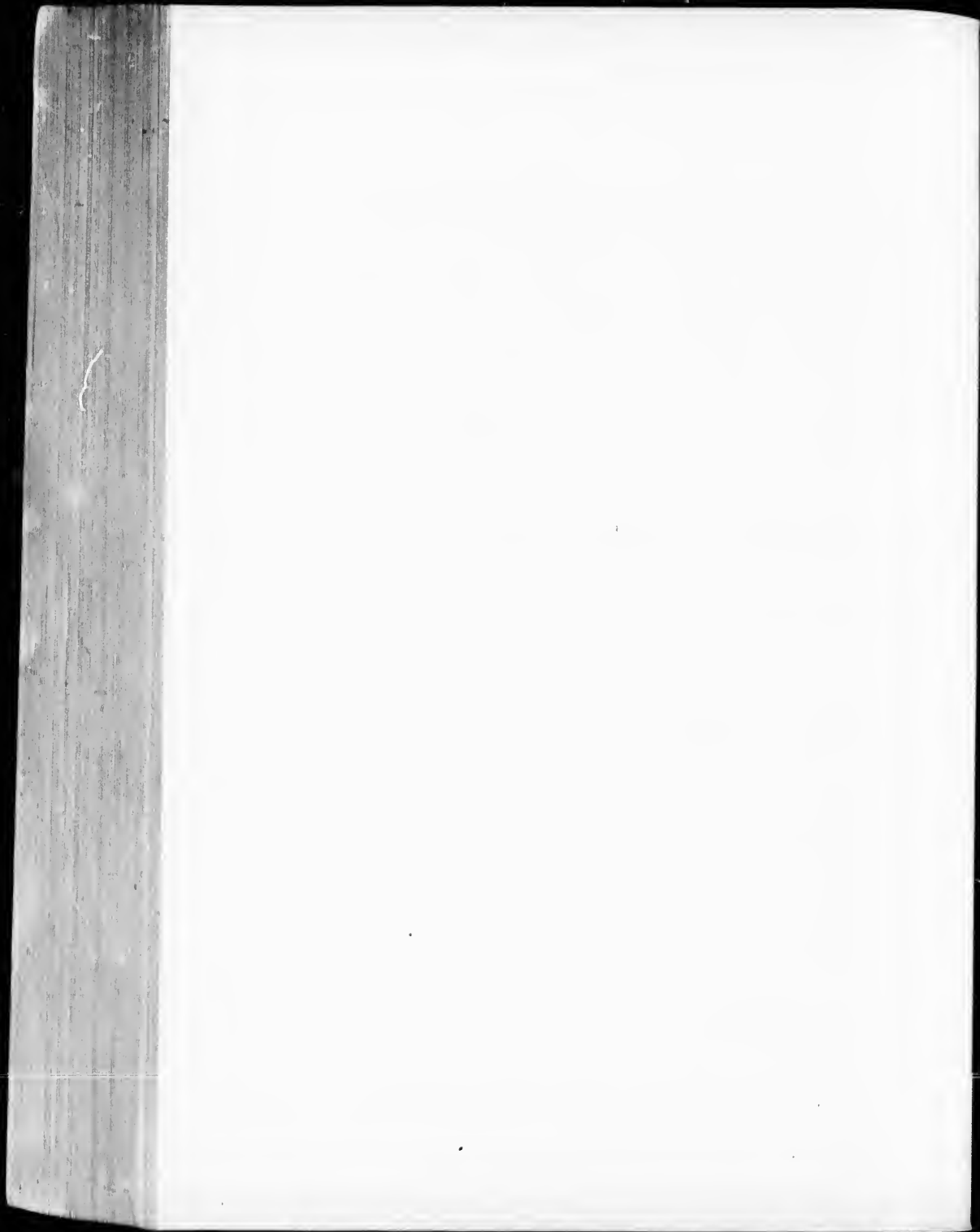
Q. Now, you make a distinction between the ores, do you, or between the two veins? A. Yes, there is a certain distinction.

Q. There is a certain distinction. It is not a distinction in the intrinsic quality of the ore itself? A. No, it is not. 35

Q. It is not a distinction in the intrinsic quality of country rock which is altered in these veins? A. No, it is not. 40

Q. There is a difference in the planes? A. Oh, yes.

Q. A difference in dip? A. And in the general appearance of the veins.



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Q. What is there in the general appearance of the veins which makes this characteristic difference? A. I would take as an example, and which is characteristic, the intersection near the end of Iron Mask upper drift. At that place the Centre Star vein, which I regard as fairly characteristic, shows a hanging seam of five inches of calcite and of five feet or four and a-half of very intimately mixed altered country rock, and pyrrhotite in large bunches and streaks below, and one inch of calcite again. That forms five feet of vein which is peculiarly characteristic of the Centre Star. 5

Q. Why, because there is five feet of it? A. That is one reason. 10

Q. Because there is five feet of it? A. That is one of the characteristics. Another characteristic is that it dips 45 degrees; and a third characteristic is in the breaking arrangements of the ore and the intimate intermingling of country rock and ore. Now, you find that Iron Mask vein also, which here is narrow, which here only consists of a few inches of practically solid pyrrhotite and chalcopyrite, with very little altered country rock or ore minerals of any kind. 15

Q. Will you say now there are no places in the Iron Mask vein where you do not find that altered country rock, that calcite and that quartz? A. I do not. 20

Q. Now then, is not your distinction to be understood because at that point you have a greater quantity of stuff between the 45 degree planes than you have between the 70 degree planes? A. That is one distinction. 25

Q. Do you say that that 45 degree dip and that characteristic distinction of the Centre Star vein in the Iron Mask upper drift continues in that drift? A. I don't believe I quite get the question. 30

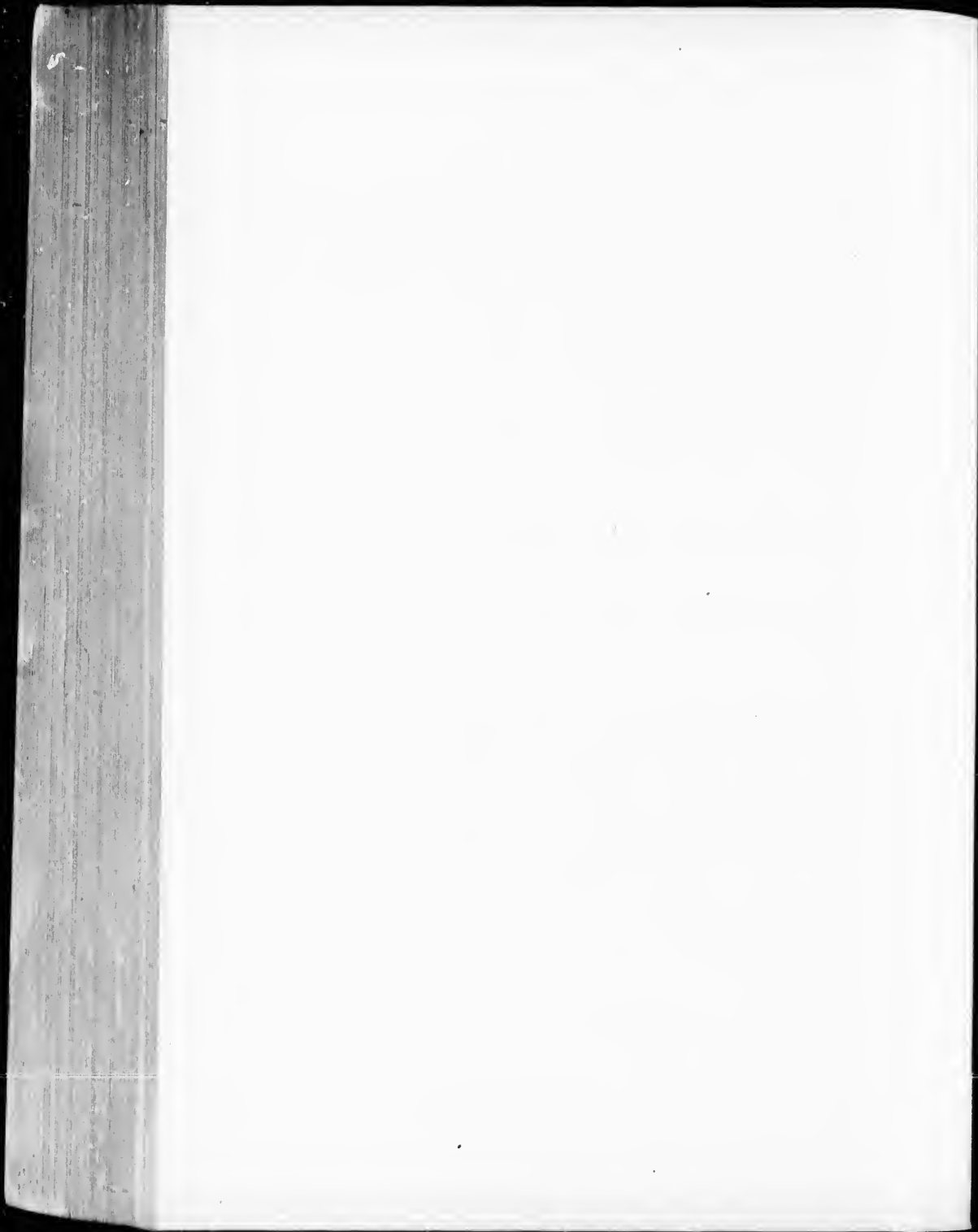
Q. (Referring to the model). You met a place here in the Iron Mask upper drift, don't you? A. Yes.

Q. If your contention is right there is a crossing of the veins at that point? A. Yes. 53

Q. And the Centre Star vein will go in this drift? A. It will.

Q. With its 45 degree dip? A. It will. 40

Q. And the Iron Mask vein will go in that direction with its 70 degree dip? A. It will.



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Q. And if the level is carried along to the east you will be able to appreciate those distinctions in the workings which are done? A. The level will very surely pass outside of the intersection.

Q. Yes, but you will find the place where the Centre Star vein comes out of the level? A. You will if you continue the drift on the strike of the Iron Mask. 5

Q. It must necessarily go out of the hanging wall of that level? A. It must if this upper Iron Mask drift is continued on the average strike of the Iron Mask in this eastwardly direction. 10

Q. But if you continue it far enough to the north to keep all the ore in the tunnel, you must necessarily find the Centre Star vein going out on the hanging side? A. In order to follow the Centre Star vein, you have only to turn your drift a little towards the north following the Centre Star strike instead of the Iron Mask strike. 15

Q. And then you must necessarily follow the Centre Star vein? A. You are on the Centre Star vein if you are on the drift. 20

Q. And if you make your drift wide enough you would be able to see both the Iron Mask and Centre Star where they leave each other? A. Yes, I should think so.

Q. So there we have a chance to make a complete demonstration of your crossing of veins? A. The Iron Mask vein has, in fact, already left the Centre Star vein at that point. It is not very well exposed right here at the winze, 20 feet west of 105. 25

The Court: There is no winze there, is there? A. Yes, a small one. 30

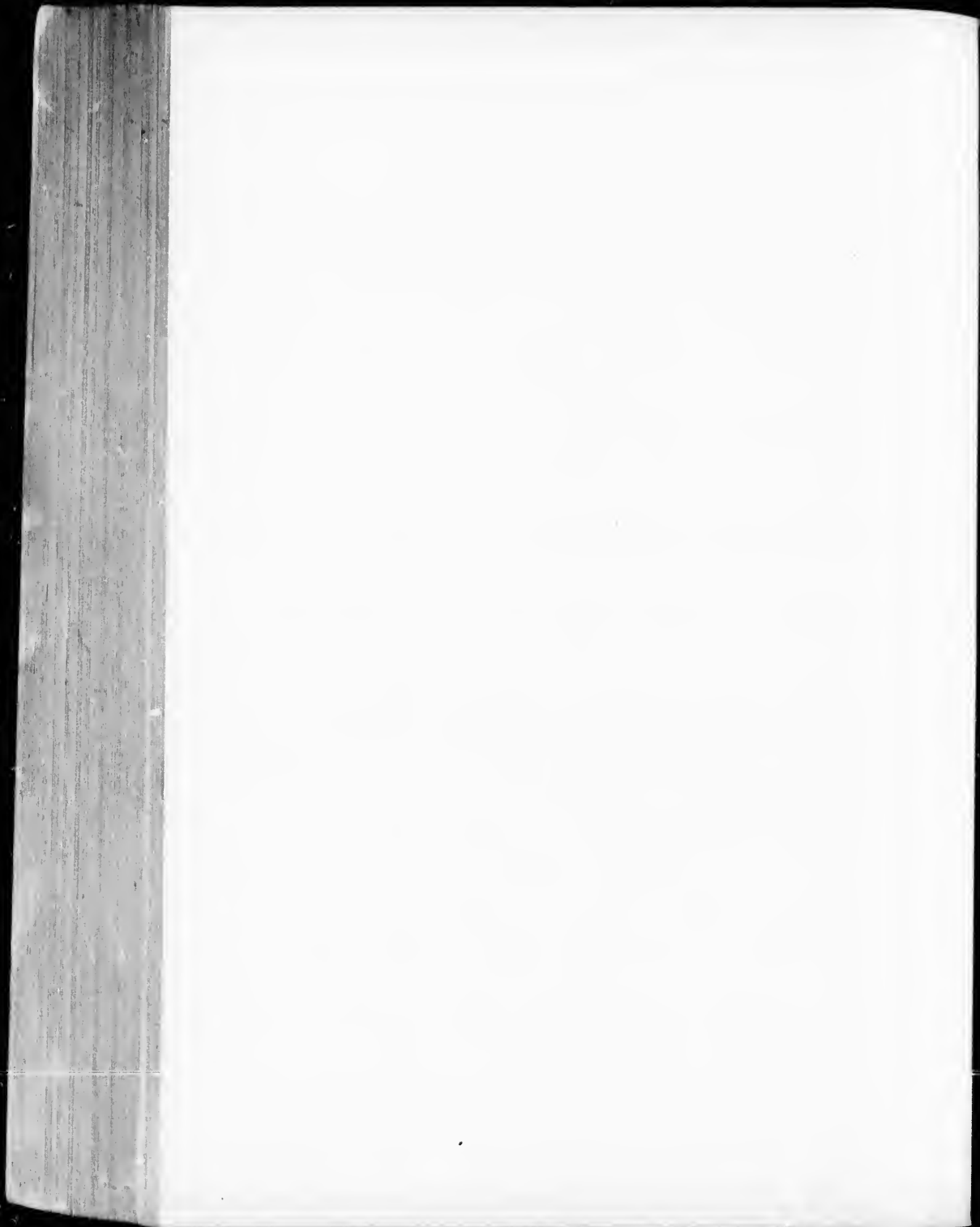
Q. I would like if you would, as much as possible—I do not want to interfere in any unnecessary way, but I want to save as much time as I can—try to answer my questions as directly as you can and as shortly as you can.

Mr. Davis: My learned friend asks his questions in such a way that that can not be done. 35

Mr. Bodwell: Mr. Lindgren knows whether they can be so answered or not.

The Witness: I will try to, to the best of my ability. 40

Q. Mr. Lindgren, going down the No. 3 incline, I understand you find a body of ore with a wall of rock enclosing that body of ore? A. Yes, I do.



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Q. And then above that you find another body of ore with a wall of rock enclosing that body of ore. I mean immediately enclosing the ore? A. I beg your pardon, I did not understand that. I do find a body of ore in the No. 3 shaft all the way down.

Q. But don't you find this—Mr. King referred to it, and that is the reason I am asking you—that he found in the first place a wall which followed the ore immediately, closely? A. Yes, sir. 5

Q. And then above that, he found another wall which he called a correlative wall? A. Yes, two or three feet above this. 10

Q. Now, I am speaking about the rock and you found a body of ore with rock immediately surrounding it, enclosing it? A. Yes, rock immediately above it. 15

Q. These bodies of ore begin small, widen out and come to a point? A. Again I am afraid I don't understand you. There is one body of solid pyrrhotite in the foot of the shaft.

Q. Is it the same size, the same measurement across all the way down? A. No, it varies from place to place. 20

Q. It swells out and narrows? A. It swells out and narrows, yes.

Q. And there is a wall of enclosing rock immediately surrounding it? A. There is a seam of calcite very frequently marking the upper limit of the ore, that is, about two feet below the upper wall which forms in most places the roof of the shaft. 25

Q. Then you found a series of walls above? A. I don't know how many walls there are above that wall in the incline. 30

Q. You found one wall consisting of a number of planes which were broken? A. I found one wall exposed in the roof of the incline which is sometimes broken into by mining operations and sometimes locally irregular, but which I measured at a number of places and found practically the same dip and strike as the vein has below. 35

Q. Going over to the No. 2 incline, now, you found a body of ore at or near the collar of the shaft which apparently leaves the incline on a much straighter dip than the incline—much steeper dip than the incline? A. Not much steeper. I should say the dip immediately at the collar would be about 60 degrees, but going down a few feet it immediately flattens out. 40



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Q. Yes, that is the dip of the incline; but this body of ore keeps the steep incline or dip? A. No, sir, the body of ore flattens out immediately below the collar.

Q. Didn't I understand you to say there was a body of ore near the collar of the shaft which practically went out of the foot wall of the shaft? A. No, I did not say so. There is, however, a bend which does go into the foot wall. I have not mentioned that, but there is. 5

The Court: You are talking about No. 2 shaft? 10

Mr. Bodwell: No. 2 incline.

The Witness: This is No. 2 incline. I beg to remark that this small seam which goes in the foot wall with a very steep dip is not the main body. The main body follows the shaft down. 15

Q. I am not asking you to distinguish at all. There is a body of ore,—a slip or seam or body of ore,—I don't care what you call it—that goes out of the foot wall of the shaft near the collar A. Yes.

Q. Then you follow down on another—you called it a fissure in the incline yesterday, didn't you, a central fissure? A. You follow down on the main body which is shewn by the cropping at the collar of the shaft. 20

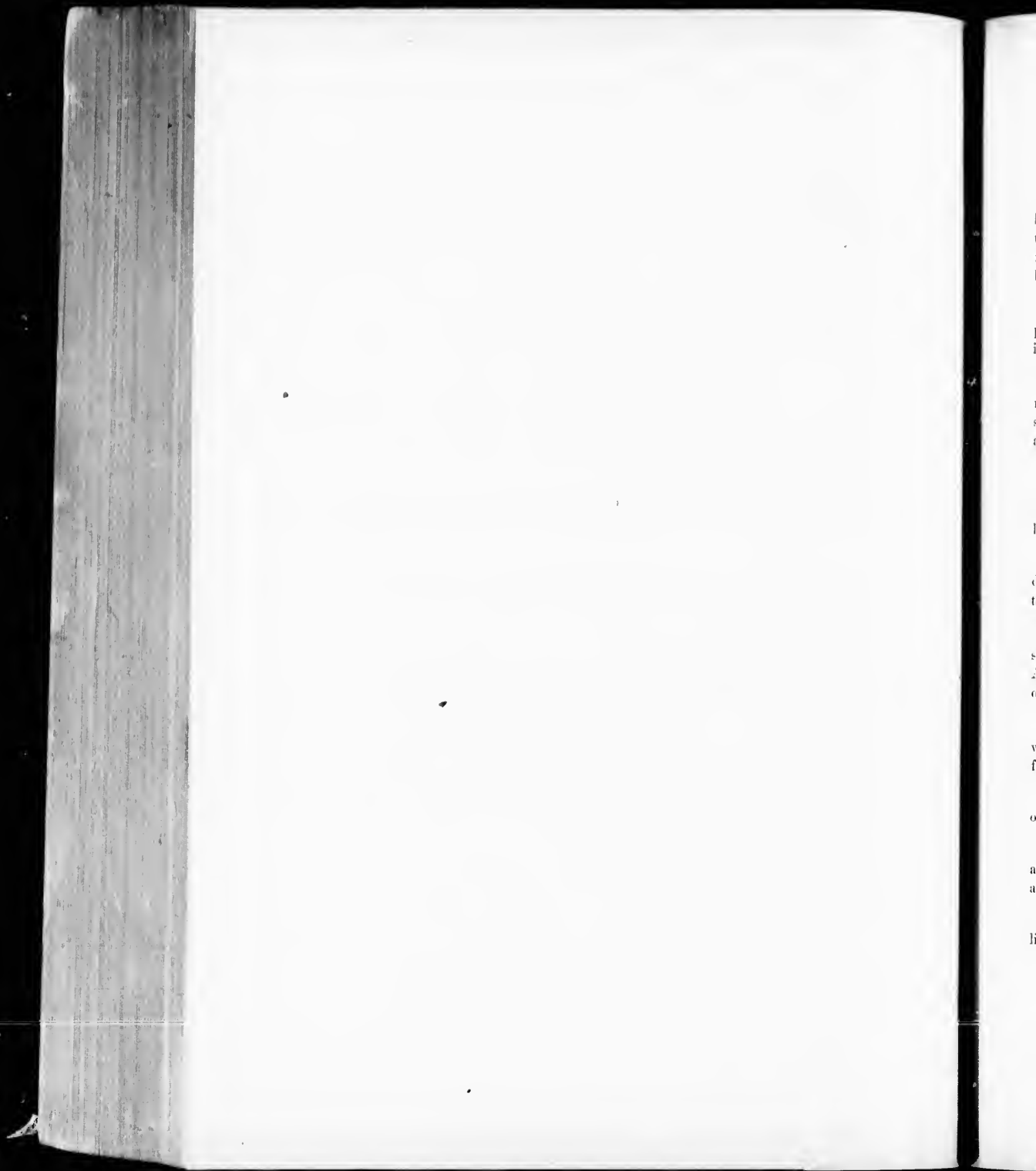
Q. But does not that mean by going down on what you yesterday termed a central fissure? A. That goes down and continues with a width of between two and three feet until a point near station S1, from which place for perhaps 50 feet further down it narrows into a fissure which is only about from six inches to a foot wide. 25

Q. And that fissure comes to a point? A. And that fissure ends, or does not end—the ore does not end, but the fissure locally ends at a place some 50 feet above the bottom of the indicated line. 30

Q. That is where it meets that coarse-grained rock? A. No, not quite. There the central fissure which I just referred to grows smaller and practically disappears, but at the same place the ore goes up into the hanging and continues, now widening to a body of— 35

Q. It leaves the fissure then, the ore does? A. It leaves that plane. It does not leave the vein; I have explained before, that ore bodies go down along one plane and change over to another plane. 40

Q. But it leaves— A. It leaves that plane which I have just described.



Q. It goes out of the hanging wall shaft? A. Yes; it goes up to the hanging wall a distance of about two feet, I guess, and there is no interruption; it simply goes up in the hanging wall and is there continuous for 20 feet further down and is a pretty heavy body. At that place about 60 feet from the bottom of the incline the coarse rock comes in.

5

Q. Then you have to trace the ore through little seams and irregular patches through that coarse rock? A. Then the rock is mineralized shewing irregular bunches and seams of pyrrhotite for 20 or 25 feet further down.

Q. Mr. King said there were some places, sometimes, an intersection of rock of 4 and 5 feet in that mass of coarse-grained rock without ore; that is to say, you had to jump from place to place from one place to another sometimes a distance of 4 or 5 feet.

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Mr. Davis: I do not think Mr. King said that.

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Mr. Bodwell: Well, put it "if he did say that," because that is my recollection of it.

A. I should think that might be the fact, if he referred to, as he probably did, the larger bunches of ore. Little masses and smaller quantities of pyrrhotite you will find in very nearly every specimen.

Q. Very well, then you go down on that and you meet a plane which stands approximately vertical in the bottom or near the bottom of that shaft. A. Yes, there is a plane at a distance of 40 feet horizontally from the bottom of the level that would bring it up about in here.

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The Court: In No. 2 shaft? A. In No. 2 shaft there is a distinct plane which crosses the Centre Star vein No. 2 and apparently goes down into the foot.

20

Q. Don't you pass across another plane before you get to raise No. 4, another vertical plane? A. No, sir, not that I know of; there is only one.

Q. There was a plane which goes down from the top of No. 4 cutting across in that direction, was there not? A. That I do not know anything about.

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Q. It may have been destroyed in the working? A. That is very likely.

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Q. Then you come over to Centre Star north level? A. Yes.

Q. And you find a strong broad vein there? A. I did find a vein from
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Q. Good solid ore—good ore? A. Solid ore, yes.

Q. With a course about north 70 west? A. Coursing about north 75 west. I beg your pardon, just one moment. No, not that much. The average strike would be indicated by the line connecting stations 53 and 49, and that would be north 75 I should say. 5

Q. Do you think you can take the average strike of the vein with that short piece exposed there? Might not that be just a local bend in it? If you take the vein cutting across from this point here, what do you make its strike? Suppose you connect these points and take the strike from that, what would you make it (referring to the model)? That is, the point from the south cross-cut No. 1 to a point say at the foot of No. 4 raise. A. I would have to have a protractor to shew this. 10

Q. Well, let that rest a minute. That vein has a pretty steep dip. A. About 55 degrees as I measured it. 15

Q. This No. 4 raise starts on the tunnel level. A. It starts on the tunnel level. 20

Q. Goes up on ore? A. It goes up on ore is my understanding, yes.

Q. Until it meets the mud-seam? A. Until it meets the mud-seam, yes. 25

Q. Then across here there is ore again? A. There is ore above the mud-seam. 30

Q. With an apparent displacement of about the width of the ore. A. I am not sure about the displacement at that place. 35

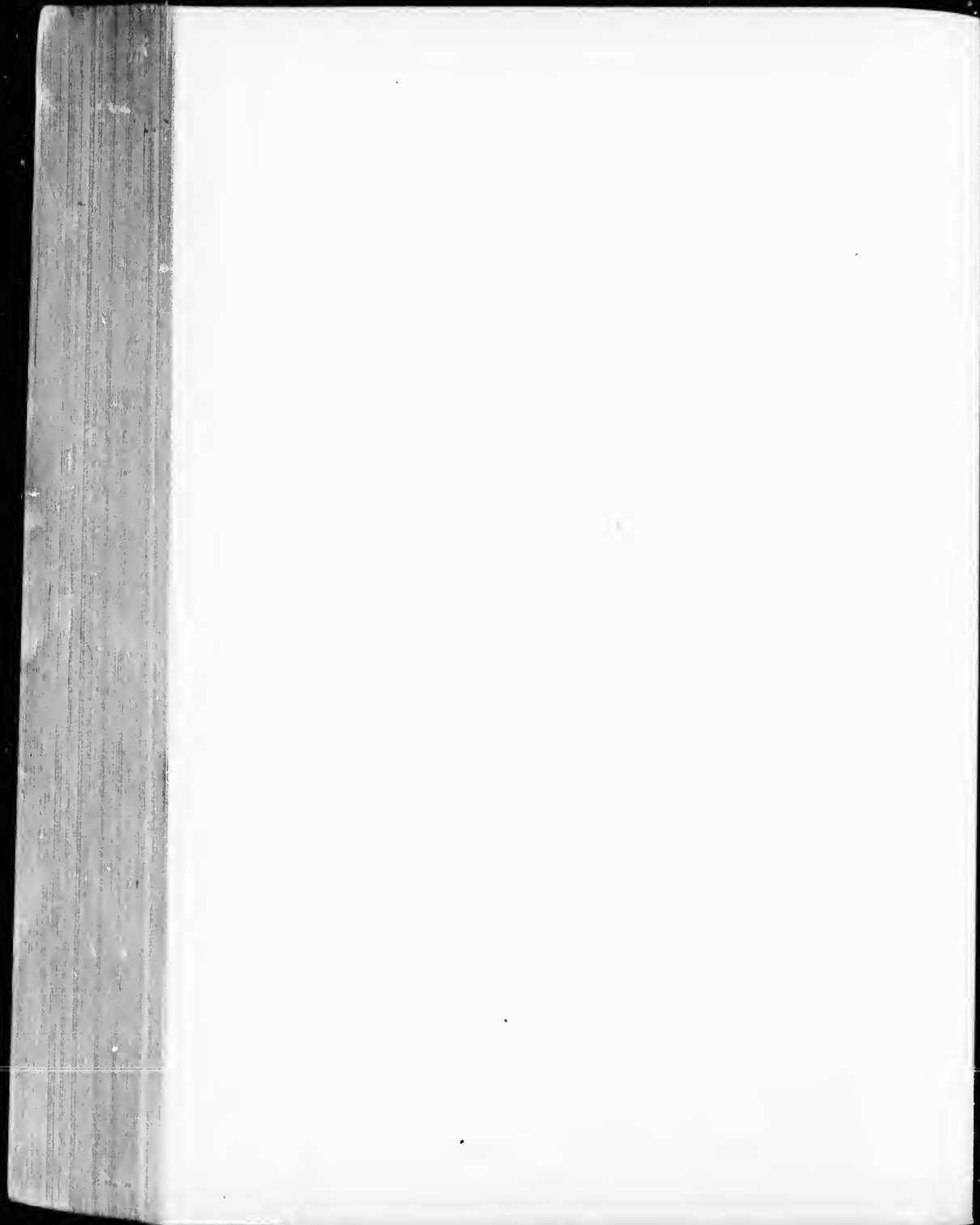
Q. And goes on up at a steep dip. A. To near the top of the incline.

Q. You don't know what vein that is. A. No, the development is not sufficient— 40

Q. It certainly is not the vein in the No. 2 incline. A. The developments are not extensive enough for my observation. 45

Q. It is not the vein in the No. 2 incline. A. It may be an offshoot from that vein. 50

Q. It has not the characteristic dip, it has not the characteristic strike, and it has not the general appearance of the vein of the incline. A. No, it has not.



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Q. But it has a strike which corresponds comparatively to the strike of the ore in the north level. A. It has a strike which corresponds to that of the ore in the north level I should say approximately.

Q. It has a dip which might very well be the corresponding dip to the ore in the north level. A. I do not think so; it has a very much steeper dip. 5

Q. But then you find these local variations of veins, don't you? For instance, the change you found in the No. 2 raise. A. I know, but the dips which I measured at a number of intervals from No. 2 raise to the point where the vein disappears 20 feet east of No. 49 all shew a very constant dip of 55 degrees. 10

Q. Yes, up to that level, up to that point. A. I say along the drift.

Q. That is how many feet? A. From here to here? 15

Q. Yes, over the ground over which you made these measurements of dip. A. Oh, perhaps 80 feet.

Q. And yet you think that this vein could not steepen in the distance from the level of the north level to a point indicated by the present top of No. 4 raise locally so that the ore in No. 4 raise might be a part of the ore of the vein in the north level. A. I should not think it would be likely. If I found at these places an indication of the steepening near this Centre Star shaft No. 2— 20 25

The Court: At the foot of No. 4. A. At the foot of No. 4 or near the foot of No. 4 upraise, I should think it would be more likely, but there the dip is very constant.

Q. Suppose No. 2 upraise were started as perpendicularly as No. 4 upraise; what would be the dip going up to the point of that bend there? A. The dip at the very foot of No. 2 upraise I measured at 55 degrees, and the raise follows that vein bending over. 30

Q. But you say the vein bends over very flat right there? A. It does bend over? 35

Q. Yes, and that incline is run partly on the strike and partly on the dip of the vein—incline No. 2? A. That is not run directly on the dip, no, no. 40

Q. It is partly on the strike? A. Partly on the strike.

Q. You found vertical planes in here filled with ore? A. I found one narrow vertical plane.

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Q. And there may have been more? A. I do not think so.

Q. Wouldn't it be a possible condition owing to the close proximity of this vein here, and the vein coming down the Centre Star No. 2 incline, and the other vein which you find in the No. 4 raise,—would not the close proximity of the fissuring of these different veins possibly create small parallel seams in the rock at that point? A. The close proximity of these two fissures might create vertical seams in the rock, by that? Yes, it might be possible.

Q. Would not it be possible to start on one body of ore at the foot of No. 2 raise, go up a certain height, meet one of these fissures and carry across from one to the other, on a raise as that is run, for you to meet another body of ore right here? A. I do not think that has been done at all, because there is no indication of any ore body going up into the hanging at all, or any planes going up into the hanging at the point of the bend of this raise, as there would be if there was a vein running up perpendicularly. I could not find any indication of such planes.

Q. But I suppose you were not looking for them? A. I was looking for it pretty closely.

Q. Pretty closely for that? A. I could not see any planes or ore.

Q. Where do you think this ore goes to in No. 4 raise? A. I would not like to venture a positive opinion on that.

Q. And the only reason you say it does not below to the vein in the north level is because it has too steep a dip for that distance? A. To the ore in the north level?

Q. Yes. A. Well, there is, I find, along the north level a well defined dip of 55 degrees corresponding with that vein which I have followed down, with the dip of the Centre Star No. 2 shaft.

Q. But that has an average of 45 degrees, has it not? A. That vein has an average of fully 45 degrees, and this has 55 in the north level—56 degrees.

Q. So that you have a vein coming down on 45 and immediately becoming a part of a vein that goes up on a dip of 56? A. Fifty-five, I think. I don't know just what it is as to the dip of this vein. I would be able to tell probably. It is 50 degrees, so there is only a difference of five degrees, which is very little.



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Q. And the 50 degrees you make in what way? Do you take the dip of the incline as the dip of the vein? A. I took the dip of the incline as the dip of the vein.

The Court: The dip of shaft No. 2? A. Of shaft No. 2.

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Q. The dip of the shaft you took for the dip of the vein? A. The dip of the shaft for the dip of the vein, because the shaft follows the vein.

Q. Yes, but part of the time it is pretty near the foot wall and part of the time in the hanging wall? A. Oh, what I consider the ore? But the planes continue with the same dip.

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Q. Then putting it at 50, that is the steepest dip you can give it? A. It is not the steepest dip, it is the average dip. Its average dip from the collar down to the bottom.

15

Q. And comes down and immediately straightens up to 56? A. Oh, there is a difference of five degrees between these; the average dip of the whole vein and the dip along the bottom.

Q. What is the exact dip of the vein in the north level at the point where the incline shaft meets it? At the very point that these two meet, what is the dip? A. Of the vein in Centre Star No. 2 shaft?

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Q. And the vein in the north level when they come together. I want the dip of the ore at that particular point if you can give it me; if you don't know it, it doesn't matter? A. The dip of the Centre Star No. 2 vein cannot be given exactly at the place from the mud-seam down to the bottom of the drift, because there are a number of bunches here; but there is no well defined plane.

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Q. Take the dip of the ore exactly at that point, and that will do for my purpose, if you can give it? A. At the foot of No. 2 shaft?

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Q. Yes, No. 4 raise. (The witness referred to his memoranda, taking some time.) Well, I will come back to that, after a time, Mr. Lindgren. A. The dips I did measure were, one exactly at point 49, another very nearly exactly at point 52. And those two dips were certainly 55 degrees.

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Q. You have not your note of it, have you? You can not turn to it without a little trouble? A. It will take me a few minutes to find it.

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Mr. Bodwell: I will leave that until you have time to look it up.

Mr. Lindgren, you said, I think yesterday, that you would class the rock in this disputed territory as augite-diorite? A. That was my determination.

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Q. It may be, however, a monzonite. I would like to get this on the notes. These distinctions between different rocks are to a great extent names only, are they not? A. They are; the distinction between monzonite and augite-diorite is a difference occasioned by the appearance of a considerable amount of orthoclase-feldspar. 5

Q. For instance, this original ground mass—I suppose that is the proper term to call it—came up in an eruption? A. The magma, yes.

Q. Composed of a number of different mineral constituents? A. Yes, 10 certainly.

Q. Now, then, if that original rock cooled under certain conditions, these minerals would associate themselves in a certain order with each other? A. They will. 15

Q. Under certain conditions, there would be a certain form of crystallization appear? A. There would under all conditions be a general sequence of crystalline, but that might differ in detail as those conditions differed. 20

Q. It would be more complete and less complete in some places, owing to various conditions, which need not be gone into? A. Yes.

Q. Under certain other conditions of cooling and crystallization those minerals might associate themselves together in a different way? A. They 25 might differ to a certain extent.

Q. And as a matter of fact, different forms of crystals would result? A. Yes, if the rock cools rapidly, it may be glassy.

Q. And the ground mass then, the altered ground mass, or the cooled ground mass, from the final result—whatever it may be called—would receive a different name according to these different circumstances under which it was evolved from its original condition. A. The names which a rock received 30 differ, to some extent, as the structure of the rock differs. If I found this rock of the same composition as a glassy rock consolidated at or near the surface as a lava flow, if it had really appeared at the surface, a flow over as a lava flow, it would have received a different name, because we differentiate these rocks from those which have consolidated in depth, which these rocks here appearing have. 35

Q. If it was at the surface, it would cool quickly and they would assume a glassy appearance? A. Probably. 40

Q. If it was under a heavy pressure, at great depth, it would cool very slowly and you would not find the glassy characteristic? A. No, sir.



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Q. But you would find the same constituent, the same minerals in the rock in both cases? A. Some minerals might not appear if the rock is consolidated, as a class.

Q. They may be lost in that process or would combine with some other chemical substance? A. They might combine somewhat differently. 5

Q. But for our purpose we may take this, for instance, you have gabbro, and augite-diorite. Now, is there any essential difference in the minerals which compose those two classes of rocks? A. There is no essential difference in the species of minerals, but there is a difference, however, in the feldspars in as much as they are feldspars in both classes of rocks. 10

Q. That is what I mean. A. But the feldspar, of the gabbro is different in composition to that of the augite-diorite. 15

Q. But what I meant to say is that you would find feldspar in both classes? A. Yes, you would find feldspar in both classes.

Q. And if any further differentiation went on in this rock, you would get a rock such as you find in the Grass Valley called amphibolite, would you not? A. No, you would not. The amphibolite which you referred to is derived from rocks like these and like gabbro, by exceedingly great pressure having been applied to the rock.

Q. But the original rock of which that was derived was diorite, you said. A. The original rock might have been diorite. 25

Q. And the feldspars that you find in this rock—you said there was orthoclase and plagioclase, didn't you, yesterday? A. Yes, sir.

Q. Familiarly known as a potash feldspar and a limestone feldspar? A. Yes, sir. 30

Q. Which is which? A. The plagioclase is a limestone feldspar.

Q. And the orthoclase is the potash feldspar? A. Yes, sir. 35

The Court: Lime and soda? A. Yes, lime and soda.

Q. Now, when these feldspars decompose, alkaline solutions are formed, are they not? A. Alkaline solutions may be formed by decomposition of the feldspars, yes, they may be formed. 40

Q. And it is generally recognized that hot alkaline solutions will take up minerals out of rocks and carry them along when they circulate, is not that so—that is, precious minerals and metallic sulphides? A. You mean to ask

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whether the feldspars are decomposed by hot alkaline solutions received from below?

Q. No, I am not on that point. A. I misunderstood you.

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Q. But it is a generally recognized fact that the metallic filling of veins is carried from one place to another in hot alkaline solutions, is it not? A. It is generally conceded that mineral veins have been deposited in a large number of instances by hot alkaline solutions, yes.

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Q. And there are certain other chemical actions arising from other solutions. Carbonated waters make another kind of solution? A. The carbonated water and alkaline waters are generally together; they are all one solution.

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Q. You mean that these alkaline solutions, carrying the constituents of the mineral veins, meet at some point a certain other lot of chemical affinities, which cause an interchange, and the original rock was substituted with the mineral that was in the solution? A. Yes, I meant that the solutions which carry the minerals, coming up on the fissures, re-acted on the rock, dissolved certain portions of the minerals in the rock, and deposited, instead of this dissolved minerals, some metallic minerals, which exist in the solutions in another form.

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Q. And all that it is necessary for them is to have the solutions meet the chemical affinities in the other rocks, the original rock? A. The solutions which ascended on the vein—on the fissures, and re-acted on the rocks, they would re-act on most rocks of this kind.

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Q. Yes, but all you would require would be hot alkaline solutions containing the dissolved minerals and a place of circulation for the water to effect this replacement? A. All I would need would be the hot alkaline solutions: they were probably hot alkaline solutions which contained the metals in question, and the country rock which these solutions could act upon.

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Q. And a plane of circulation? A. And a plane of circulation.

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Q. And the circulation is the most important thing in this connection, is it not? A. It is certainly an essential thing. I should say the most important thing would be that the solutions carried the minerals.

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Mr. Bodwell: Perhaps that is right.

The Court: I would rather have you use his words instead of "circulation." It is exceedingly simple what he says.

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Q. This is what I am asking about, and I will just read it to you, Mr. Lindgren, and see if you say it is right.

The Court: You are asking your questions, and you must see that I do not want to interrupt you at all. 5

Mr. Bodwell: I understand, your Lordship.

The Court: But when it comes to planes and circulation and a lot of those pyrotechnic terms, I would like to hear them explained. The witness is a kind of glossary to-day, and in the most simple form. It is like a physician who describes a black eye as ecchymosis accompanied by an extravasation or something else. 10

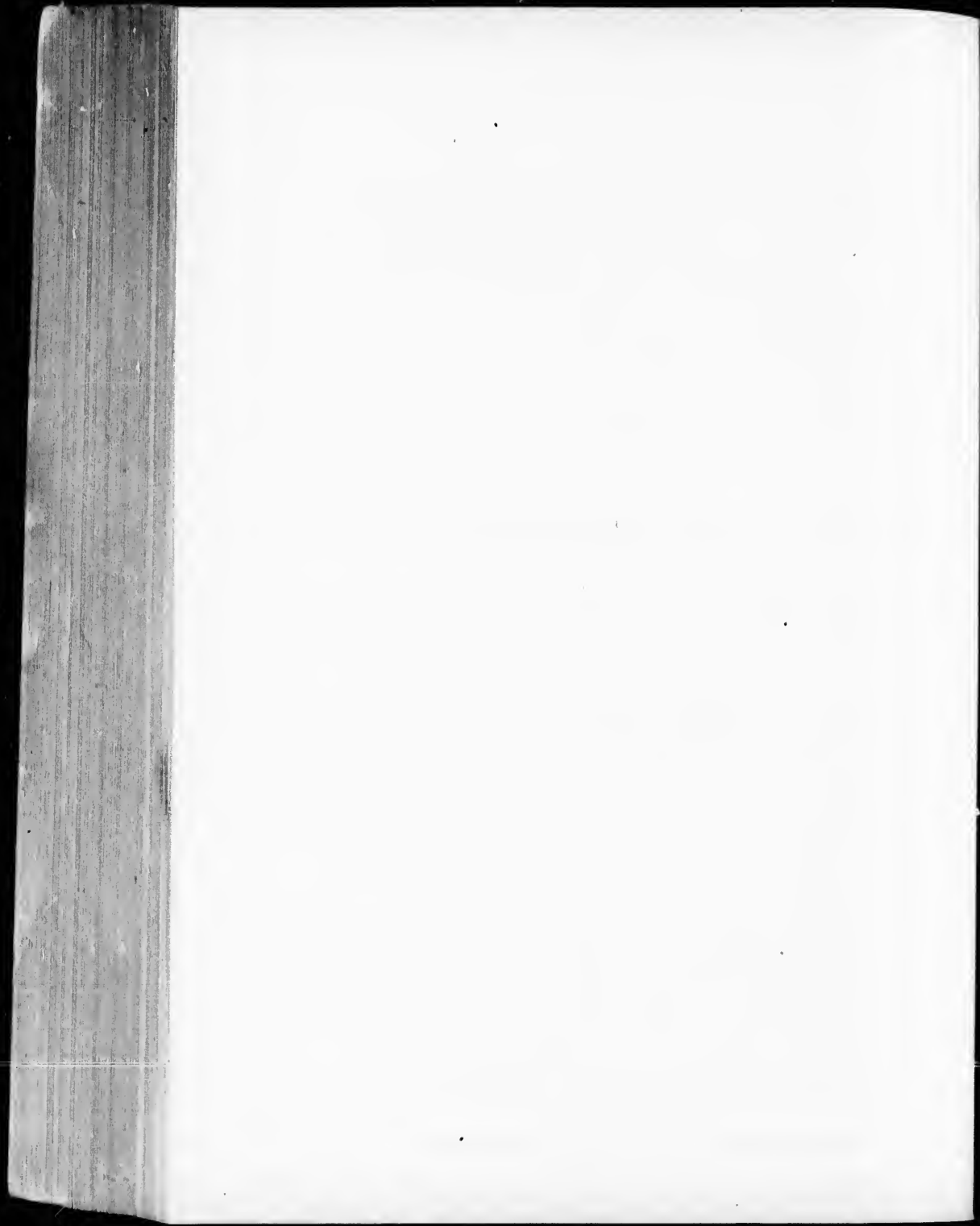
Q. (Reading.) "The word 'circulation' is the key to the whole matter. There has been a tendency to speak of descending lateral and ascending currents as though the one adjective would cover the manner of movement of all mineral solutions. An ascending flow was supposed to have formed this lode, descending that one, while others again, steering a middle course have imagined that ore-formations derived their origin from solutions having a lateral flow. In each case a narrow view of the subject is both unphilosophic and unscientific; it has too often been the obstacle to progress in this branch of geology. One great fact confronts us, and that is circulation." 15 20 25

That is to say, wherever you have alkaline solutions and a plane of circulation, you will have mineral deposits either formed by the circulation or in any other way in which we know that veins are formed. A. I should say those were some of the conditions. The other conditions would be that those alkaline solutions were strongly charged with mineral water and were ascending in a fissure. 30

Q. Not necessarily ascending? You recognize Professor Le Conte as an authority, don't you? A. Yes, to some extent. 35

Q. Do you agree with this statement, which is said to have been made by him: "In the uncolored light of a very comprehensive view, many of the difficulties and obscurities of the subject disappear." 40

Q. You could have heat produced by mechanical or chemical forces, could you not? A. You could have heat produced by mechanical processes.



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Q. By mechanical processes. A. You certainly can have heat produced by mechanical processes, but I don't think the heat of waters are derived from that sort of a process to any very great extent.

Q. You can have heat from mechanical sources, can you not? A. We certainly will have heat from mechanical sources. 5

Q. If you have great movement you are bound to have heat? A. If you have very great movement, you certainly will have some heat; yes. 10

Q. And if you have certain kind of chemical reactions you are bound to have heat also? A. Certain kind of chemical reactions do develop heat.

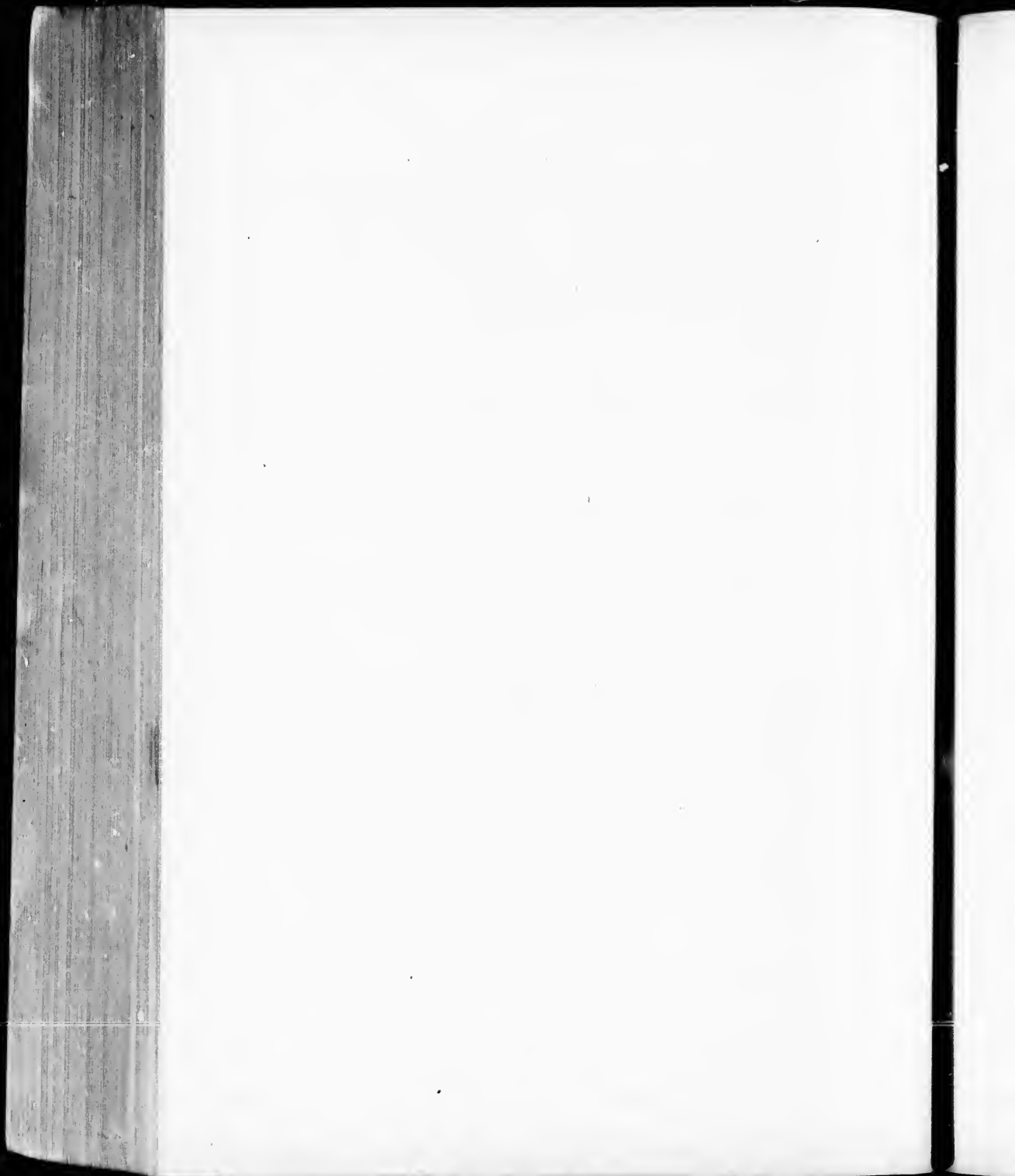
Q. And if you have a place with those forces acting on the water, there you are bound to have hot water, you cannot help it. A. There is another thing that depends on, whether the movement and the chemical reactions will produce sufficient heat to heat the water to a sufficient degree, which I— 15

Q. (Interrupting.) Can you say— A. I beg your pardon— 20

Q. (Interrupting.) Can you say there is any place where you can say this will not produce ore, that there is any one condition of circulating water, heat and circulating water that will not produce ore, if the ore is in the rocks in which the water is circulating? A. If I can say whether there is— 25

Q. Any one condition of hot solutions, alkaline solutions, passing through rock containing ore that will not take up ore and carry it along into circulation? A. If the alkaline solutions exist in a rock and water traverses it, that will necessarily dissolve more or less of the contents of the rock and of the metals which are contained in it. 30

Q. Is it known, Mr. Lindgren, the exact amount of heat that is always required to do that? A. The exact amount of heat—well, the heat which is taken up, which is the heat of the waters, is not in any way identified; that has been maintained by nobody, any movements which have taken place from the chemical reactions. The heat of the water depends upon the heat of the earth where it is; the surface water in other words, descends by capillary, by the drawing or sucking in by the minute pores of the rock; the water descends all through the rock, and then finally at depth strikes certain planes which offer easy return to the surface. The waters have descended to such a depth that they are heated, and if they strike an easier path to return to the surface, they will then necessarily follow that—that is to say, necessarily follow a fissure back to the surface. 35 40



Q. Is there any authoritative statement as to the exact amount of heat that is necessary to produce the solutions that will bring up the ore? A. The exact amount of heat, no, I don't think it has been calculated by anybody.

Q. That is still in the realm of conjecture, is it not? A. Nobody has assumed very seriously that the heat of the hot waters is derived by such processes. 5

Q. By what processes? A. By movement and chemical reactions. 10

Q. I did not ask you that. That is where you misunderstood me. I was simply asking you if you did not get heat from mechanical processes? A. Yes, you get heat from mechanical processes.

Q. I was not asking you for any deduction from it at all. A. I beg pardon. I thought you certainly drew that heat from mechanical processes. 15

Q. Now, you found in your Grass Valley investigations, didn't you, pyrrhotite as an original constituent of the rock there? A. I did. 20

Q. And copper pyrites? A. I believe I did.

Q. And iron pyrites—you certainly did. A. Iron pyrites and copper pyrites—I don't think I did find copper pyrites positively; I did find pyrrhotite and pyrite. 25

Q. Your opinion was that pyrrhotite and pyrite might have been evolved from the original rocks by processes which you call dynamo-chemical metamorphism? A. Yes. 30

Q. You found that, didn't you? Perhaps it would be better for me to read that? A. That is right.

Q. At page 93 of your Grass Valley report: "Too little attention has been paid to the occurrence and genesis of pyrite and pyrrhotite, so common in the rocks of many districts. For the study of mineral deposits this subject has the deepest interest, and it may therefore be of some value to summarize the results attained in regard to this during this investigation. 35

"Pyrite and pyrrhotite can be formed in many different ways, in fact by any of the processes above enumerated, except by weathering under ordinary atmospheric influences. And still the pyrite in the rocks when mentioned at all in descriptions is often referred to as a product of weathering. 40



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"Pyrite and pyrrhotite may both be constituents of magmatic consolidation. Cogent proof of this is, of course, difficult to bring, and the fact is hardly yet quite universally recognized." You go on to mention some places. "Besides excellent occurrences in the Maryland and the North Star diabase area, these minerals have been so frequently found in other rocks, chiefly diabase or porphyritic, under circumstances which strongly suggest, though not positively prove, primary origin, that the proposition may be confidently advanced that there are as a rule accessory primary constituents of the rock." I suppose that they are— A. They are the pyrrhotite, yes.

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Q. (Reading.) "As distinct traces of copper have also been found in one of the above mentioned fresh rocks, it may be regarded as probable that chalcopyrite also occurs as a primary constituent." A. That is correct.

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Q. (Reading.) "Pyrrhotite has been recognized as an integral part of the allotriomorphic aggregates produced by contact to metamorphism. In the metamorphic rocks produced from igneous and sedimentary material pyrite and pyrrhotite have been observed as unquestionably constituents of the newly formed aggregates." A. Certainly.

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Q. (Reading.) "Intergrowths of magnetite and pyrite are frequent. In certain amphibolitic schists in various parts of the Sierra Nevada large quantities of pyrite and chalcopyrite have been concentrated by these dynamo-chemical processes, forming the exact equivalents of the frequently described 'fahlbands' from other parts of the world. It would seem suitable to reserve the designation fahlband for sulphides formed in schists by dynamo-chemical processes, thus not including in its schists altered by subsequent hydrothermal action. These fahlbands sometimes appear to contain some silver and a little gold." That was the result of your observations there? A. That is correct, yes, sir.

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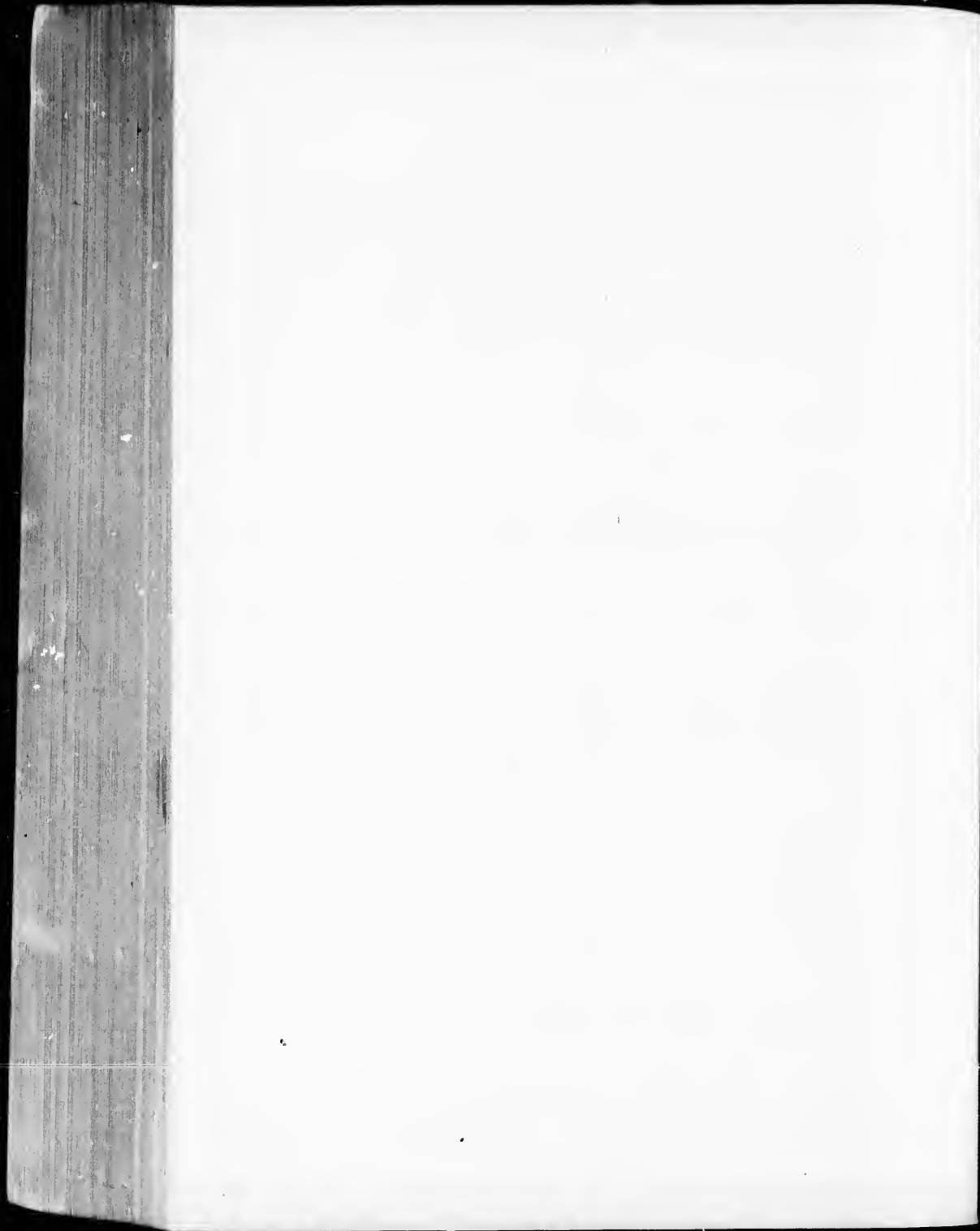
Q. And over at page 95: "It is, perhaps, rather to be regarded as probable that the sulphides have resulted from a concentration and re-crystallization of the sulphur and the iron primarily contained both in sedimentary and igneous rocks." A. What sulphides does that refer to?

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Q. The cause of the vein is in this case undoubtedly. I will ask you if you want to make any distinction. (Shewing witness the portions of the report from which he read.) And you have also described at pages 90 and 91 and running over to 92 the characters of metamorphism? A. Yes.

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Q. In which you describe this dynamo-chemical metamorphism and contact metamorphism? A. Yes.



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Q. And the effect which that has upon rocks containing as a part of their original constituents pyrrhotite, pyrite and so on? A. Yes.

Mr. Bodwell: We might put that right in the notes. Do you object?

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Mr. Davis: No. We will have liberty to put in any part of the book which bears on that matter.

Mr. Bodwell: My reason for putting it in is that we may not be able to get it when we want it. It is the witness's report on the Nevada City and Grass Valley districts, California, published in 1896 by the United States Geological Survey Department, chapter on "Metamorphic Processes," at pages 90, 91 and 92 of the Report. I will put in the whole thing.

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The same is as follows.

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"CHAPTER VI.

"METAMORPHIC PROCESSES.

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"REMARKS ON METAMORPHISM.

"Giving to the word metamorphism a somewhat wider sense than that in which it is commonly used, it may be defined as any transformation in the mineralogical composition or structure of a rock, with or without addition or subtraction of substance. This transformation can be brought about by different agencies and with widely differing results. The term metasomatism, or metasomatic action, is usually employed to designate a change in the chemical as well as the mineralogical composition, involving addition or subtraction of substance.

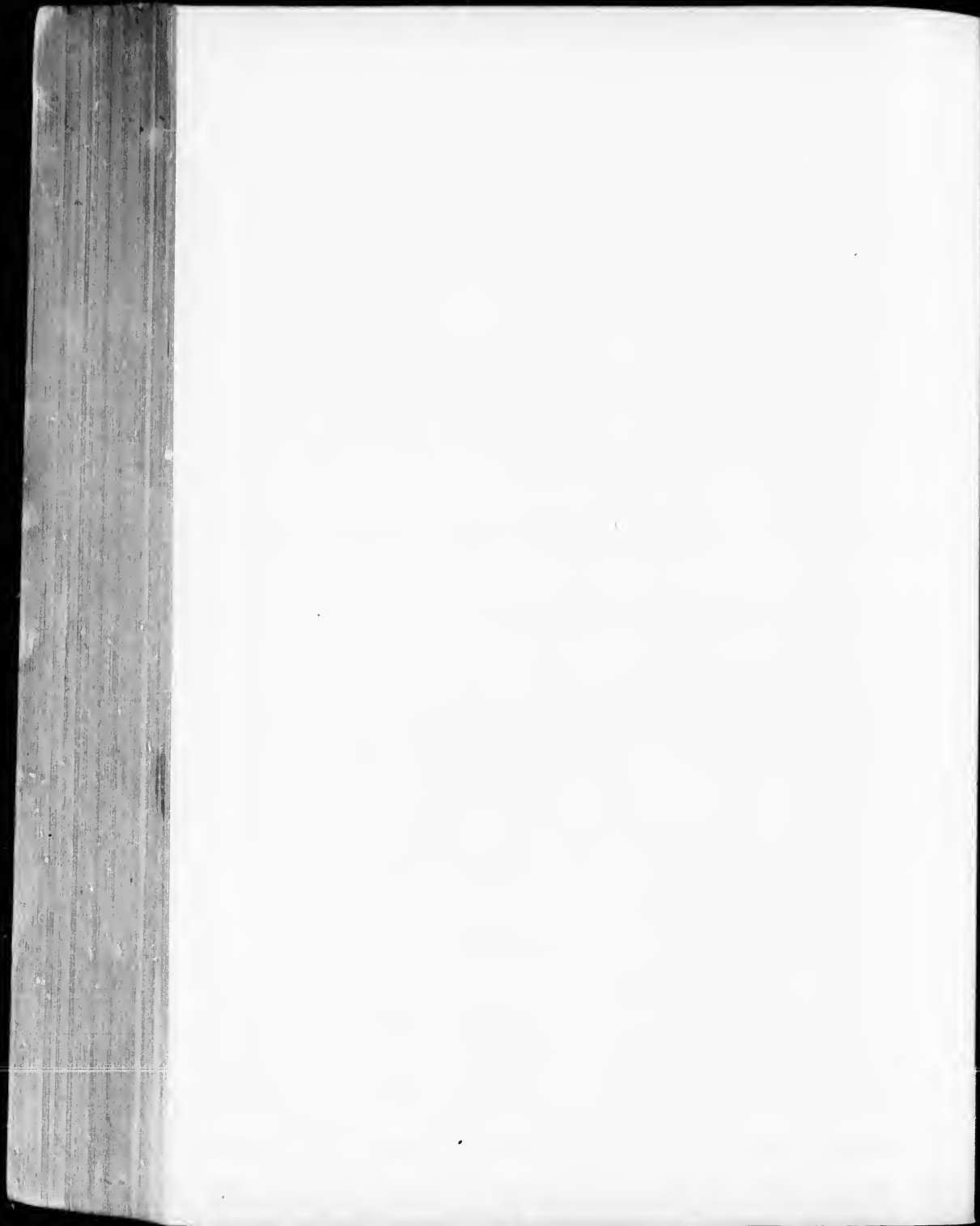
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"Restricting the wider definition of metamorphism, it is convenient to exclude from it the superficial weathering and disintegration, produced chiefly above the ground water level by the action of atmospheric waters carrying oxygen and carbon dioxide. By this process there is not only a mineralogical transformation, but the rock as such is destroyed. The products of this process are, besides soluble salts, chiefly silica, ferric hydrate, carbonates, and kaolin. Processes like cementation, or ordinary hardening of soft sedimentary rocks without extensive mineralogical or structural change, are likewise excluded.

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"Large metamorphosed areas are often spoken of as affected by regional metamorphism, a general term not designating the cause of the action. A large part of the Sierra Nevada may thus be said to have been subjected to regional



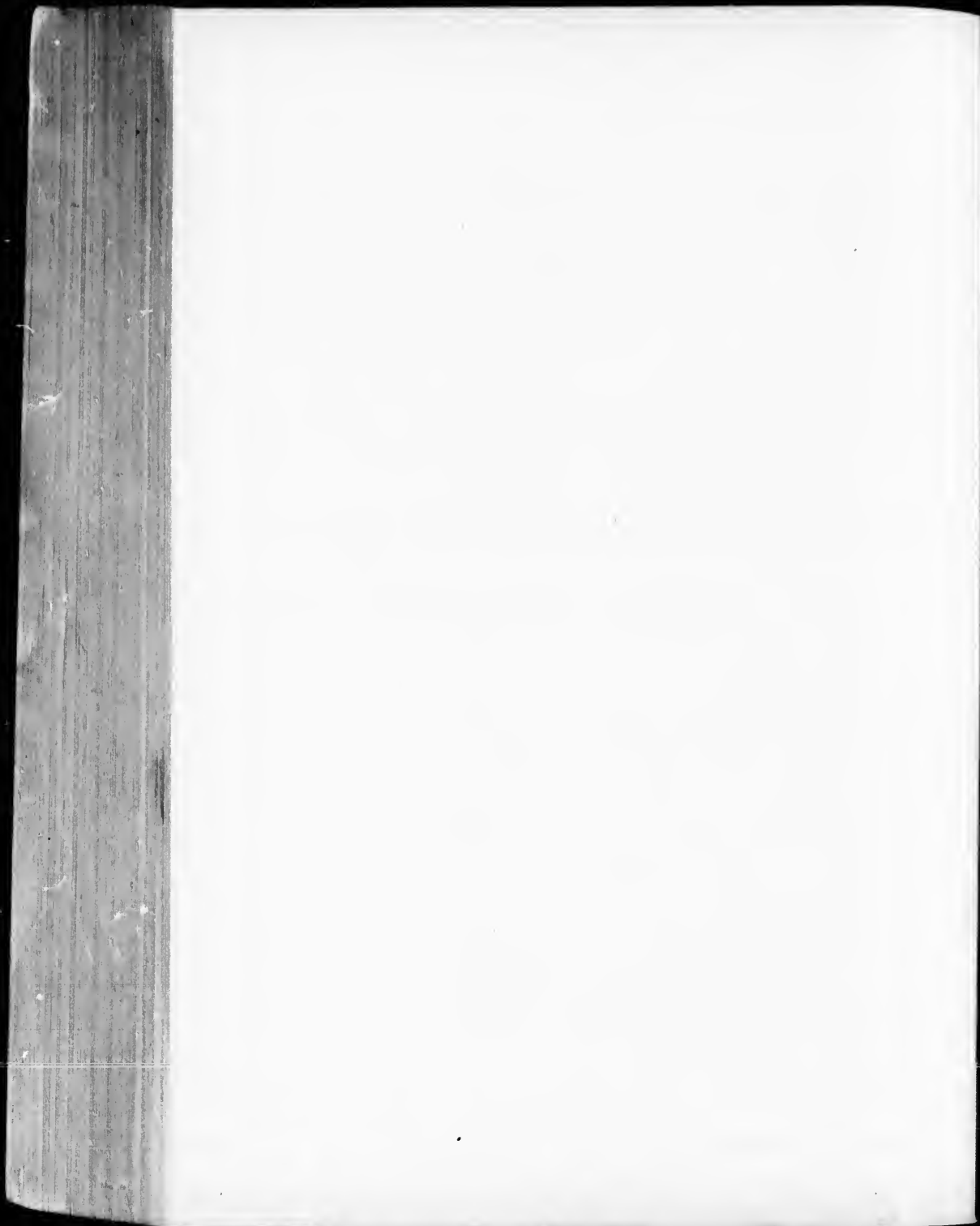
metamorphism. The main cause, however, undoubtedly being organic pressure, the rocks are referred to as altered by dynamo-metamorphism. Strictly speaking, this term refers only to the purely dynamic process of crushing and shearing by compressive stress distributed evenly through the rock or relieved along certain planes. A stretching action produced by a tensile stress has also been recognized by several investigators, but no decided evidence of its existence can be said to have been found during the examination of the rocks in this district.

"While examples of dynamo-metamorphism without extensive mineralogical alterations occur, chemical forces are nearly always involved and very generally play a most important part, incited by the increase in temperature accompanying the pressure at points far below the surface and aided by the moisture of the rocks. It is not at all probable, however, that the heat during the dynamo-metamorphic processes in the Sierra Nevada has exceeded a few hundred degrees centigrade, and the fusion there is no indication at all. It is not necessary for the initiation of the re-crystallizing action that the pressure should have been carried to a point at which the limits of cohesion were reached and the schistose structure produced.

"The process should perhaps more fittingly be designated dynamo-chemical metamorphism. It generally is characterized by a very moderate hydration and the formation of clear, fresh aggregates of mosaic structure. It usually produces a rock of finer texture than the original one. Igneous and sedimentary rocks are similarly affected, though the ultimate products usually differ. The chemical composition of the rock does not appear to be greatly altered by the process.

"Dynamo-chemical metamorphism, best illustrated in this district by the Indian Flat amphibolite area and by the Grass Valley Calaveras slates area, ordinarily produces the following minerals: Feldspar (probably very large albite), quartz, hornblende, biotite, muscovite, chlorite (?), epidote, titanite, magnetite, pyrite and pyrrhotite. The original feldspars are converted into albite, epidote, hornblende, quartz and muscovite. The pyroxene alters to uranalite and re-crystallize hornblende, biotite and epidote. The larger grains of plastic or porphyritic character are not only crushed but also resolved to secondary aggregates by a corrosively acting process of substitution, the new formed minerals projecting into the primary grains.

"Another and extremely prevalent form of metamorphism is apparent in certain rocks, such as the North Star and Osburn Hill diabase areas, which have certainly not been subjected to notable dynamic action. This process, characterized by the formation of confused mineral aggregates, not so much by clear secondary mosaics, and by a moderately extensive hydration, might provision-



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ally be designated common hydro-metamorphism. The process may evidently be begun and accomplished at a comparatively low temperature and depth under the influence of the moisture permeating the rocks below the ground water level; the results imply that these were waters not oxidizing and which contained no great amount of dioxide. As the depth increases, the character of the metamorphism will naturally change by reason of increasing temperature and static pressure.

"The minerals former are chlorite, serpentine, hornblende, epidote, muscovite, probably also scapolite; further, magnetite, pyrite, and pyrrhotite; also zeolites. Secondary feldspars are apparently not formed in this process. The original feldspar alters to epidote, muscovite and scapolite; the augite to hornblende, epidote, chlorite and pyrite; ilmenite to titanite.

"On of the principal differences between this process and dynamo-chemical metamorphism is the absence of the secondary feldspar and the mosaic structure. It is clear from the above that, as the mineral series of the two processes overlap, there must frequently be great difficulty experienced in distinguishing them, and the processes may in fact gradually merge into each other. Many of the products of the hydro-metamorphism have formerly been regarded as caused by surface decomposition or weathering.

"Another form of hydro-chemical alteration in which hydration plays the most important part is serpentinization, by which certain basic igneous rocks, rich in magnesia, over large areas and to great depth, be transformed into serpentine. Being an essentially deep-seated process serpentinization should certainly not be referred to weathering.

"Still another form of chemical alteration is that effected by thermal ascending waters, and which may conveniently be designated hydro-thermo metamorphism. The results of this may vary considerably according to the composition of the waters. If gaseous compounds of sulphur associated with aqueous vapor are the chief agents, it should be referred to solfataric metamorphism. Under certain conditions, the hydro-metamorphism may be almost indistinguishable from the ordinary hydro-chemical process, which, indeed is to be expected.

"In the case of the gold quartz veins here described, the waters were rich in carbon dioxide and sulphuretted hydrogen, and the characteristic results of the intense metasomatic action are carbonates, muscovites and pyrites.

"Finally, by another transformation certain rocks may re-crystallize when in close proximity to hot, inclusive, igneous magmas, principally those in a state of aqueous fusion. This is compact metamorphism, and its products are

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generally characterized by the same allotrimorphs, granular, fresh Mosaic aggregate which characterizes the dynamo-chemical processes. The minerals formed are feldspar (chiefly albite) quartz, biotite, hornblende, pyroxene and nalsite and wollastonite, magnetite, pyrrhotite and others. While the dynamo-chemical process tends to produce finer grained aggregates than the original rock, contact metamorphism usually makes the texture coarser; this is illustrated by the contact near the Federal Loan mine. Nearly all sedimentary rocks and tuffs as well as igneous rocks with a fine grained ground-mass, are subject to this alteration close to the contact, while coarser grained igneous rocks appear to be but little affected, this is shown by the occurrence of fresh diabase close up to the granodiorite contacts.

"The processes herein enumerated are doubtless the most important ones, and each is in its way distinct and characteristic. Still, many places occur where it may be doubtful to which of these causes the effects observed are due, and especially difficult is the task when, as so often is the case, several kinds of metamorphism have successively affected the rocks. Among these doubtful cases must be counted the metamorphism of the Banner Hill breccias, with their abundant pyrrhotite and new formed aggregates of quartz and a mineral strongly resembling pyroxene."

Q. In your report on the Ophir district, Mr. Lindgren, you found similar conditions, or primary pyrite and pyrrhotite in the amphibolite of that district? A. I found pyrrhotite and pyrite in the amphibolites which were developed in that rock. I did not find primary pyrrhotite in diorite or any of the rocks which have consolidated from magmas direct.

Q. (Reading from page 256 of 14th Annual Report of U. S. Geological Survey, 1892-93.) "The amphibolite is entirely of secondary origin; it is derived by dynamo-metamorphic processes from igneous rocks, such as diabases, perhaps also from diorites and gabbros." That was the result of your observation, was it not? A. Yes.

Q. (Reading from page 257 same work.) "Small aggregates and streaks of yellowish-green epidote are often seen. Scattered grains of metallic sulphides, predominantly iron pyrites but also pyrrhotite and copper pyrites are universally present. A specimen from the Auburn Railroad station gives a good idea by which a massive igneous rock may be converted to an amphibolite. The rock is dark grayish-green, fine grained and massive, and, although considerably altered, gives more evidence than usual of having been a diabase. Small square and elongated cleavage faces of feldspar may be frequently seen. It may be mentioned in this place that it is not necessary that dynamo-metamorphosed rock should exhibit a schistose structure. Some radically amphibolized diabases have preserved their massive structure, and on the other hand there are some in which, though distinctly schistose, the original augite and feldspar have been

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largely preserved. Grains of pyrrhotite and magnetite, in part intergrown, are common in the rock." You are quite satisfied that those observations are accurate, Mr. Lindgren? A. I hope they are.

Q. I mean to say that since the writing you have had no occasion to change them? A. Always, of course, noting the observations referred to in those particular places. 5

Q. Of those particular places. But they refer to any amphibolite which was the result of diabase and perhaps diorite and gabbro. A. Yes. 10

Q. Now, you also found in the Grass Valley what you call iron belts? A. At Ophir, not Grass Valley. 10

Q. Yes. In referring to that, page 262 of the Report, you say: "These lines or belts of heavy impregnation have an important bearing on the ore bodies, and the miners, early recognizing this, call them 'iron belts,' which term has been adopted here as a convenient expression." Further down on the same page: "Though iron pyrites is the most common mineral in these impregnations, copper pyrites also occur, and sometimes indeed, so abundantly as to be of some economic importance." Then leaving out something which I think is not material: "The iron and copper pyrites in the iron belts appear to contain both gold and silver. The amounts are of course small, but the metals have frequently been concentrated in the decomposed, rusty surface rock, which in such cases may be, and has been, worked for gold, as for instance, at Whisky Diggings and in the Good Friday iron belts. The silver seems always present in considerably larger quantities than the gold. From all the data at hand and from a careful inspection of the specimens assayed, there is no doubt in my mind that the earlier impregnations of pyrites are auriferous. A complete proof of this is not easy to furnish;" and you come to this conclusion: "It is perfectly evident that the iron belts described above are identical with the 'fahlband' first noticed at Congsborg, Norway, and subsequently described from many parts of Europe, and consisting of sulphides in fine distribution through gneiss and other schists. Like those described here they universally have the characteristic of enriching the mineral veins passing through them." And in your diagram you shew them on the plate 17, don't you? A. Yes, sir. 15 20 25 30 35

The Court: There are two things Mr. Bodwell wants. He wants an answer to the question he recently put, and he also wants the angles of this No. 4 raise. A. Yes, I will find them.

The Court: Information connected with the No. 4 upraise. The dip you say was 50 degrees and he asked you to give exact information, and you said you would find it afterwards. 40

Thereupon an adjournment was taken to 2:30 p.m.



AFTERNOON SESSION.

2:30 o'clock p.m., May 2, 1899.

Trial Resumed.

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WALDEMAR LINDGREN.

CROSS EXAMINATION RESUMED.

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By Mr. Bodwell—

Q. This shear-zone vein, you say, Mr. Lindgren, is a type? A. The composite vein shewing several faulting planes is a very common type, yes. 15

Q. What width do you give to these veins in the shear-zone? A. The width of the individual plane? 20

Q. Yes. A. Each individual plane—each individual fissure, if I may say so, is very narrow indeed; it is simply a seam. 25

Mr. Davis: Is that question directed to this particular vein, or shear-zones in general? 25

Mr. Bodwell: I am speaking of this one now.

The Court: While you are on that point, I am going to ask you two gentlemen by and by, whenever it is convenient to take me to see this intersection



in the railroad cut; that is, if you think it will be of any service to you. If it is not, I do not want to go.

Q. You say they are very narrow. About how narrow would you put them? A. That is a matter which is a little difficult to say, because the subsequent mineralization has masked the fissure to some extent. The solutions in ascending these narrow fissures have eaten into the sides and in many cases masked the fissures to a considerable extent. Some openings may have been an inch or two, or possibly several inches. Most of them were pretty narrow seams, at any rate.

Q. How deep down would you put them before they reach the seat of the ore? A. Do you mean to what depth the vein reaches?

Q. Yes. A. What I call the vein. That I do not know. I do not know the depth of that vein.

Q. Have you any theory about it at all? A. I have an opinion that a vein of that kind, a well-marked vein of that kind, must continue down to a very considerable depth, a depth commensurate with the outcrop.

Q. And originally, then, fissures were very narrow, extending an indefinite depth? A. The fissures were probably very narrow. They were probably open to some extent, sufficiently open to permit the water to circulate in them.

Q. Do you find evidence of more than one time of opening? A. No, I do not.

Q. Do you think, then, that the calcite was formed at the same time that the vein material was brought in? A. I am of that opinion, yes, as far as the calcite is concerned which appears in the Centre Star vein No. 2.

Q. And you would say the same thing of the quartz? A. I would say the same thing of the quartz, yes.

Q. Between these fissures of the shear-zone there is altered rock, I suppose? A. There is altered rock, yes.

Q. What is the widest, or what is the average width of those sections of altered rock between the fissures? A. I should say not more than a few feet anyway. That is, you mean the average width between the planes, I presume?

Q. Yes. A. I should say not more than a few feet, taking, for instance, the brown crosscut leading from the Iron Mask stope to Centre Star vein No. 2. And I found two walls which were about four feet apart, I should think, that would be perhaps.

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Q. And you distinguish between the rock in these—do you call them walls separating the planes? Do you call the altered country rock walls? A. I call the fissures separating the altered country rock walls, yes.

Q. Do you distinguish between the rock in those walls and the rock which you call the vein filling of the fissures? A. You asked me whether I distinguish between those walls on one side, and what I consider— 5

Q. I will tell you what I mean, Mr. Lindgren. Between these planes there is a section of what I suppose it is proper to call altered rock, between the different planes? A. Yes. 10

Q. Now, you speak of vein filling and you speak of this as altered country rock. Do you distinguish between what you call the vein filling and the rock in those sections which exist between the planes of the shear-zones? A. I do not draw any strict division between them, no. They are altered in the same manner and more or less extensively. 15

Q. Then you could not fix any line where you would call it vein matter and where you would call it altered rock between two planes of a shear-zone? A. But the shear-zone coincides with the vein. 20

Q. I understand that, but between the planes of the shear-zone there is a mass or section of altered country rock? A. There is, yes.

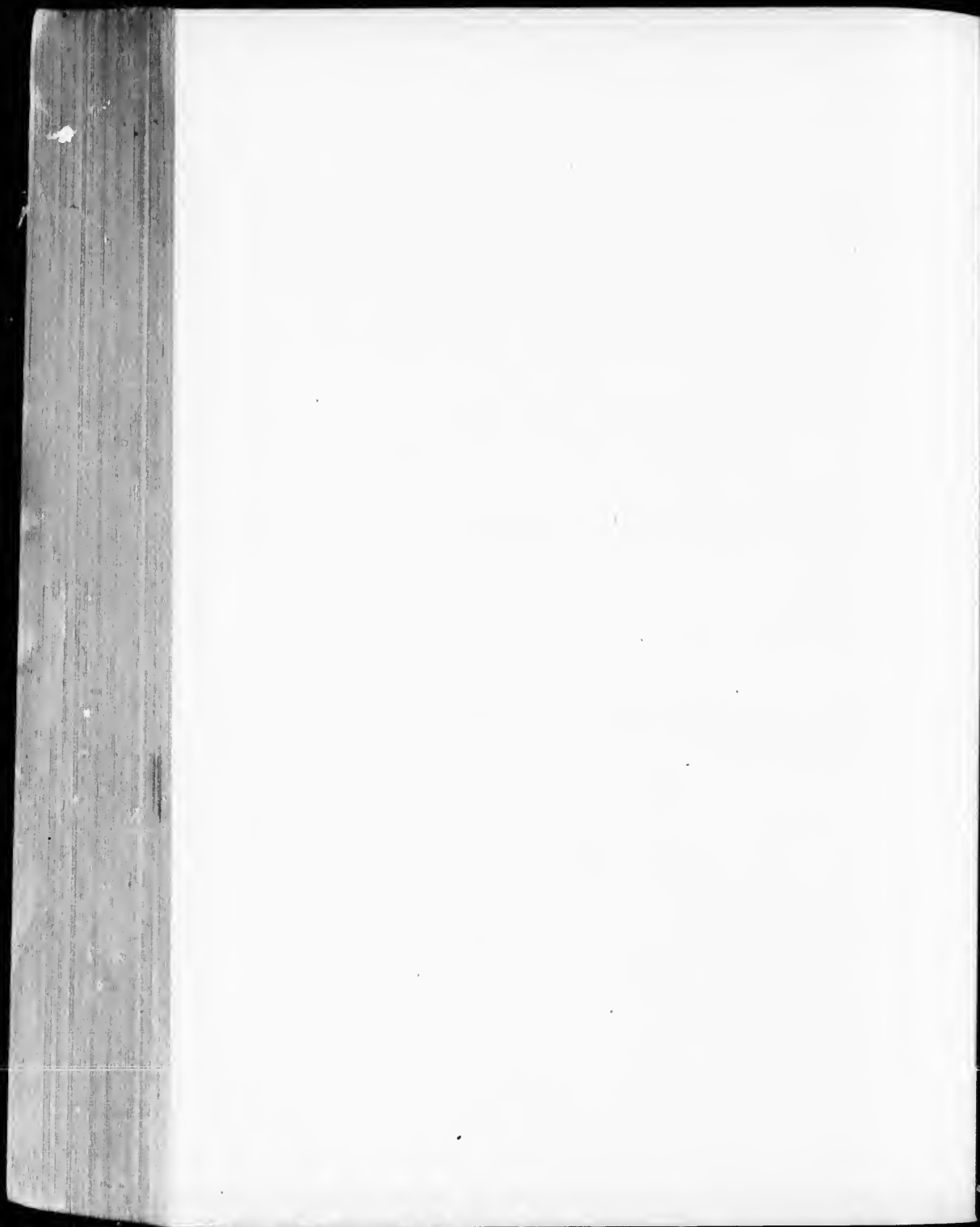
Q. And that you say is altered in the same manner as the vein filling? A. That is a part of the vein filling really, what is termed vein matter. 25

Q. That is what I want to get at. You would call that section of the country rock between the planes vein matter? A. I would say that it was vein matter. 30

Q. Where do you get your outside wall of the fissure, of the shear-zone? A. They are generally given—the outside limit of the veins is generally given by the walls themselves. The alteration of the country rock changes in character beyond those walls. 35

Q. In what way; what change or alteration between the vein matter and the outside country do you find at the places that you call the wall? A. Outside of the walls you find a comparatively slight alteration, if any. 40

Q. In what direction? What is the character of the alteration that you find outside? A. Outside of the walls you sometimes find little specks of pyrrhotite and pyrite in the rock, but the rock itself is fresh. You can recog-



nize the different constituents very plainly, and if there is any alteration it simply manifests itself by little specks of these secondary sulphides which have found their way from the vein, sometimes some distance outside of the walls. I would not call it vein matter at all, but a slight impregnation or a slight sprinkling of the rock with sulphides.

5

Q. Would you say it had been created by the same force which created the vein matter? A. I do, in my opinion.

Q. And as I understood you yesterday, you would only reach what you consider the ultimate wall of the vein when you reached the ultimate point of mineralization? A. No, I did not mean that quite. As I said just now, there are no hard and fast lines in nature, and a slight mineralization may be noted even outside of the walls. If you imagine the solutions ascending these walls of this composite vein and filling that with mineral matter you will readily see that it is almost inevitable that some of the adjoining rock must also have been attacked by these solutions and changed a little, but only to a very little extent.

Q. This is what you said to my learned friend: "Now, how would you then get to the limit of the hanging wall of the vein proper? A. You would find the mineralization gradually decreasing. That is the only thing. The limit of the vein then, even if there were others beyond, would be the limit of mineralization? A. The limit of mineralization, yes." So I understood you to mean that in looking for the limit of the hanging wall of this vein you would follow from plane to plane until you reached the limit of mineralization? A. Until I reached the limit of a permanent and apparent mineralization. I might find by examining rock under the microscope some distance from the walls little specks of pyrrhotite in it.

30

Q. But if you found mineralization which is apparent without the aid of the microscope you would still consider you were within the possible limits of the vein walls? A. No, no, because I have seen in rock coming from between two veins little specks of pyrrhotite that are well visible to the naked eye. But I have never seen a complete and thorough alteration of the rock.

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Q. But you would not from a slight or a considerable change in the mineralization think you were outside of the vein? For instance, if you found ore rich in one place and poor in another that is not evidence that you are outside of the vein itself, is it, in itself? A. Not necessarily, no.

40

Q. And if you found planes and mineralization, according to what you say you would still be within the limits of the vein? A. Well, that depends



upon the extent of the mineralization. I have said before that it is very common to find a little bit of mineralization extending beyond the walls of the vein.

Q. Yes, I know, but if you found mineralization, greater or less, and you have not done cross-cutting far enough to say whether you have reached the planes beyond, you might still think you were within the limits of the vein? 5
A. If I had not done any cross-cutting I certainly would not know whether I was within the limit of the vein.

Q. And the vein might become richer in a foot from that place; the mineralization might become richer and you might come into another portion of the same vein? A. It might possibly, but if there was a considerable interval of comparatively barren rock, of practically barren rock, I should probably consider it a different vein. 10

Q. But how could you be sure? You see, your test is a plane, that is the first test; the second test is mineralization of the rock. Now, you say you can not tell whether there are planes beyond, therefore you are reduced to the question of mineralization. Now, can you tell at any one point, unless you are absolutely out of mineralized rock, whether you are beyond the vein or not? A. You refer of course, to this vein? 15 20

Q. Yes, if you prefer the question that way. A. It would depend on the extent of cross-cutting which was done. I know the average width of the vein in this case. 25

Q. How have you ascertained the average width? A. Because I have seen it exposed in a few places, from what I consider from wall to wall.

Q. Have you ever been able to say you were at the ultimate wall, either foot or hanging? A. I think so, yes, at several places. 30

Q. One at the brown cross-cut? A. At the brown cross-cut for one place, yes.

Q. But you did find mineralized rock beyond the last plane you speak of? A. I found some scattered pyrrhotite in the rock beyond that last plane, yes. 35

Q. You characterized it yesterday as mineralized rock, slightly mineralized? A. Slightly mineralized, yes.

Q. Can you be sure you will not find a plane still beyond the one which you fix as the ultimate wall? A. In each individual case? 40

Q. Take the brown cross-cut; at the brown cross-cut can you be sure you will not find another plane beyond? A. As a matter of fact, I do not find



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another plane beyond the last one which I indicated there which is 15 feet from the end.

Q. Yes, but you would not find it in that cross-cut, because it might be further than the dip of the vein. As I understand you, Mr. Lindgren, (referring now to the model) you found the vein dipping across this brown cross-cut like that? A. Yes. 5

Q. And you called that the ultimate hanging wall? A. I call that the ultimate hanging wall.

Q. How can you say you will not find another ultimate hanging wall out here at a level below the level of the brown cross-cut? A. Another hanging wall at the level might possibly come in at the level below at a distance of, very close to or within a foot or two from that last hanging wall which I observed. But if there was a considerable interval between them I should be very much inclined to doubt whether they would be the same vein or not. 10 15

Q. How much interval do you have here? You have two hanging walls there? A. Four feet apart.

Q. Well, if you came down here and found one eight feet from that would you say it was not another plane, another correlative plane? A. If by going below there I should find one four feet farther out— 20

Q. You would call it another correlative plane? A. I suppose I might.

Q. And if you found one a little farther down, four feet farther out, would you call that another correlative plane? A. I might or I might not. This thing comes to certain limits defined by the— 25

Q. (Interrupting.) Well, going down there, say ten feet farther below and four feet farther out, or any distance you like for the purpose of illustration, would you still call it the ultimate hanging wall, another plane of that hanging wall? A. I have not seen any such plane where the planes continue indefinitely. 30

Q. But I am asking you what you would say about it? A. I should say it would be a very unlikely thing to find an indefinite set of planes like that. 35

Q. But haven't you found them? A. An indefinite set? No, sir.

Q. You have found one plane over another? A. Yes.

Q. Having comparatively the same dip, the 45 degree dip? A. About that, yes. 40

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Q. And you found mineralized rock between? A. Yes.

Q. Therefore, you call the whole of that place the vein? A. In that place yes,

Q. If you went down farther on the level and found another leaf out 5
four feet with that 45 degree dip, what would you call it? A. If I found
it enclosed by the other wall I would probably say it belonged to that vein, yes.

Q. And if you went farther down and found another one you would still
call it a plane of the same vein, would you not? A. Well, I might very 10
likely.

Q. Then where is your limit? What is your limiting mark for this
shear-zone? A. Oh, for this shear-zone?

Q. Yes. A. For this shear-zone I should place the limit about twenty 15
feet.

Q. Why do you do that? A. Because I have never seen them farther
than that in this case.

Q. Is there anything other than the character of the zone itself? Is 20
there any particular line exposed in the country here which will indicate the
ultimate bounds of your shear-zone? A. Oh, yes, in a number of places.

Q. What is it? A. In the cross-cut here (referring to the model). 25

Q. The long cross-cut? A. In the long cross-cut in the north drift
of the Centre Star; I have examined the rock for a long distance back of a
place near where the cross-cut is connected with the shaft by means of a bore
hole.

Q. You do not find any plane? A. I do not find any plane. 30

Q. And that is the reason you say that is the limit of the shear-zone? A.
That is one of my reasons for saying that is the limit of the vein. The other
reason is, the very intense alteration of the country rock beginning near 68 and 35
continuous to point 16.

Q. Yes, but that was also not confined to the planes beyond, that would
be consistent to the vein not going below that level, as well as being the 40
ultimate wall of the zone. A. I beg your pardon, I did not catch that question.

Q. Well, it does not matter, it is more a matter of comment than evi-
dence, and it was not exactly what I referred to. What I want to know is this:
What did you find running through this country as a characteristic feature of

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the country, which marks the limit of your shear-zone? A. I find running through the country a belt of highly mineralized country bounded by planes to the north and to the south. The width of them, as far as I have observed it, is not any more than 15 to 20 feet, and it is generally less.

Q. You find the same thing—did you examine to find whether you would not find the same thing with reference to the vein which appears in No. 30 west drift? A. I have not examined that vein very carefully; I have seen it. 5

Q. How can you say then that that does not belong to this same vein? A. Because I find a stretch of barren country with no planes of any kind south of this point. 10

Q. But suppose the vein disclosed in that drift were carried up to the surface? A. In this drift?

Q. Yes, on that upraise, were carried to the surface, where do you think it would come out; where would it appear on the surface? A. I do not know; I do not know from my own inspection that the vein is in this upraise. 15

Q. Have you never been there? A. I have never been up that raise, 20 no, sir.

Q. You do not know that going up there a plane was crossed that will probably come out nearly on a line with the collar of No. 3 incline shaft? A. I can form no opinion of that because I have not seen that raise. 25

Q. You don't know whether that vein belongs to the shear-zone in which your incline shaft starts or not? A. Oh, I am confident it does not.

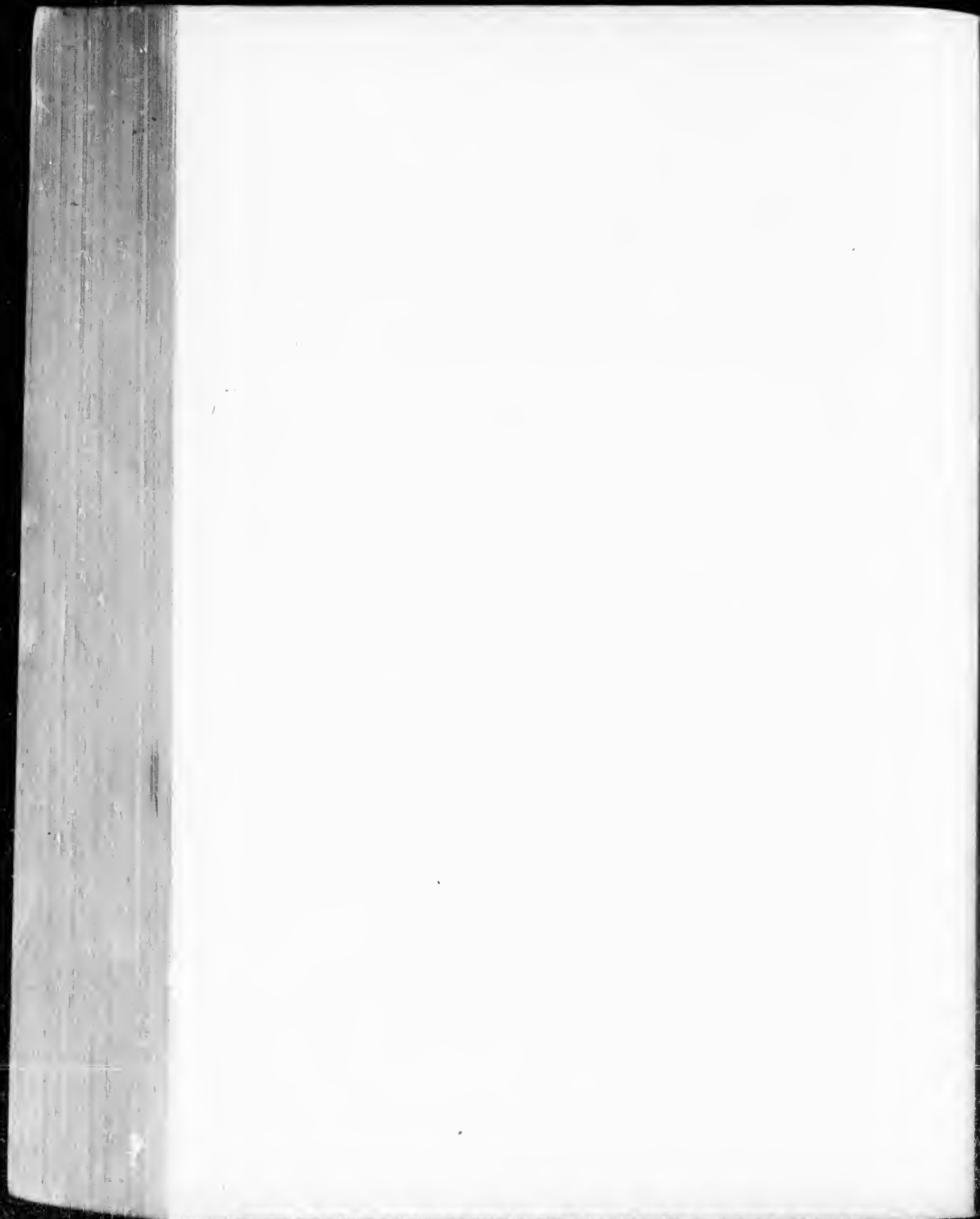
Q. Why? A. In the first place, it is separated from the Centre Star vein No. 2 by a long and barren cross-cut extending over 100 feet. 30

Q. Then the incline shaft may have passed from that vein? A. It may have passed from that vein. I do not know anything about the direction of these veins. This may very well, I may assume may be possible that this vein is a vein with a somewhat steeper dip which comes up to the surface at some point near or back of the collar of No. 3 shaft. 35

Q. Did you find a vein over here at station 40, Iron Mask shaft? A. Yes, I believe I did find a vein there. 40

Q. You did not examine that? A. Not very carefully, but I saw it.

Q. Did you find a vein over at station 111? A. I did.



Q. Did you examine that carefully? A. I examined it to the extent of taking its dip and strike, I think.

Q. Now, did you conclude that these veins are all shear-zone veins, or are they not? A. I have already explained that the Iron Mask vein is not in my opinion a shear-zone plane, at least the planes that—they are hardly ever more than two well defined planes along its course. As to this vein you have just referred to, I can not tell. I am not positive about it because I have only seen the vein here and there in one place, and that may be the very foot wall for all I know.

10

Q. Mr. King said he recognized independent ore bodies within the lateral boundaries of the shear-zone. Now, can not you extend your zone wide enough to take in the Iron Mask, this small, little fissure of the Iron Mask vein, as you describe it, within the shear-zone? A. No, sir, I cannot under any circumstances.

15

Q. Why do you say so? It was formed by compressive force from north to south or from south to north or both together? Your shear-zone was formed by force acting in this direction, was it not? A. I think it was formed that way; that is my opinion.

20

Q. Where did that force begin to operate and where did it end? A. That is going into the realm of theory to a considerable extent and I am not prepared to state exactly what direction, what size, what extent and so on, the compressive force had, because to do that would take an exhaustive study of the whole district.

25

Q. I know, but here you find strong fissuring developed from the Centre Star main vein, don't you? A. Yes.

30

Q. A very strong line or faulting running through the country? A. I don't know very much about it except what I have seen of it here.

Q. You might find a corresponding line across here to the north of any of the workings shewn? A. Might find corresponding vein up there, you mean.

35

Q. A corresponding break or marking through the country? A. You might find a vein out there very well indeed.

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Q. Why should not the force begin down here and begin up there to the north and operate all at the same time? A. You mean why should not the result of the forces shew all through the interval?



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Q. Why should not the creative cause of the forces have its beginning over here on one side and over there on the other? Can you say it would not?
 A. The force acted, as I believe, in a general way from north to south, and there might be several results. You might find as a result of that force several fissures, clean-cut and well-defined at several intervals, or you might find several shear-zone veins through that interval. You can not tell.

5

Q. How can you place the limits of your shear-zone then in a mineralized country like this? Where are you going to put it? A. From the actual inspection—from the actual developments, along the Centre Star vein I find a well defined ore streak; I find two or three planes in the hanging wall, and the exact limit of that lies—if you go into detail it is going to be a matter of microscopic detail.

10

Q. Mr. Lindgren, isn't it right then to say that you can only ascertain the limits of that shear zone with the microscope? A. Oh, no, the shear-zone is very well defined.

15

Q. But the exact limit where the force ended which created it? A. There are no geometrical lines in a vein of this kind; there are no absolute limits; you cannot say that the mineralization positively ends on this place and beyond that there is absolutely nothing. That is not possible.

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Q. That is what I understand you to say, that there is no geometrical line, as you call it—I suppose that is as good a definition as anything—bounding the limit of this zone? A. There are geometric planes bounding the limit of the zone.

25

Q. But no line that you can fix as the ultimate limit of it and be sure that you are right? A. I can fix the ultimate limit wherever the place is developed by sufficient cross-cutting.

Q. But you can only say this, that you have reached a plane, and you do not see anything beyond it, but it is possible you might find it. Is not that what you come to every time? A. If I have cross-cut it to a sufficient extent I can say there are no planes beyond it and that the composite vein ends at this place.

30

Q. If anybody should find a plane beyond having a parallel dip and strike and took you out and shewed it to you, you would still say your zone was there, would you not? A. I would, yes; but the number of actual places disclosed by mining operations here shew there is no such indefinite multiplication of planes as you suggest.

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Q. But that is the extent of your observation up to date? A. I cannot tell any more.



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Q. I do not want you to anticipate conclusions. The only thing I ask you is this, Mr. Lindgren: if you should find planes beyond, correlative in appearance, and having a similar dip—beyond any you have mentioned, either to the south or to the north, would you say you were within the limits of your zone? A. That is a hypothetical question, is it? 5

Q. Well, I have asked the question, and I suppose it is hypothetical? A. What I mean is, does it refer to this vein particularly?

Q. Yes, I say if you find the planes beyond any you have mentioned having a corresponding dip and find also mineralized rock, would you say you were within the limits of your zone or without it? A. If I found veins within a short distance of my last hanging wall, then I should say I was within the limits of the vein yet. 10

Q. What is the ultimate distance you place beyond which you will not go in placing the boundaries of your zone? A. I assume by that you mean to ask me what is the ultimate width of a composite vein or shear-zone. 15

Q. No, I ask you what is the ultimate limit of distance beyond any plane you have already seen which if it exists, you will say does not belong to the shear-zone in question? A. Well, I should take the average distance of the planes within the shear-zone, and if I did not find any more planes beyond that average distance in going to the north or to the south, in the future or in any event, I should say that is the end of the shear-zone vein. 20

Q. What is that distance? A. In this case I should say a few feet. 25

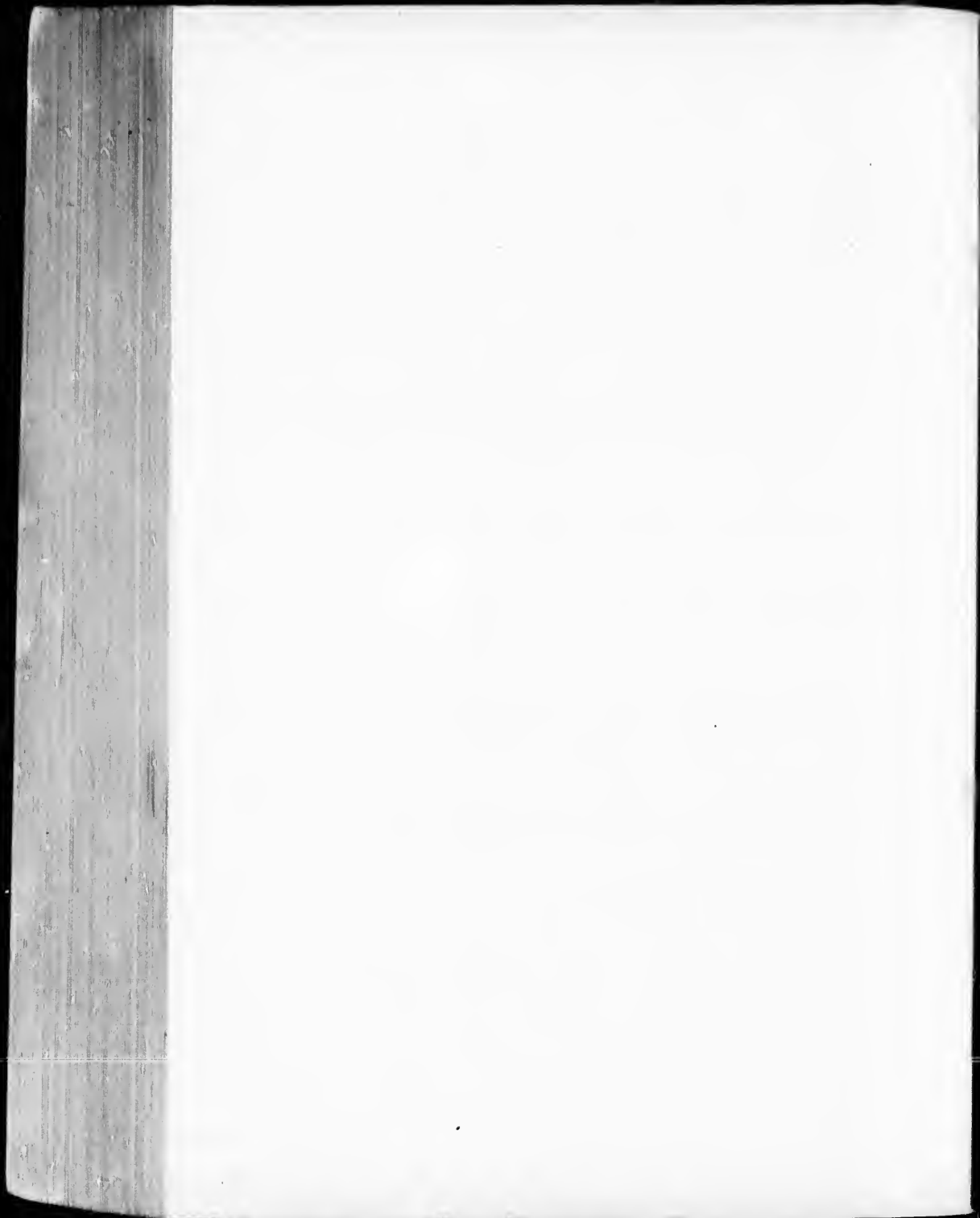
Q. Why would you fix it there? A. Because from my observation of the croppings, or at the numerous places where the vein is cross-cut, I place it at that distance. 30

Q. But you can not say that you have seen the ultimate wall in the cropping? A. The exposure at the railroad cut is very good and quite convincing. 35

Q. But how do you know that you have got to the last plane? A. Because the rock is exposed for quite a distance north and south of the place where the actual—

Q. (Interrupting.) But you have not gone down behind the rock that is already exposed, to see? A. I mean to say that the railroad cut exposes quite an extent—quite a thickness of rock. 40

Q. Yes, as wide as you think the vein ought to be; but will you say it is as wide as the vein is—as wide as the zone is? A. The exposures at that



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place are so good that I do not think any extensive multiplication of veins could exist without my having seen it.

Q. Why shouldn't it exist? Is there anything in the nature of things to prevent its existence? A. Oh, no, a shear-zone or a vein may be much wider than this vein is. 5

Q. Of course, it is possible that it may be a good deal wider. A. It is possible it may 10

Q. And the most you can say from what you have seen uncovered is that you think it does not get any wider than that, which is that you think it does not get any wider than that which is exposed at the railroad cut? A. From what I have seen there and from numerous crosscuts below. 15

Q. Yes, but coming down the incline shaft Mr. King told us he could not be sure that he had seen the ultimate hanging wall. You are not sure that you have seen the ultimate hanging wall? A. No, at that place I am not. 20

Q. In the brown cross-cut you can not say, because farther down you may find another hanging wall? A. In the brown cross-cut you can say, because there you do see the ultimate hanging wall. 25

Q. But you don't know that it is the same? A. I certainly do; it is the same. 30

Q. But you can not say there is not another wall below there having the same plane as you see in the cross-cut? A. In composite veins of this kind they have in general, fairly well defined width. Occasionally other planes may come in, but they can not come in to an indefinite extent. 35

Q. Well, what is your width? Tell me the widest part and the narrowest you know? A. Of a shear-zone vein? 40

Q. Yes.

Mr. Davis: Are you speaking of this particular vein now? 45

Mr. Bodwell: No, of shear-zones generally.

Q. Do you know a vein of that kind 100 feet in width? A. No, I do not remember any. I do remember some though, that are 50 feet in width, the character of which as a single vein has never been disputed, that is to say, by lawsuit.



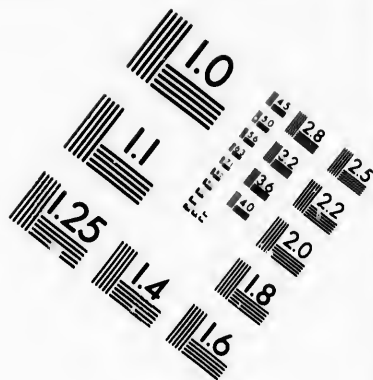
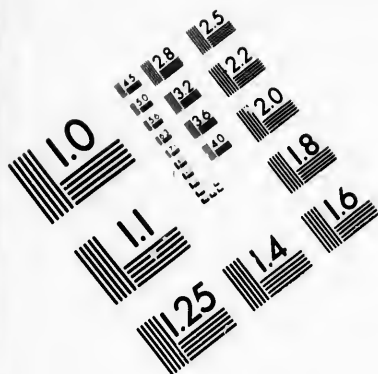
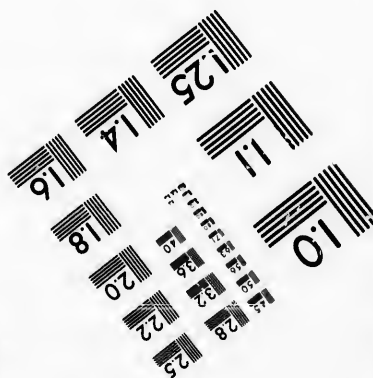
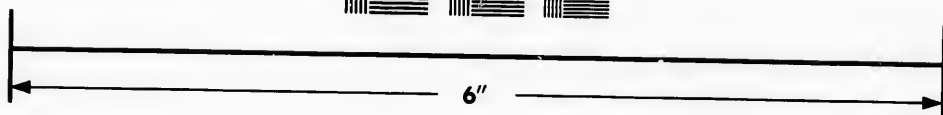
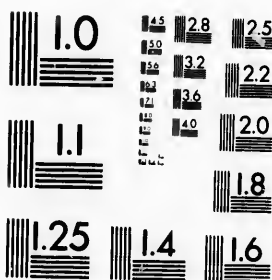


IMAGE EVALUATION TEST TARGET (MT-3)



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Q. Haven't you heard of them 100 feet in width? I think Mr. King referred to one 100 feet in width? A. I should think a shear-zone vein might be 100 feet in width.

Q. And the narrowest one you know of would be how wide? A. Well, 5
you can have several planes only a few inches apart.

Q. Down to what width do you know of a shear-zone plane? Give me the narrowest one you know, at the narrowest point? A. That is somewhat difficult to answer, because when you get beyond a certain limit, the walls being close to each other, it is difficult to distinguish and it finally runs practically into one wall. When the walls are a few inches thick they often practically run together, and so get to a place where it is difficult to continue your sub-division any further. 10

Q. You have in your own mind some standard, I suppose. Give me 15
what you call the narrowest vein that you know of? A. Where it is well defined, I should think you might have a foot wide wall plainly visible.

The Court: Are those planes vertical? A. These planes may dip at any angle. 20

The Court: They dip, for instance, with the shaft? A. Yes, they are straight.

The Court: They run with the shaft or with the sink? A. Run with 25
the shaft or with the sink straight down.

The Court: They dip on the vein? A. Yes.

Q. What would you call that, what kind of a zone (showing the witness a diagram or plate)? Would you say that was as well mineralized as the one that you have been looking at in the Centre Star? You know that place, don't you? That is the Calico district. A. Yes, I do. Let me look at it. (The witness examines the plate.) 30

Q. That is a vertical section (referring to one part of the plate) and that is a horizontal section (referring to the other part)? A. Yes. I have not seen this for twelve years. 35

Q. Have you better characteristics of a zone here than there is there, from what you know of the ground and from what you see on the section I shew you? 40

The Court: You understand this section shewn to you, do you? A. I do.



(Mr. Bodwell hands the diagram or plate to the Court.)

Q. Do you find greater mineralization here than there was to be found in that zone? A. A greater mineralization than where?

Q. Than was found in this zone between the Silver King vein and the south vein, in this Silver King mine? A. Well, according to that map the zone of mineralization there is about 100 feet wide, is it not? 5

Mr. Davis: Three hundred or 400 feet, I think. 10

Mr. Bodwell: Oh, no, it narrows down to a very fine point in some places.

Witness: I didn't measure it particularly.

Q. You can measure it; there is a scale there? 15

The Court: You call the upper a plane? A. Yes, sir.

Q. And the lower is a section? A. Is a section; yes, sir. (After measuring on map.) The thickness of that zone, as shewn on that map, varies from 200 to 80 feet. 20

Q. What I mean, comparatively speaking, is the mineralization greater here than it was there or less between the limits? 25

Mr. Davis: What do you mean by the limits?

Q. Well, you have given us the limits of the shear-zone here and I have shewn you the limits of the zone there. Will you compare the mineralization between the boundaries of the zone as shewn on this map with the mineralization within the boundaries of the shear-zone, as you fix them? A. That is here? 30

Q. Yes, comparatively. A. The mineralization within the extent of the shear-zone, as shewn on that map, is very much larger than that shewn to the Centre Star No. 2 vein. 35

Q. Well, how does the mineralization as shewn there compare with the mineralization as shewn here? I mean, there you have a district of country between two planes? A. Yes. 40

Q. Mineralized? A. Yes.

Q. You have a district of country here between two planes mineralized? A. Generally.



Q. How does the extent of mineralization here compare with the extent of mineralization there? A. You mean as to width?

Q. No, comparatively speaking. As to character of mineralization itself? 5

Q. Well, as to quantity of mineralization, perhaps I had better put it that way. A. Excepting the evidence of that map, I should say there was very much larger mineralization there.

Q. Here (referring to map)? A. According to that map, simply. 10

Q. According to this map? A. Yes.

Mr. Bodwell: This map which I have shewn the witness is a copy of Exhibit "R" which was used in the Waterloo vs. Doe case. 15

The Court: What state was that in?

Mr. Bodwell: In the Calico district, California, I think. 20

The Witness: Yes, in California.

Q. Now you know that country, do you not, Mr. Lindgren? You wrote a report on the Calico district, did you not? A. I wrote a paper on the Calico district; it was not a report really. 25

Q. And you know there was a vein on the north of that disputed territory called the Silver King vein? A. There was a vein called the Silver King vein on the north, yes, sir.

Q. And down to the south there was a vein called the South vein? A. I think there was, but— 30

Q. And crossing between the two was a vein they called the middle vein? A. Well, I could not say as to that. It is twelve years since I wrote that report and those details are not in my mind now. 35

Q. But the country there was liparite? A. Yes.

Q. You know that? A. Yes.

Q. Now, between the south vein and the north vein there was a country that was greatly fissured and highly mineralized, was there not? A. There was an extent of country that was quite highly mineralized? 40

A. Yes.



Q. And broken up into all kinds of fissures and sub-fractures between those two small veins? A. That may be so or may not. I can't go into details for the same reason, as I spent about two weeks in the district, or something like that, and wrote a description of the whole district, and did not go into the details of any one vein.

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Q. Well, according to this map I shewed you that would appear to be so, would it not? A. It would appear to be so from that map, yes.

Q. Perhaps I can shew you another plan here that will shew it still stronger. (Referring to a book.) A. I would add, that I would be able to speak with greater confidence if I had a copy of my report here; much of that has passed from my remembrance.

10

Q. I know, and you were only writing of the district generally in your report? A. Yes, sir.

15

Q. You were not writing of this particular property, I know that? A. No, sir.

20

Q. (Another map or plan shewn witness.) That is supposed to be a horizontal plane? A. Yes.

Q. It would appear to be a very highly mineralized country? A. I think it was, in general, between certain limits.

25

Q. Crushed and broken and fissured and fractured in several directions? A. I think it was, from my recollection, yes.

Q. And you attributed the force which produced that crushing to the dynamic forces which created the fissure, did you not, or did you say anything about that part of it? A. I did not say anything about that particular part of it.

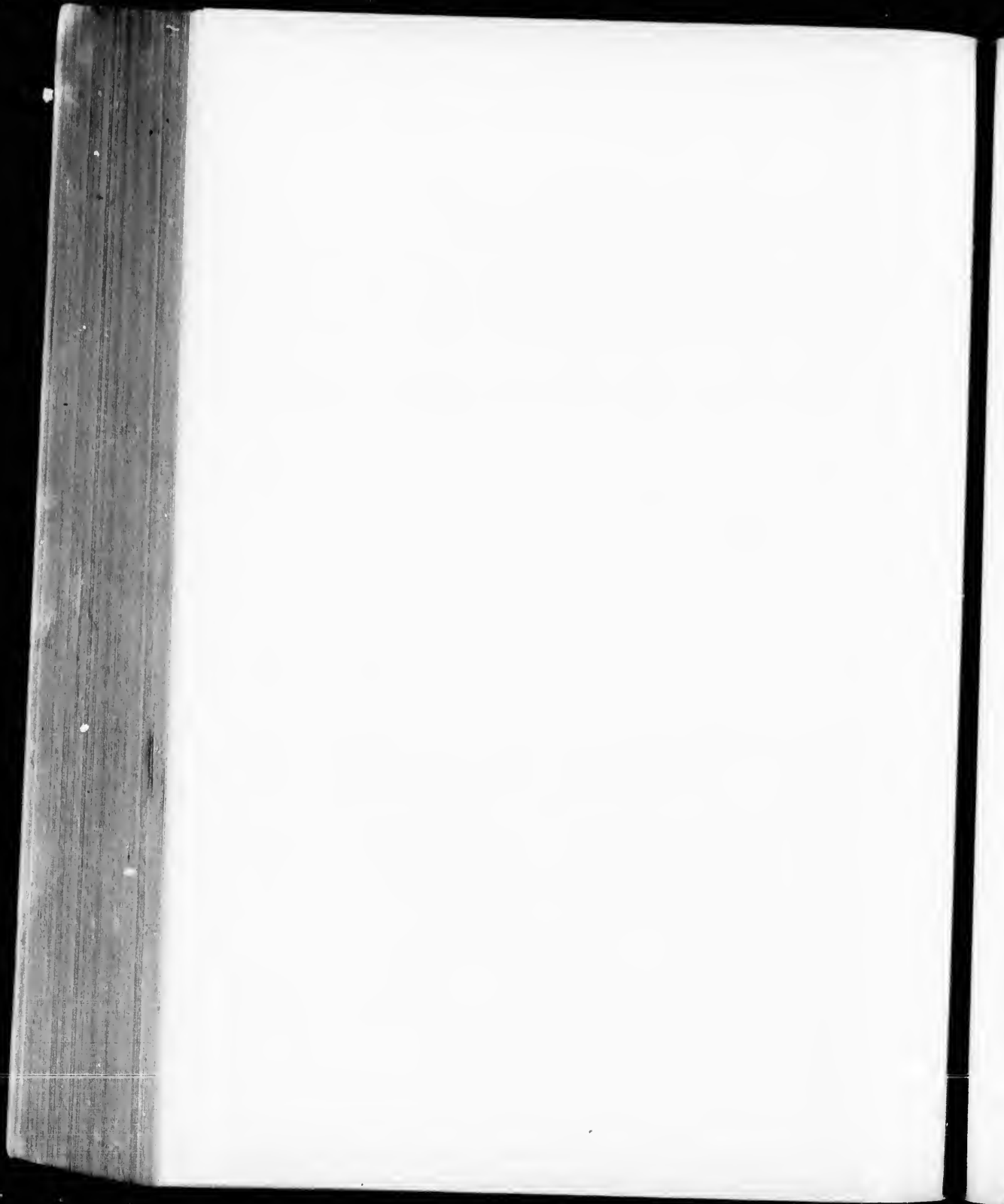
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Q. Well, asking you now from your recollection, would your opinion be, that the central fissuring and cracking was caused by the dynamic forces that created the large fissures? A. I would be inclined to believe it was.

35

Q. I noticed yesterday, Mr. Lindgren, in giving your evidence you spoke of the ore going down the incline shaft as being literally continuous; but you spoke of the ore on the outcrop as being practically continuous; did you intend to make a distinction? A. Along the outcrop might possibly be a stretch of a few inches or possibly a foot, along which there was no pyrrhotite or chalcopyrite, but along the No. 3 shaft it was——

40



The Court: Downward? A. Down, positively continuous, in a way that you could put your pick on the ore.

Q. No, I was asking about the outcrop. You spoke of the outcrop as being practically continuous? A. Yes. 5

Q. You spoke of the ore in the incline shaft as being literally continuous? A. Yes.

Q. Did you mean that there were breaks in the ore in the outcrop? A. 10
There might be a break of a few inches to a foot.

Q. Well, can you say whether there is or is not any break in the outcrop? A. There are several breaks, yes. One break at least that I recollect. 15

Q. Where did you find the break? A. Where a dyke crosses the vein.

Q. Whereabouts would that be? A. About 90 feet from the No. 3 shaft. 20

The Court: To the east or west? A. To the east.

Q. You find a dyke? A. Yes, sir.

Q. Going east from that point do you find any other breaks? A. Yes, 25
you do find a break at the railroad cut.

Q. What is there, a space of barren rock? A. No, but during the process of grading the outcrop has been covered over naturally with ballast and ties and so on, and it is not visible for that distance. 30

Q. You did not pick down underneath to find out what there was there in that fill in the railroad cut? A. In this here one, I did not.

Q. So you cannot say whether or not, below that artificial covering which 35
the railroad company have put there, you cannot say whether or not there is an actual break in the ore? A. I believe I did see it in the trench on one side of the railroad.

Q. Did you find a break in the ore, a break in the continuity of the ore? 40
A. I did not find the ore over the space occupied by the railroad, except, I think, in one place at a little trench at the side of the road, where it shows a little cropping; otherwise it was covered and I did not attempt to uncover it.

Q. You said you found planes? A. I did.



Q. Striking across the course of that outcrop in different directions? A. Striking across the outcrop?

Q. You said you found planes striking across the course of that outcrop in different directions—did you say that? I don't know whether you said that or not, but is that the fact? A. I don't think I did. 5

Q. Well are there planes striking across the outcrop? A. There is one plane striking across the outcrop.

Q. Where is that? A. Immediately at the railroad cut. 10

Q. You found none other? A. None that I can recollect now.

Q. Will you give me the course or direction of the first 60 feet of the ore from the No. 2 incline shaft in the outcrop? A. From the No. 2 incline? 15 Yes, sir.

Q. Going west? A. The direction is a few degrees, perhaps 10 degrees, south of east; the distance from the point 60 feet west of the Centro Star No. 2 shaft to the shaft; that is the distance you mean, I presume. 20

Q. Well, the trench ends away from that direction (indicating on model), pretty nearly at—well, at a very large angle, does it? A. It makes an angle, yes; the outcrop makes a bend there.

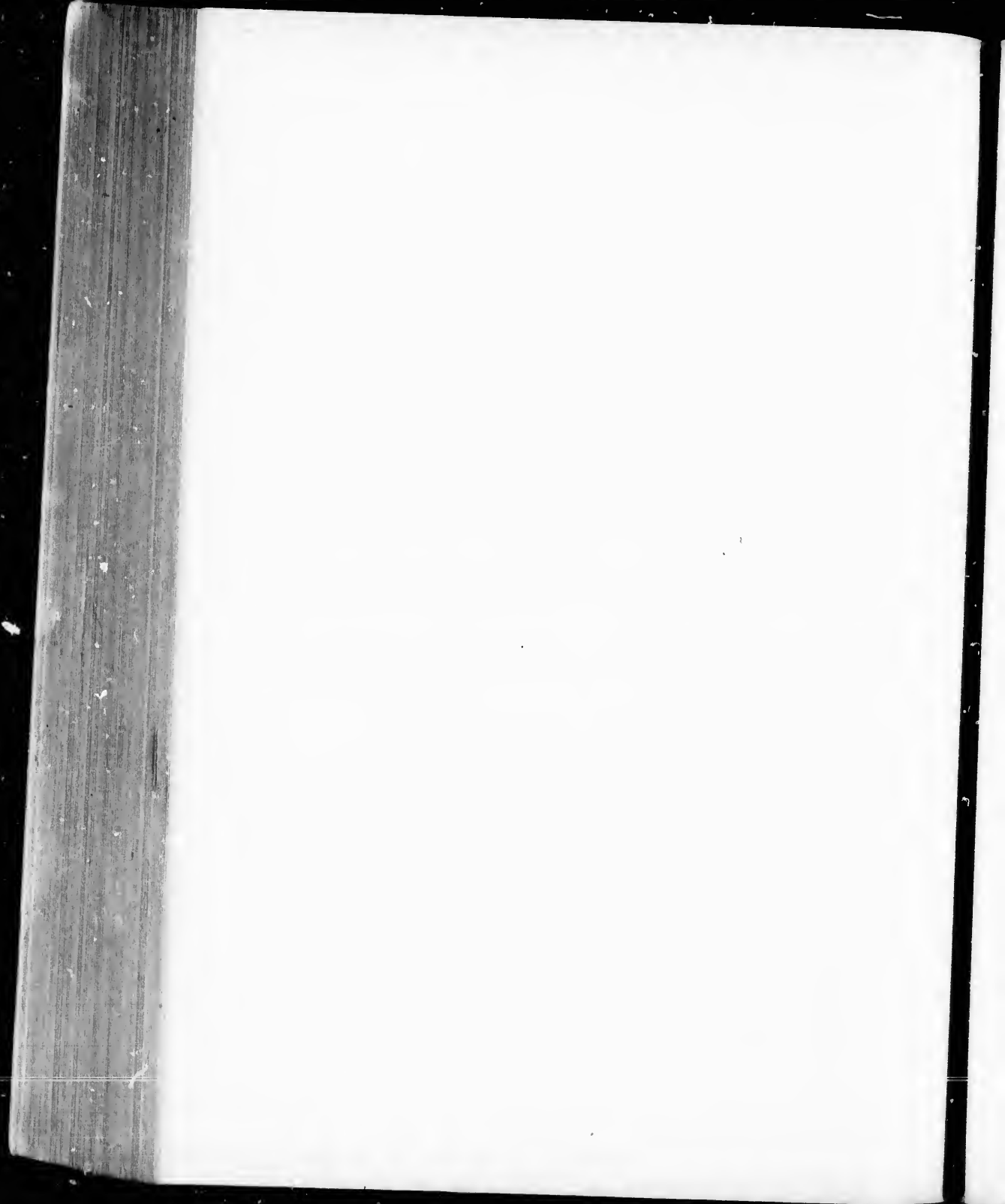
Q. Well, is that the outcrop that makes that bend, or is it the trench that makes the bend? A. Both. 25

Q. Do you say that the outcrop on that first plane turns east at that particular point as that ditch turns? A. As you go along from Centre Star No. 2 shaft, you run in the direction I indicated, for about 60 feet westward; at that point there is a rounded bend of the vein, by which it assumes a direction some 20 degrees north of east; but the ore is continuous and the ditch must follow the ore. 30

Q. Do you say that the outcrop bends around at that point in the way you have indicated? A. The outcrop bends at that point. 35

Q. Will you say that it is not another seam of ore that comes in and intersects that seam going across to the northwest there? A. I do not think—I do not see how it could be. The outcrop shews not any heavier than before, 40 it shews continuously—

Q. Don't you find any other planes along that outcrop, which come in to each other, Mr. Lindgren—I cannot describe exactly how, but something like



that (illustrating), with a plane coming in represented in that way (illustrating), and then you go along a little ways and another two planes meet again and go back in another direction, roughly speaking? A. I have not seen anything like that.

Q. You have not noticed that condition here? A. Oh, I have seen 5
a plane coming here, coming in near the collar of the shaft and dipping steeply down this plane (indicating on model), across a little bit of ore.

Q. Is that the only one of those planes you have noticed? A. That 10
was the only one of those planes I have noticed.

Q. Did you come over here to the east of No. 2 shaft? A. I did.

Q. To the lowest place where vein matter was exposed there? A. I 15
don't know. I went down for a distance of, I should say—

Q. You found quite a long cut down here (indicating on model)? A.
I did.

Q. Did you take the direction of the fracture that is exposed there? A. 20
I went down for a distance of about 49 to 50 feet in an easterly direction from the Centre Star shaft No. 2.

Q. Did you take the strike of the fracture which is exposed in the ore 25
at that point? A. I took the direction of it, looking westward, and I found that it had a direction that was very nearly east and west, not as much north-west as the first place, the first part of the Centre Star vein for 60 feet west of the No. 2 shaft, and pointing somewhat more in the direction of the No. 2 shaft.

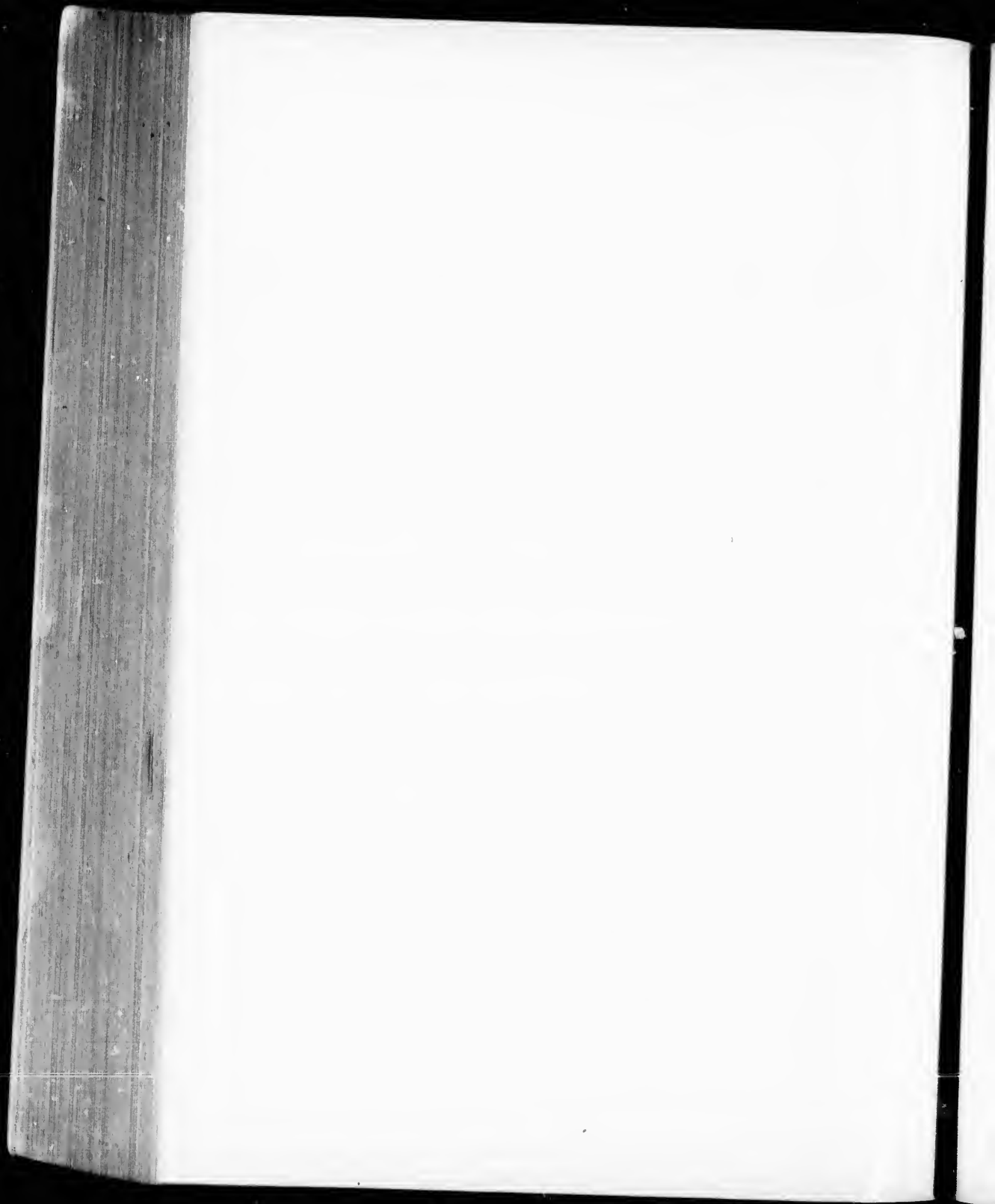
Q. Well, if it were produced so as to intersect the fracture which you saw 30
at the Centre Star incline No. 2, how would those two fractures join? A. Which fractures do you refer to?

Q. The fracture in the vein or in the ore exposed at that point east of the 35
incline, and the fracture which appears in that trench for the first 60 feet from the No. 2 incline? A. I should say it is not exactly the same strike.

Q. You have not mapped it and so you cannot tell? A. I have not
mapped it, simply took a bearing.

Q. Did you trace the outcrop to its uttermost western limit? A. I 40
did trace it to a point about 30 feet west of the collar of the No. 3 shaft.

Q. That is where it goes down the hill, do you mean? A. You mean
from here, do you not? (Referring to point on model),



Q. Yes. Did it continue on a line that way across the Iron Mask line that outcropped? A. No, sir, it did not.

Q. Then you refer to a piece of outcrop you saw down at the south? A. No, I do not. I refer to the continuous outcrop which I saw which begins at the western side of the No. 3 shaft and is continuous for 30 feet westward. 5

Q. It goes 30 feet west beyond that point? A. It does.

Q. That is right? A. It is not exactly west, because it is a little south of west, and has in general the same direction as the outcrop shewn here (indicating on model). 10

Q. It is just to know if you and I are talking about the same thing. Will you just lay your ruler where you find that outcrop on the plane there? A. I find the outcrop in a direction something like that (illustrating with ruler on model), very much like that, and I find it for a distance of 30 feet, that is to say, about this distance (indicating on model) from the collar of No. 3 shaft. 15

Q. Is that the end of the outcrop in your opinion? A. I looked for it beyond that point, and there is a great deal of gravel and sand and products of disintegration that cover up the continuation, so I could not find it beyond that place. 20

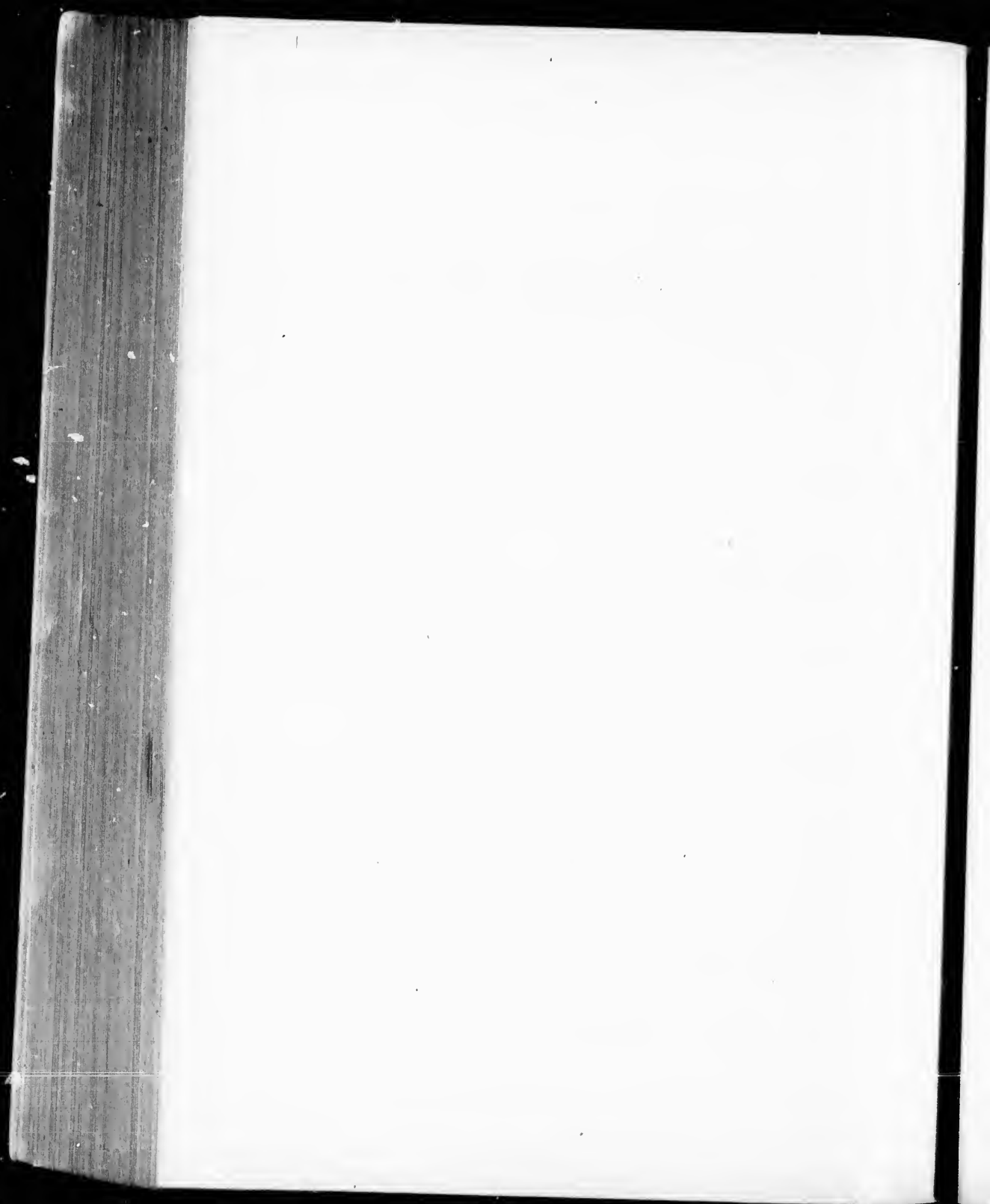
Q. Well, you are pretty close to War Eagle dump, there, too, are you not? A. To the War Eagle dump, yes, and the place which I refer to is not under the War Eagle dump. 25

Q. No. A. You trace the outcrop to a distance of 30 feet, say to this point (indicating on model). Now, beyond that, and in the direction in which you would expect to find it, the surface is covered by loose dirt and accumulations. 30

Q. Have you any doubt in your own mind whether it continues through in the same direction? A. I don't know whether it does or not; I have not seen it. 35

Q. Well, what do you think about it from what you did see? A. I can form no opinion of it, except that it stopped there and was not seen beyond on account of surface accumulations. 40

Q. Well, there was nothing else except the mere fact that you did not see it, to make you believe it did not continue? A. There was not. You presumably refer to its being cut off by something.



Q. Yes. Did you see any mark of its being cut off? A. I did not; no, sir.

The Court: It comes to this, then, from what you have said, that the outcrop runs 30 feet further westward from No. 3 shaft? A. It does.

The Court: And that outcrop is not shewn on the plan? A. No, it is not.

The Court: I would like that noted here, if it has any point. The outcrop between No. 2 shaft and No. 3 shaft is shewn and the outcrop which you are speaking of, 30 feet to the westward of No. 3 shaft, is not shewn on the plan? A. It is not.

Q. Do you not find, Mr. Lindgren, in examining the ore in those veins, that there is a fine grained pyrrhotite and a coarse grained pyrrhotite? A. Yes, I believe I have seen those two varieties.

Q. Well, have you any reason or any theory to assign for the existence of those two kinds of pyrrhotite? A. No, I really have not. I have not given sufficient thought to that subject.

Q. I suppose you know that the coarse grained pyrrhotite does not carry as good values as the other? A. I confess I was not aware of the fact.

Q. Now, I noticed in speaking of the mud-seam yesterday and to-day, you did not recognize any movement on that plane of any moment? A. A maximum amount of a foot and a-half or two feet.

Q. Now, have you any reason to say that that movement did not occur, except the ones you mentioned yesterday, where you find the ore at different places above and below the mud-seam and measured the displacement by that? A. I do not think I understood your question.

Q. As I understood you, perhaps I was wrong, but I understood you to say that in certain places you found ore coming down to the mud-seam on the one side and going up to it below? A. Yes.

Q. And from the appearance of that ore above and below you ascertained the amount of movement there was on that mud-seam, was I right on that? A. From the position of that ore, yes.

Q. Now have you anything else to say, to give us a reason why you do not attribute any movement along the plane of that mud-seam to any greater amount than that you have mentioned? A. The fact that you do not find the dyke



disturbed by the mud-seam shews, is another reason for saying, that there has not been any considerable movement. The veins and the dyke form the two criteria upon which are based the——

Q. But you do find over there indications of movement. You find a large 5
mass of triturated matter between the walls? A. You find a mass of attrition
matter, varying from a couple of inches up to a maximum of two feet.

Q. You found striation marks on the rocks all over that country over
that mud-seam? A. I cannot say that. I have been looking for striation 10
marks, but I could not find any.

Q. (Piece of rock handed witness.) Here is a piece that came out near
there. Can't you see striation marks on that, would you call that striation
marks? A. There are some striation marks on this piece of rock: such as you 15
often find.

Q. I am told that came out of the new work in the Centre Star winze?
A. It may have.

Q. Well, if that was 10 feet below the mud-seam, you could not account 20
for any movement there, except a movement caused by the mud-seam, could
you—by the fracture which created the mud-seam, I mean? A. Why, a slight
amount of movement along joints is a very common occurrence.

Q. Would it make striation marks of that character and to that extent? 25
A. I think it would. You can't judge of the extent of the movement, by the
striation marks; a very slight——

Q. You say you cannot——

Mr. Davis: Let him finish his answer. "A very slight"—What were 30
you going to say, Mr. Lindgren?

A. (Continued.) A very slight movement may have produced a very
remarkably strong striation line. 35

Q. Why? A. Because when two slices of rock, separated by a fault,
move over each other, it will require but a very short movement, considering
the numerous stresses that are in play, to produce a smoother surface and the ap-
pearance of continuation may very well have been caused by successive particles
rubbing in the same direction. 40

Q. But in a hard rock like this, would you expect to find comparative
deeply bedded striations without considerable amount of movement? A. The
striation which you shew me I consider very fine.



Mr. Bodwell: That is a piece that I happened to pick up, but did you find other sections with deeply bedded striations, what would you say about that? A. Well, even then it is not safe to conclude about a movement, because in such a fault you have often a vibratory movement, a movement backward and forward, which may produce deep grooves with very little movement.

5

Q. At any rate, these circumstances would be consistent with a movement of considerable extent? A. If you mean to ask me, whether movements of great extent are accompanied by slickensides, I say yes.

Q. And by striation marks on the rocks, too? A. Movements of considerable extent are oftener accompanied by striation marks.

10

Q. Now, Mr. Lindgren, what theory have you as to the origin of the coarse grained rock in the No. 2 incline? A. There are two theories which might be suggested. The one is that it is a dyke later than the surrounding main mass of rock, but earlier than the mineralization of the vein. The second theory would be that it is a segregation of material, having taken place in the molten magma just before it was consolidated.

15

Q. What would you conclude from the fact, if it is a fact, that you find in one part of that disputed territory generally a coarse grained rock, and alongside of it for a considerable extent of territory a much finer grained rock, say, from the Centre Star incline No. 2 to No. 3—just as an illustration, I do not know that it exists there—fine grained rock, and from the Centre Star incline No. 2, a coarse grained, much heavier, basic rock than the other; would you draw any conclusions from that in itself? A. Well, as a matter of fact, there is not quite such pronounced divisions here, but you mean if there were, I presume.

20

Q. Yes, if there were what would be your conclusion? A. I would draw the conclusion that the crystallization of the molten magma has proceeded in a somewhat irregular manner.

30

Q. Would you say it had proceeded under altogether different conditions? A. No, I would not say that. The difference in the case of rocks in this district is not sufficient to say that.

35

Q. You cannot say, then, that the difference in the crystallization in the rocks, or the difference in the association of the constituent minerals are not here any indications of the different conditions under which the rocks were cooled or crystallized? A. They are indicative of a certain difference.

40

Q. But not anything from which you can draw any sharply marked distinction? A. I do not think the differences in this rock in the immediate



vicinity are such as to infer there were any very radical differences in the processes of and conditions of consolidation.

Q. And your answer would apply to the whole territory, I understand.
A. The whole territory as far as I have examined it. 5

Q. You have examined all the territory in dispute in this action? A.
Yes, sir.

Q. And you have made a more or less careful examination of the rock in
the Iron Mask mine? A. Yes. 10

Q. And you saw nothing in the course of your investigations to qualify
the opinion you have just given? A. In speaking of these rocks you do not
refer to the dykes now, do you? 15

Q. No, I am just speaking of the main rocks there. Now, speaking of
dykes, you found a great many dykes, did you not? A. I did.

Q. Now have you the number that you did discover? A. No, I have
not. I certainly found a dozen. 20

Q. Twelve or fourteen of them? A. Yes, I should say that easy.

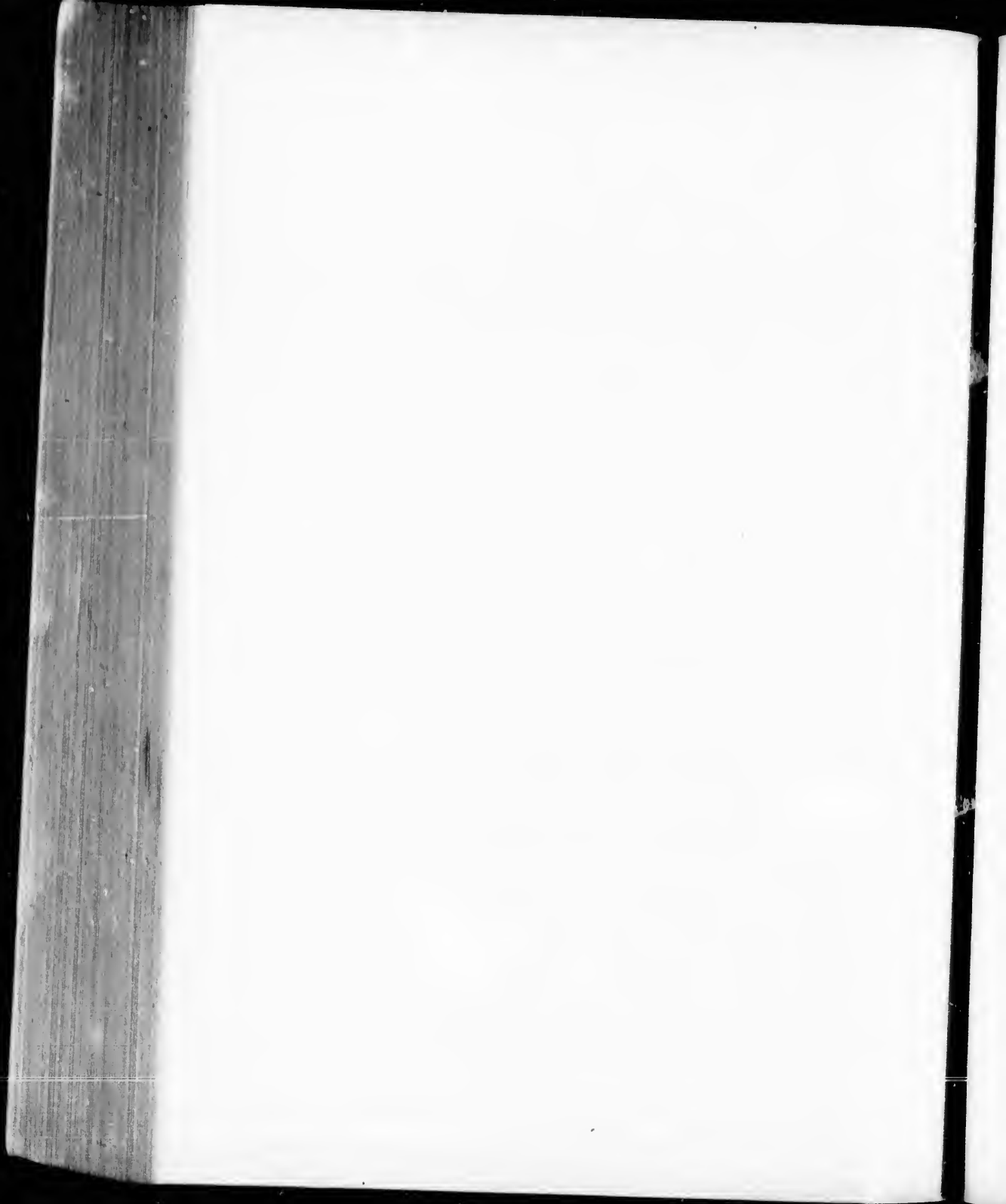
Q. Now how many of them have a considerable importance, as to size,
persistence, and so on? A. They all are quite persistent, most of them, at
least, can be traced for a considerable distance; where you expect to find them
in the drift below you usually do find them there. 25

Q. You do not infer any dislocation along these dykes at any point do
you? A. I do not think there has been any dislocation along the dykes; that
is to say, there has been no immediate dislocation at the time the fissures which
were open to admit the molten magma which now constitutes the dyke were
formed. There are few fissures which are parallel to the dykes, but they do not
usually follow the conditions of the dykes and have altogether been created at
a later time than the dykes. 30

Q. Well, do you find evidence of any movement on any of the fissures
filled with vein matter in the territory? By movement I do not mean a foot
or two, but an extensive movement? A. Along any vein in the territory,
along the vein fissures, you mean? 35

Q. Along the vein fissures, yes? A. I cannot say that I have. 40

Mr. Davis: That is east of the big dyke, is it?



Q. We will say east of the big dyke, then— A. I have not found any evidence of a considerable movement along the fissures of the veins themselves.

Q. West of the big dyke do you? A. West of the big dyke I have not found any considerable evidence of movement. You mean, movement parallel to this plane, say for instance, to the plane of this vein, that is east, you mean, if I understand you right? 5

Q. Well, I will take it that way first, Mr. Lindgren? A. I say I did not; any movement by which, we will say, the walls, for illustration, of the Iron Mask have slipped one over the other—I have not. I would not deny it, but I have not found any particularly. 10

Q. Well, have you found anything which would indicate a horizontal displacement of veins due to a vertical faulting on any lines? A. Yes, I have. 15

Q. Where have you found that? A. I found some evidence at the No. 3 in Centre Star north drift. 20

Q. You are speaking west of the big dyke? A. West of the big dyke. There appears to be a movement along the vertical fissure by which the Iron Mask vein has been thrown some 20 feet. 25

Q. To what do you attribute that throwing? A. A movement along the plane having a north and south strike and a very steep dip, nearly vertical. 30

The Court: And which way? The dyke runs that way, north and south, I thought? A. Yes. The movements, your Lordship, would parallel to the dyke. 35

The Court: That is, it would move with the dyke then? A. The movement has taken place in a fissure which apparently lies in the dyke, and it has taken place later than the dyke. It is a fissure created after the dyke had made its appearance. 40

The Court: There are two dykes there and the fissure between? A. There are two dykes, but the fissure I refer to now is in the middle of the easterly dyke. 45

The Court: And not between the two? A. There is some crushed rock between the two. 50

The Court: I know, but the fissure you refer to is within the dyke and not between the two dykes? A. Not between the two dykes. 55

Q. What do you think becomes of the mud-seam to the west of No. 4? I mean the vertical dyke, the strong vertical dyke you call it? A. I don't know.

Q. Haven't formed any theory about it at all? A. I did not see it. 5

Q. I did not ask you that? Have you formed any—perhaps we will call it conjecture, from what you have observed, have you any theory about it? A. The movement may have been quite considerable, but I have not formed a definite opinion of where it is at the present time. 10

Q. You think, then, there may have been considerable movement on the mud-seam west of the strong large dyke? A. On the mud-seam? No, sir, no movement on the mud-seam, but the mud-seam itself has been faulted evidently by—— 15

The Court: Up or down, which way? A. I would not like to express an opinion on that. 15

Q. You do not know where, if at all, the mud-seam comes to the surface? A. I do not know. 20

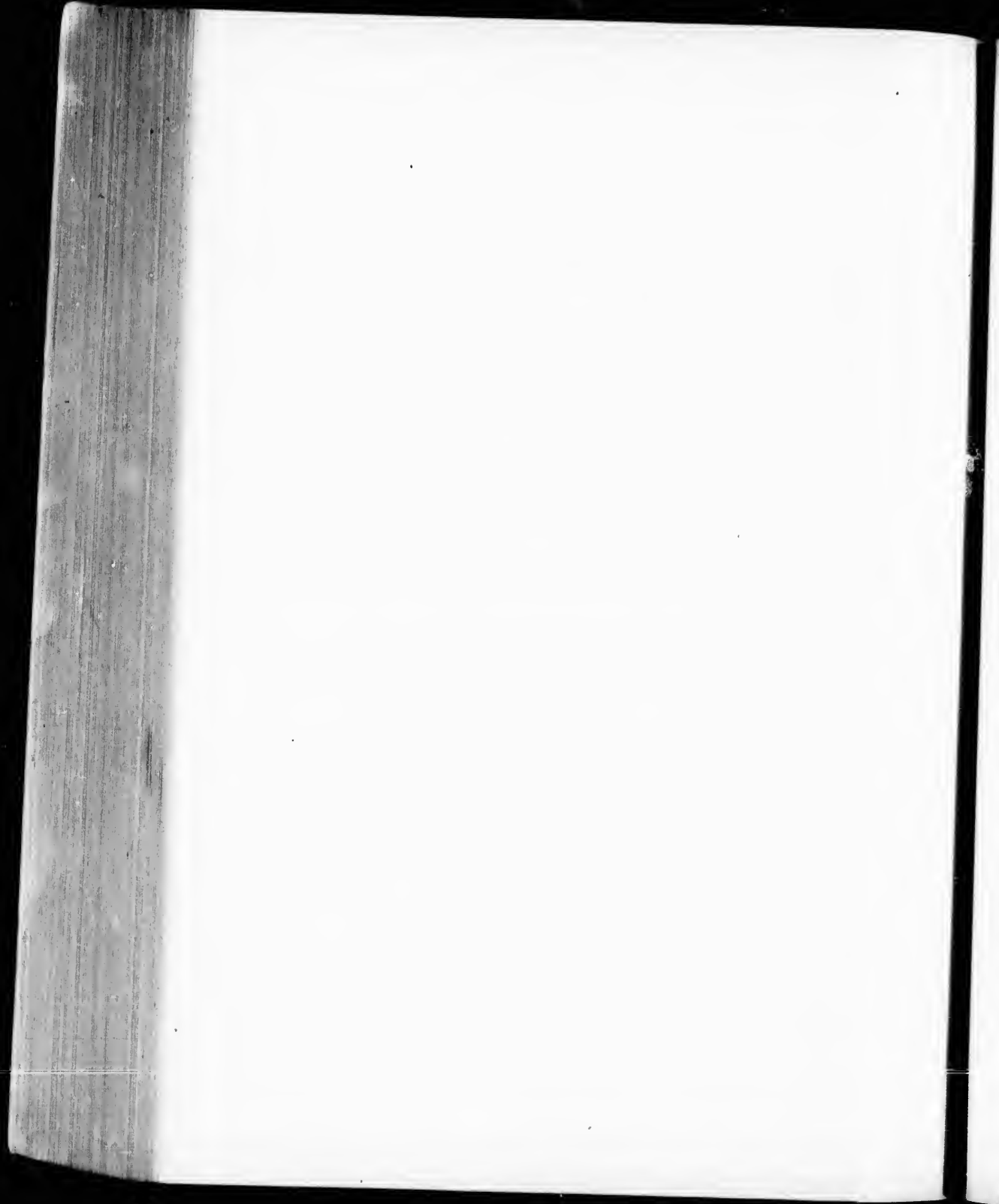
Q. Where would it naturally come to the surface if projected on the lines which you saw it had at the Centre Star end line No. 3, as an illustration? A. I have not calculated it; it would come to the surface quite high up on the hill some place; I have not seen it on the surface, and it would be very unlikely to show there. 25

Q. You think that on the surface there would be nothing but some crushed rock to identify it by? A. Yes, and that would be covered over by gravel and sand, subsequent glaciation, and it would not be likely to shew. 30

Q. Now, did you not notice calcite seams above and below the mud-seam at different places in the course of your investigations? A. I have in a few places, yes. 35

Q. Did you not find planes running vertically towards the mud-seam, both above and below it at places? A. No, sir; I do not remember that. I have seen parallel calcite seams, a few feet above the mud-seam, in one or two places, but I do not remember any vertical planes. The planes, if there are any above and below the mud-seam, are generally more or less horizontal. I do not remember any. 40

Q. But I understood you to say there was no jointing of any description in any of those planes? A. Why, I don't say but what there is. There may be, but it was not pronounced enough to call my attention to it. Little vertical



joints are very common, and they were not prominent enough to attract my attention.

Q. Did you see any vertical planes above or below the mud-seam, half or three-quarters of an inch wide, filled with calcite? A. No, sir; I did not. The only planes which I have seen filled with calcite have been parallel to the mud-seam. 5

Q. Have you your notes of your examination at station 45 on the Iron Mask tunnel? A. Yes, I have been there. 10

Q. Well, have you got your notes of that? A. I have.

Q. Now, do you find vertical calcite seams of that description standing in the vertical planes at that point? A. I have not a note of them; I don't remember seeing them. 15

Q. I just give you that point as an illustration, Mr. Lindgren. A. I don't deny that they exist; they might possibly exist, but they are certainly not prominent enough to call my attention to it. 20

Q. Now, going back to No. 4 raise, you presume that that raise was run up there in the course of mining on the vein? A. It evidently was, because the vein seam shews it.

Q. Then miners would not as a rule leave the good ore in going up from the tunnel level? A. I presume not if it was worth while taking out. 25

Q. They would not leave the vein on which they started, would they; that is not the practice of miners? A. I don't know at what time that No. 4 upraise was made; I don't know anything about it. 30

Q. Well, have you ascertained? You were going to look at your notes about the dip of No. 4 raise? A. Yes, I find that I have two dips (referring to book); one is close to station 52, Centre Star No. 2 tunnel, and I think a dip of 56 degrees. 35

The Court: Station 52. A. Station 52, yes. I have another note of a strike and dip at station 49 the same tunnel, which shews an east and west strike astronomically,—that is true east and west—and a dip of 58 degrees, a good wall is exposed at that place. Those are the two places of which I have made notes. 40

Q. And those were taken at the tunnel level? A. Those were taken at the tunnel level.



Q. You have dips taken in the upraise? A. You mean in No. 4 raise?

Q. Yes, in No. 4 upraise for instance. A. No, I don't believe I have except I know from the time of my examination that it was nearly vertical.

Q. Now, then, No. 2 raise is distinct from No. 4 raise, about 80 feet—90 feet? A. Something like that; 80 feet I believe.

Q. Practically on a line, is it not? A. Practically on a line.

Q. That is to say, if you start that upraise and follow from the foot up to the top of the work you are bound to run across where a line produced from No. 4 raise would intersect, are you not? Do you understand what I mean—I do not express myself very clearly—you are bound to strike that line somewhere in that upraise, are you not? A. In No. 4 upraise?

Q. I mean to say No. 2, you are bound to strike a line produced from No. 4? A. In No. 2 upraise you say you must strike a line which is produced from No. 4?

Q. From the top of No. 4? A. I don't quite understand what you mean by "line produced."

Q. Lay this sheet of paper as the way the vein runs across the No. 4 raise. A. The vein runs across the No. 4 raise like this? (Illustrating).

Q. Yes. A. Yes.

Q. Now, then, produce that line and you are bound to get part of that raise, are you not? A. Produce that line and you would come I would say a little in the hanging wall, or somewhere in that vicinity.

Q. Now, then, you would find the intersection of the vein in No. 4 in No. 2 raise, then, would you not? A. I think that the explanation, if you drift it on that vein from this point—or No. 4 near the top, we will say, of No. 4 raise, you would eventually come into the Centre Star No. 2 vein.

Q. Yes, and the vein which runs through. A. That is my opinion simply.

Q. The vein which runs through No. 4 raise would certainly be seen at some point or other in the No. 3 cross-cut, that is, taking it from that point to the end? A. If it ran in any other direction.

Q. If it did not come into the No. 2 raise, you would find it somewhere in this cross-cut? A. Yes, I should think so.



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10

RE-DIRECT EXAMINATION.

15

By MR. DAVIS—

Q. My learned friend asked you if a certain drift were continued and widened whether it would shew the partings of the vein. Which was he referring to at that time, the Iron Mask drift? 20

Mr. Bodwell: The Iron Mask upper drift.

A. The Iron Mask upper drift. 25

Q. Now, how wide would it need to be to shew the partings of the veins? Or rather, you can answer it in this way; what would be the extent of the intersection between those two veins, how much ground would it cover, roughly speaking? A. Judging from the extent of the vein, the intersection No. 2 as shewn in the end of the Iron Mask upper drift, I should say it would be at least 20 feet, that is to say, the Iron Mask, which is there narrow, would enter the Iron Mask which is there wide and continue into that quite a distance, because the veins intersect at acute angles. 30

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Q. It is a piece of mathematics, is it not, if one vein were 20 feet wide, and the other were 10, coming down the angle, to find where the two veins would get entirely clear of each other at the bottom? A. Exactly.

Q. The result would be that it is only a matter of figuring it out? A. 40 Yes.

Q. You spoke about finding pyrrhotite in the country rock in Grass Valley. Was the rock which you were speaking of there primary rock or secondary



rock? A. I did find some pyrrhotite as a primary constituent of igneous rock. I have also found some pyrrhotite disseminated through an altered rock, that is to say, the pyrrhotite has been placed in that position by a process analogous to that by which it appears in the vein.

Q. The rock here, is it primary or secondary? A. It is a primary rock. 5

Q. Have you found, as far as your observation has gone, pyrrhotite in the country rock here away from veins? A. You mean as a primary constituent? 10

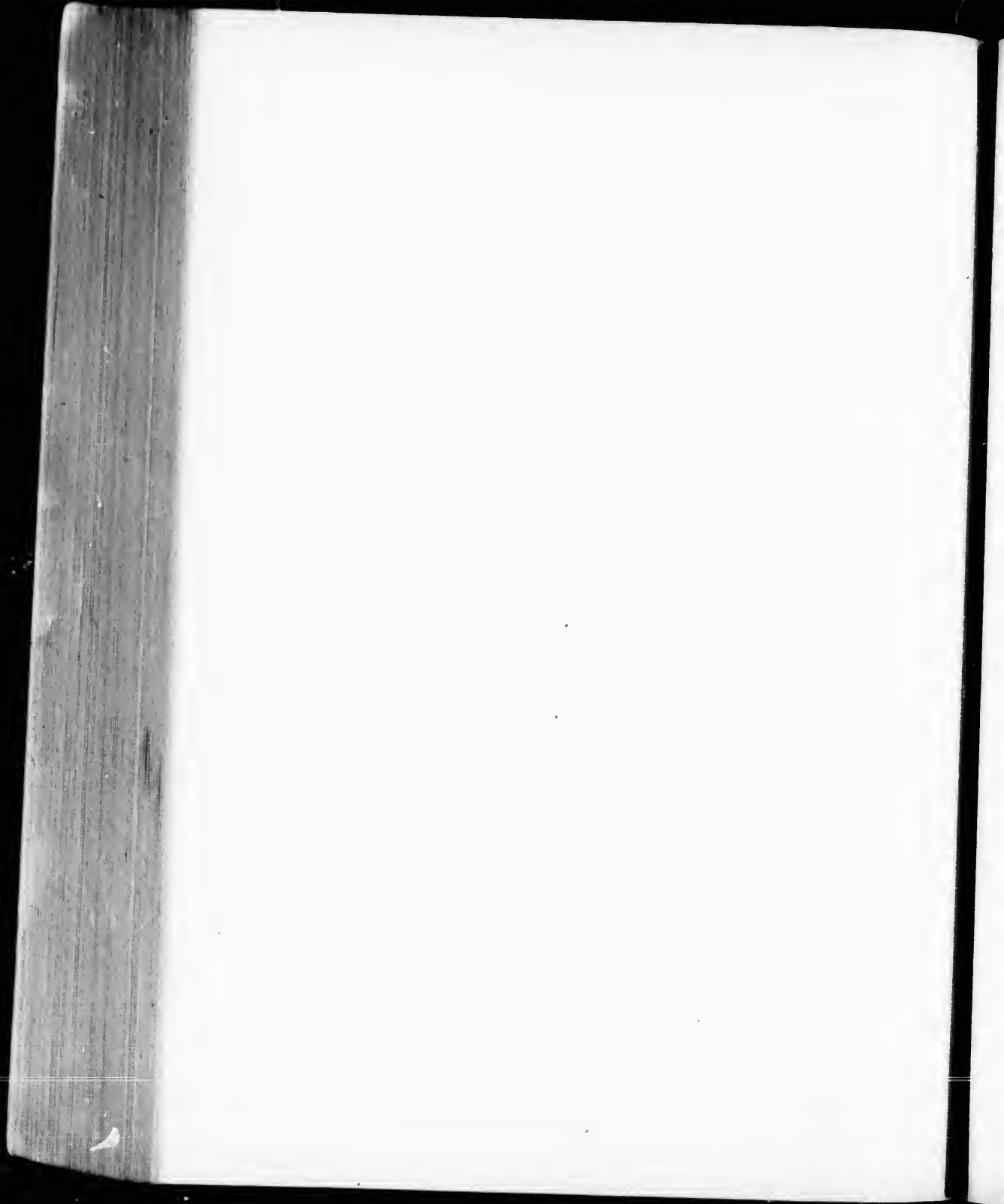
Q. Yes. A. I have not. The rock in this vicinity is remarkably free from not only pyrrhotite and pyrite, but even magnetite, which elsewhere is an exceedingly common mineral in eruptive rocks. 15

Q. And the primary rock which you spoke of in Grass Valley, was that the same rock which you find here? A. That was a diabase. 20

Q. That would be a different rock from what you have here? A. That would be a different rock from what you find here. 25

Q. My learned friend asked you about "fahlband." Will you describe what the difference between that and a replacement vein, we will say such as you have here. A. A fahlband is a term the old German miners gave to certain rocks, and ill-defined streaks in schists and schistose rocks which contained more or less finely disseminated grains of pyrite, pyrrhotite, chalcopyrite and other things. Those fahlbands, as they are called, only appear as far as I know in schistose rocks, and they are characterized by these disseminated minerals which may occur in quite considerable amounts in places very rarely, exceptional, in such amount that they will pay to work; but they are distinguished from all veins by the primary fact that there are no planes, that they do not follow in well defined planes. They do not follow any fissures; they have no connection in origin with fissures. 30

Q. Now, in that map of the Silver King region which my friend shewed to you, you stated with reference to it that there was very much larger mineralization there than appears in the veins here as I understood you. Will you explain fully what you mean by that exactly, because I did not exactly understand. A. I meant that according to the plan which Mr. Bodwell shewed me there appeared between two forms which were comparatively barren, according to that plan, a wide belt from two hundred to eighty feet wide, which was marked as heavily mineralized, and containing a number of planes, and that is the only reason that I said it was apparently more mineralized, to judge from the— 35 40



Q. (Interrupting.) When you say "apparently more mineralized" are you speaking of the quantity, that there is a broader stretch of country—bigger stretch of country? A. A broader stretch of country as to width, yes.

Mr. Bodwell: I asked him the comparative degree of mineralization. I wish you would ask him now that same point. 5

Mr. Davis: The question and answer might have been taken to mean as to whether the country did not contain more mineral, comparatively speaking.

The Court: What do you mean by "planes?" You mean planes in a somewhat vertical direction, not horizontal? A. Not horizontal, no. Vertical, or approximately vertical. 10

The Court: These might not be exact, but incline or vertical planes? A. Yes, sir.

Q. What I understand my learned friend to ask you there, and from what he says now I am sure I am right about it, is this: whether as a fact, taking the stretches of country in that Silver King map that he shewed you, which existed between the three veins, there are three veins there which exist between the first and the second and the second and the third,—taking that country between, whether that was as much mineralized as the vein that we have here,—whether you knew as a fact how it stood. A. I could not answer that question at all because I have no definite recollection about that fact. 15 20

The Court: What I understood Mr. Bodwell wanted to know, and he did not get an answer, he simply referred to that plan. 25

The Witness: As to the actual facts in that case, as to the actual width of the vein, as to the extent of the minerals, the degree of mineralization, I have no distinct recollection at this time.

The Court: I want to ask you another thing. I don't know now what bearing it has, but it may have some bearing by and by. There (illustrating on model) is the No. 3 shaft, here is the No. 2, here is an outcrop. You have described the vein, and other witnesses have described the vein as being seen between each of these shafts, and therefore as being at the angle coincident with the incline. Now, you are asked about this upraise, and also upraise No. 4, and also upraise No. 2, and also by Mr. Bodwell, that if you join those two, run a drift between the two, whether it would not be naturally on a vein—if this is vein matter and this is vein matter (illustrating on model), your answer is yes. Now, what vein is this? I recollect your saying in your examination in chief that it was the Centre Star vein, and that was the reason you were asked to give the degree. A. (Illustrating on model.) This I regard as the Centre Star vein No. 2. 30 35 40



The Court: That is the same as Centre Star vein No. 2? A. Yes, sir. 20

The Court: Also, it bulges out, as it were, in that way—taking an eccentric turn? A. Yes, and this vein I refer to as the Centre Star No. 2; and also this vein (illustrating on model).

The Court: Does the vein take the place as my stick indicates then, and run off to No. 3 incline; here is the outcrop here? A. Your Lordship means if the vein was continued up? 5

The Court: You say Centre Star No. 2. Now, here is Centre Star No. 10
2. A. Yes, here is Centre Star No. 2, and there is Centre Star No. 2.

The Court: Here is the top of this, and across, where my stick is, there is—in a rough way, you need not be exact. A. No, sir, but there is a point in the outcrop which is shewn at this place, which the centre vein partly follows the bend of this level, exactly as it is represented. 15

The Court: In other words, that is parallel to this. A. That is exactly parallel to that. That was the point I was trying to bring out.

The Court: And that is the first time it has been brought out. A. Yes, I did not bring it out quite clearly. 20

The Court: At least, why you say it is Centre Star vein No. 2—of course you don't know. A. Because it reproduces the curve at the outcrop and dip. 25

Excused.

Mr. Davis: We are now at a stage when I would ask my learned friend to settle whether or not he wishes to have an adjournment, because what I do next will depend upon whether the case goes on or whether we adjourn 30

Mr. Bodwell: I understand the other day that when this question was argued and your Lordship said that you would not force us to trial if we felt that under the circumstances we were not prepared, owing to the surprise which had taken place with reference to our construction of the Full Court's order; and I also understand that the order which your Lordship would make would be that the adjournment would be at the defendants' costs in the case in any event. 35

The Court: No, I did not make that order, except you have drawn up the order in that way. I did not qualify it in that way. I refused to make it costs in any event, but if you agree to it, it is all right. 40

Mr. Bodwell: That is the reason why I am mentioning it now.

The Court: No, Mr. Davis objected to it very strongly.



Mr. Bodwell: No, I think that is what my learned friend asked.

The Court: Is that true, Mr. Davis?

Mr. Davis: I consented to it in that shape.

5

Mr. Bodwell: The costs of the cause in any event, and that the question of costs was to be appealable.

The Court: Yes. I see, Mr. Bodwell, in reflecting over the matter, you 10 could not appeal about the costs, because you would have been obliged to appeal.

Mr. Bodwell: It is all in the notes.

The Court: You would have been appealing from your own order—the 15 order that you asked for.

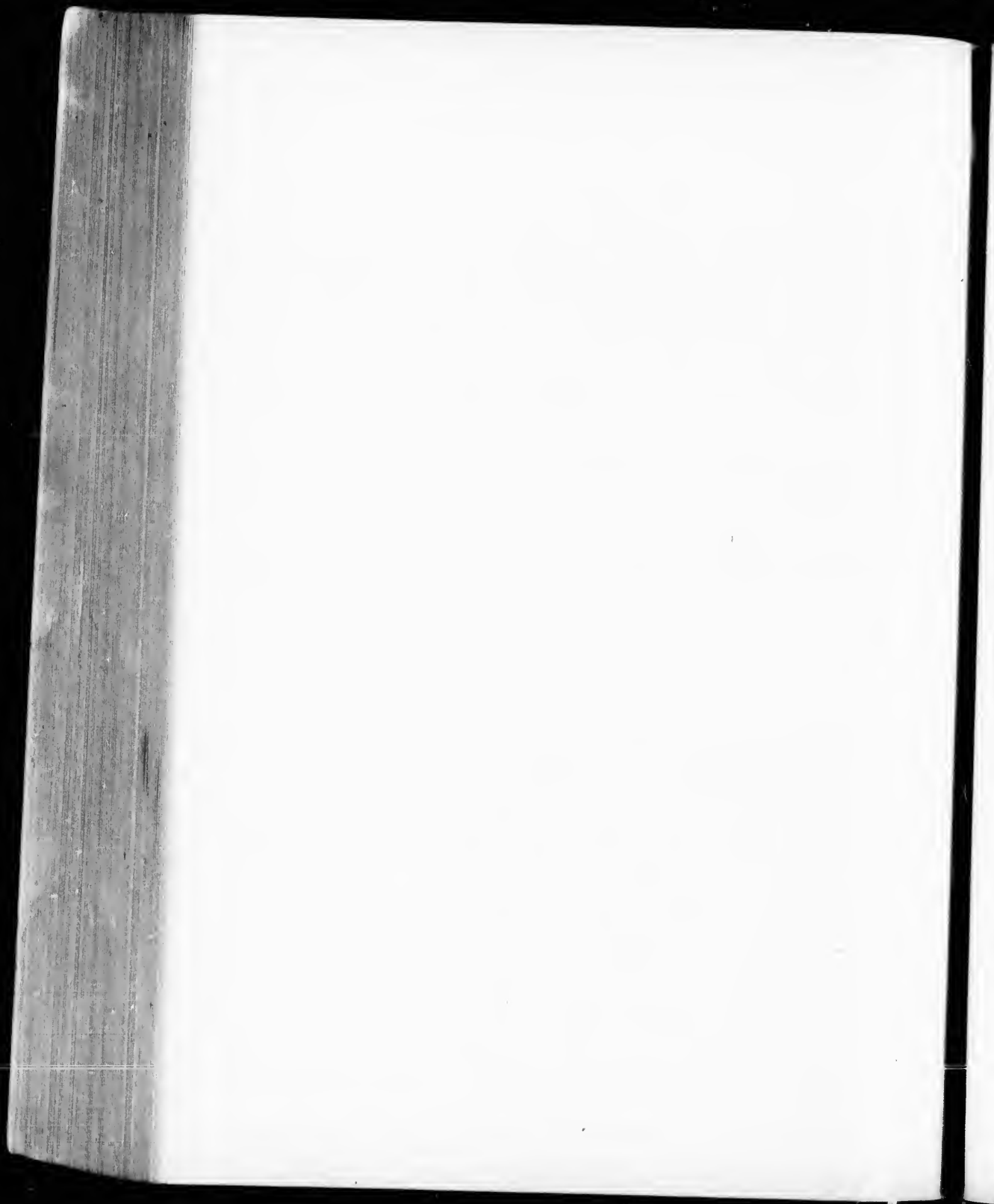
Mr. Bodwell: I am sorry, but we must have an adjournment; we cannot go on, while we are doing this work, and I suppose the question of adjournment would be to a day to be fixed; we cannot say now.

20

Mr. Davis: Yes, I agree to that; I think it is the only way we can do, because they cannot tell what work they will want to do, and your Lordship has given us permission to do work, and we may ask further permission to do work, and we might get leave to fix it. I think that is the only way we can 25 arrange it. I ask leave to put in Dr. Raymond before we adjourn.

The Court: You don't require any other witness.

Mr. Davis: No other witness.



ROSSITER WELLINGTON RAYMOND—Sworn on behalf of Defendants.

DIRECT EXAMINATION.

By MR. DAVIS—

5

Q. What is your business, Dr. Raymond? A. Mining engineer.

Q. Living, I believe, in New York? A. Yes. 10

Q. For how many years have you been following that business? A. Thirty-six.

Q. Where did you receive your professional education? A. I graduated in 1858 at the Polytechnic School of Brooklyn, New York; went to Germany in that year, studied at the University of Heidelberg in the Polytechnic School of Munich and the Mining Academy of Freiburg, Saxony, during the next three years; returned to this country in 1861, and after service in the army of two years, began the practice of my profession in the City of New York as a consulting engineer. 15

Q. I believe for some 20 years you have been the editor of the "Engineering and Mining Journal" of New York? A. Yes, from 1866, I suppose some 20 years, connected either as sole editor or one of the editors. 25

Q. And also for five years as one of the professors of Lafayette College in Pennsylvania? A. I was lecturer for five years in that college on the subject of the science of ore deposits.



Q. Did you hold any official position from 1868 to 1878 in the United States? A. From 1868 to 1876 I was United States Mining Commissioner for the States and Territories in and west of the Rocky Mountains, and published in that capacity eight octavo annual reports. During that period I was also sent to Vienna by the Government as Commissioner to the Vienna Exposition. 5

Q. You are a member, of course, I presume, of the American Institute of Mining Engineers? A. One of the founders of that institute; was president for three years and vice-president for two years, and have been secretary for the last 15 years, and am now secretary and editor of its annual volume of transactions. 10

Q. From 1875 to 1895 what position did you hold? A. In addition to some of the other positions, which covered beyond that period, I was from 1875 to 1895 consulting engineer of Messrs. Cooper, Hewitt & Co., a firm of New York City owning large property and iron mines, and some collieries and blast furnaces; I had charge of mining, metallurgical matters and metallurgical patents for that firm. 15

Q. I believe you, like Mr. King, were one of the witnesses in the great Eureka-Richmond case? A. I was engaged in that case and a number of other cases. 20

Q. In what countries has your mining experience been? A. Mostly in the United States. I have travelled abroad, seen some mines in other countries, and I have been conducting myself in the Eastern States, and have had charge of mines in the Rocky Mountains, have visited a great many mines in all of the States and Territories, I think, mining States and Territories of the Western United States. 25

Q. I believe you are also a member of the New York Bar, are you not? A. I am a member of the Bar of the Supreme Court of the State of New York, and also the Federal and Circuit Courts of the United States. 30

Q. And you have written a very great deal on mining matters, I believe, especially this law of apex, have you not? A. Yes, sir, I had the unfortunate honor to name it "the law of the apex." It seems to have stuck, and I have written a good deal about it. 35

Q. You arrived in Rossland about what time, Doctor? A. On the 5th of April. 40

Q. And your sole business since has been investigating the matters in dispute in this action? A. I have been continuously in investigation upon



that subject every day, either in the mines on the ground or over maps and so forth and specimens.

Mr. Davis: As we are just at the beginning of the material part of the introduction of this examination, I ask that we not break it in two and take it 5
up to-morrow morning.

Thereupon an adjournment was taken to to-morrow morning, May 3rd, 1899, at 11 o'clock a.m.

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15

ROSSITER WELLINGTON RAYMOND—A witness for defendants, 20
on the stand.

DIRECT EXAMINATION RESUMED.

25

By Mr. Davis—

Q. You have examined the ground in dispute here, Dr. Raymond, and 30
have heard the evidence up to date, and know what the points in dispute in this
action are? A. I do.

Q. Will you please tell the Court fully the conclusions that you have
come to in reference to these matters in dispute and your reasons for coming to 35
that conclusion. A. In my examination of this subject, after having famil-
iarized myself with what had been previously put into the case in the way of
evidence, maps, etc., and pleadings, I addressed myself to three questions, the
same three questions which Mr. Davis stated in his opening, namely, is there
within the lines of the Centre Star mineral claim the apex of a vein; second, is 40
there extending downward from this apex into the Iron Mask mineral claim, a
continuous vein going as far down as the so-called flat fault, and without any in-
terruption between the apex and the flat fault; third, does the flat fault cut off
or destroy the identity or continuity of that vein, or to what extent, if any, does



it affect the continuity of the vein. I have come, as a result of my examination and study of the ground, to these conclusions: first, that there is such an apex; second, that there is such a vein extending from that apex, continuous and unbroken, down to the flat fault; third, that the flat fault does not interrupt its practical continuity or at all obscure its identity. And with the permission of your Lordship, I will take up these three points and give the evidence upon which I base my conclusion in each case, after which I suppose it will be appropriate, because it will shed some side light upon the issues, although in my judgment it is not essentially connected with them, I will give my opinion, as the result of observation and study here, as to the character of that vein, although in my judgment the character of the vein, if it be a vein and be continuous, is entirely irrelevant to the issue in the case. I suppose, however, an explanation of the character of the vein would be relevant as throwing some side light upon the intelligence of my examination and the reasonableness of my conclusions regarding it.

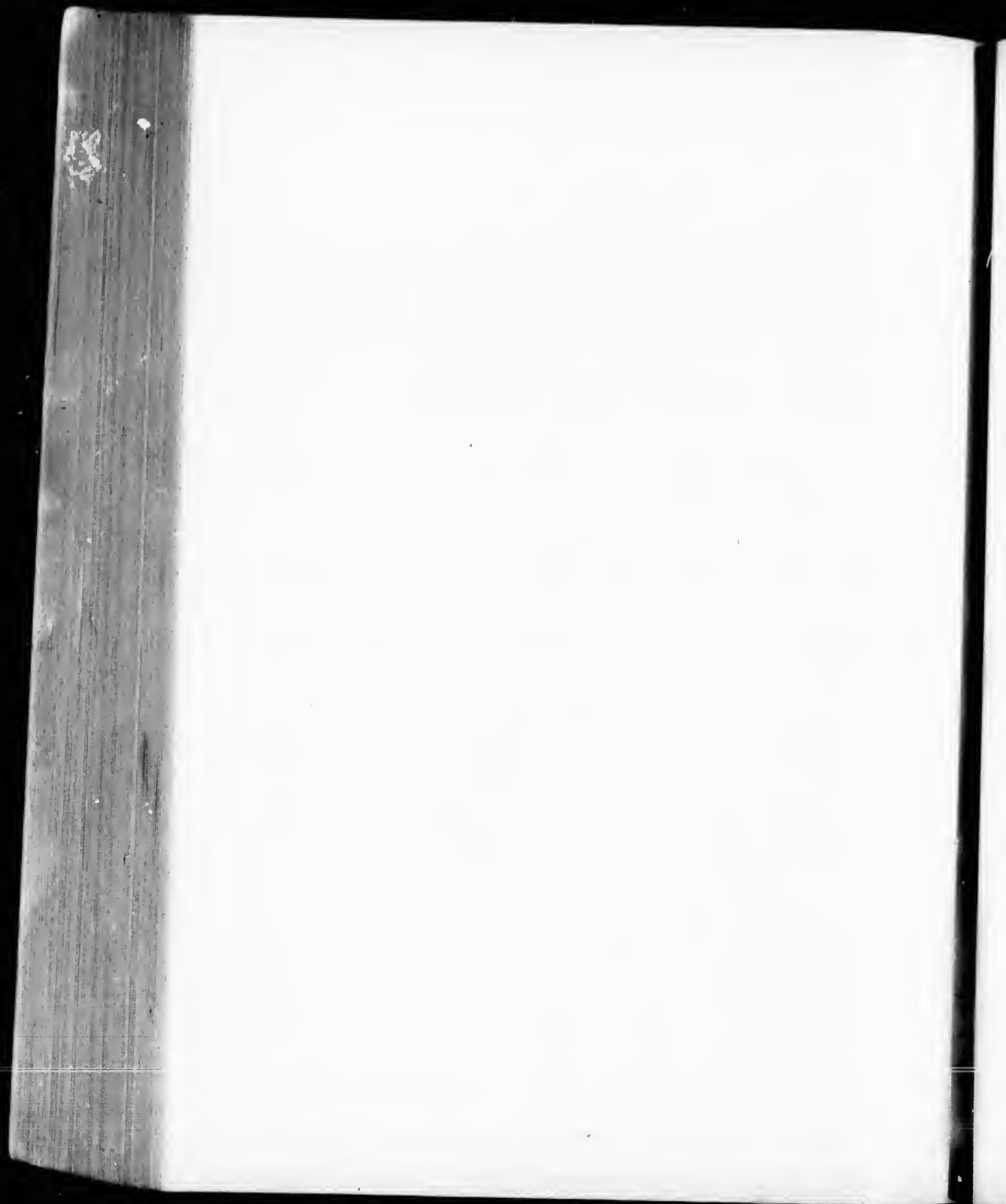
First, with regard to the apex. The existence of such an apex is purely a matter of fact. I have had the lines of the Centre Star claim pointed out to me on the surface, and I have seen also, on the maps which are in evidence and sworn to, and I have traced the apex from 30 feet or 29 feet west of the top of the No. 3 incline shaft eastward to 40 feet beyond the top of No. 2.

The Court: The outcrop. A. The outcrop. An apex is not necessarily an outcrop, but it is better to say the outcrop here, because for that distance the apex is the outcrop. If it were covered up so we could not get at it at any point, it would still be the apex, if it was the upper edge of the vein nearest to the surface; but in this case, by the wrenching which has been done on the surface, this apex is exposed from one end to the other, as a pure matter of fact, therefore, I have found such an apex and traced it foot by foot from the points named west of the top of No. 3 incline shaft eastward to 40 feet beyond shaft No. 2. Now, before I proceed with the further points in my evidence, in the beginning I beg leave to make some explanation of a very rude model I have prepared to shorten and simplify the testimony I shall give. This model is on the table here, and I will presently explain it, but before I do that, I wish to apologize for its shortcomings. I am called upon the stand a week or ten days earlier than I expected to be, and I did hope to have got the material as well as the time to make a model, although I do not think it would make things any clearer, which would have more exactly and completely corresponded in all respects to this model (referring to large model), which is exactly to scale throughout. In the first place, this model of mine, this little pasteboard affair has several drawbacks and deficiencies. The first is that I was obliged in my hurry, in finishing it at the last to take pasteboard instead of either something transparent or something in wood, which I expected to use, by which I could represent the different thicknesses of the different planes. For instance, I have



in this model all the different planes shewn here, this plane (indicating), this plane (indicating) and these two planes (indicating) are here all just alike, the same thickness of pasteboard. That is not true in nature, that is not true in the ground. They are not the same thickness. The dyke for instance, is not the same thickness as the mud-seam, and the other dyke is not the same thickness as the west dyke. The result of that will be, that in representing intersections where both of the intersecting veins, both bodies, are not of the same thickness, as they are not, the representation will not come out in this model with the mathematical accuracy it would as if one was represented as thicker than the other, as was explained by Mr. Lindgren with regard to one of these intersections between the Iron Mask and Centre Star vein; the intersection on the model shows as a short intersection whereas it may be a considerable line running 10 obliquely through the drift; that I was not able to represent on this model.

The Court: They do intersect obliquely anyhow? A. Yes. I will say the model now represents it with that qualification. In the next place this model is incomplete from the fact that it does not come further east than the No. 3 raise on the map which is under the model already in court (referring to large model), and the reason it does not come nearer it is because that is where the workings pass out of the Iron Mask claim and into the Centre Star claim; moreover there was a deficiency of material to carry the model out and represent it, and lack of time, and as I frankly admit, at this time it was not possible for me to represent all the planes around the Centre Star No. 2 shaft where that vertical upraise comes in with the same confidence I can the planes here. And this opens up the disputed ground, the whole length of it; that outside ground around No. 2 shaft I would be very glad to have in the model if I had time to work it out, or if I had full data to know what became of that upraise No. 4 and other features of that ground, and I will discuss them somewhat, with a frank confession of whatever obscurity there is about them, later on. For the present I will say that what is accurate in this model is the dip and strike of each of these planes; here (indicating) for instance, is the outerop, the upper edge of this plane in the model is the outerop, which I have found within the Centre Star claim and to the east of Centre Star No. 2 vein; this (indicating) is the top of No. 3 shaft; the outerop goes down here irregularly, as shewn here on the surface, this is pretty closely drawn to the real topography, and comes over here somewhere to No. 2, which I think does not belong on there; the outerop is shewn here (indicating), the shaft is shewn here (indicating), and this (indicating) represents the average dip, which is 44 degrees, of the Centre Star vein, as taken throughout the whole map, not recognizing or paying any attention to small irregularities, that, reducing everything to average planes, would be another technical defect in the model, which could be remedied only by a very careful, elaborate and long continued construction, copying every irregularity found under the ground by surveying. For the purpose of my explanation, it is quite indifferent to me, I can get along just as well by presenting to



your Lordship plans which have been reduced to average as found by surveys. Now this plane which runs north 88 degrees east, a horizontal line here (indicating), in which it is the apex—

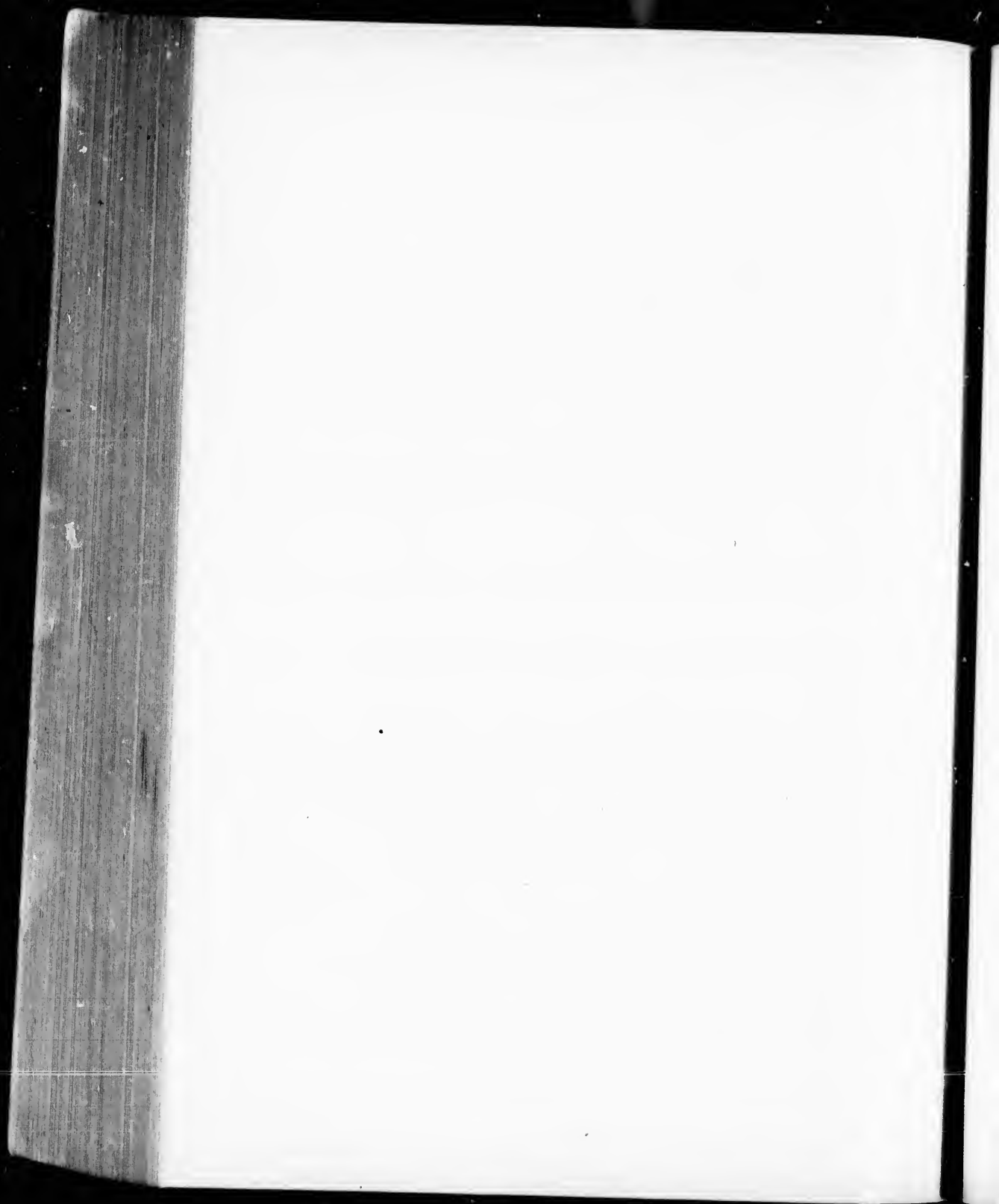
The Court: I understand, the incline. A. The absolutely true course of the vein is shewn by the level line in it, but the drift in it would be north 88 degrees east. The course of the apex, as long as it goes down hill, will constantly make northerly, and therefore it will be further north, has the appearance on the surface of being further north—the course of the apex on the surface is a little further north than the true course of the vein, which is 88 degrees east, and the dip is 44 degrees north. Now, before I proceed any further with that, I will simply say that these two bodies here in pasteboard at the right and left hand of the model, this was set up to represent a dyke which crosses at No. 3 raise, and this (indicating) was put up intended to represent the dyke at the other end. I shall try to have it changed so as to bring it to here (indicating), because this edge here is the real position of that dyke.

The Court: West of shaft No. 3. A. West of shaft No. 3. The gentleman who assisted in making this model thought I only wanted this (indicating) as a support, and that I would paste on below, but it ought to be considered as coming to this point (indicating). The exact position of that then, is not correct. Now, commencing with this apex, I followed down this dip to the No. 3 incline shaft to a point 303 feet, I think—well, the point of the 59 east drift, and I found down this shaft all the way, in both sides of the shaft, a continuous body of solid pyrrhotite, chalcopyrite and pyrite, with some calcite, a good deal of quartz and silica. The body has a sharp definition immediately at the top of it; that is, this massive ore is almost all the way sharply distinguished from the layer of the next rock, whatever it may be, coming above. As near as you can get at it, the shaft did not go so as to disclose the foot wall or foot body of that solid ore, talking about larger bodies at present, but I followed down the solid body of continuous ore of that character to that winze, in both sides of the shaft, until it strikes the dyke, which has always been mentioned and spoken of here, and after that in the right-hand side of the shaft, at this point where the dyke is struck, the body is notably large, four feet or something more than four feet in thickness. That is a point which I will come back to afterwards.

The Court: Do you mean depth or width? A. I mean thickness.

The Court: From the top of the shaft down. A. Consider it as in the shape of a blanket laid down.

The Court: Do you mean from the roof of the shaft to the floor of the shaft? A. No, sir; from the roof of the ore to the floor of the ore. The shaft is six feet in height and the ore does not fill the whole wall of the shaft. I



also followed the seam horizontally without a break of connection, the same body of solid pyrite, pyrrhotite, chalcopyrite, quartz and calcite, through the 59 east drift, the green drift, to the head of the winze in which work is now being done. I have also followed the same body down that winze to the flat fault, where it is intersected by the flat fault. This gives me a continuous, irregular line, a broken line, in the plane of the vein, if there be such a vein. It shews the dip here, it shews the strike and dip there, and it shews a further dip—

The Court: The strike and dip to the winze? A. Excuse me. It shews a dip in the shaft, a strike and dip also in the drift, and a further strike and dip in the winze. I consider that that exposure alone is conclusive as to the second question, namely, that there is a continuous vein from this apex to the flat fault, without investigating any other point. At the same time, I will now enumerate the various other collateral evidences corroborating this, which puts the matter, in my judgment, mathematically beyond doubt. And in the first place I find, in continuing into the region below, further evidences on the same plane and continued down—

The Court: Below what? A. Below the mudseam. I find further evidences—

The Court: In the winze? A. In all the surveys, in all the workings, wherever this seam should come, there I find it with ore, although the continuity of that ore may or may not have been shewn, whether it is shewn at any particular point to be continuous ore or not, I find it as it ought to be as this plane goes on down, but as I am now speaking of the plane above the mud-seam, I will simply say, that coming on further to the east of this model there are other corroborative appearances of ore in the continuation of this same plane, and when it comes to any point which has been intersected by the workings of the mine, where this plane continued on to shew in the mine workings, this vein, there it is, within a very few feet, within a distance of probable area quite covered by the difference in the thickness of these pasteboards, and by the local variations in the dip and strike of the vein. The only exception to that would be away over just to the west of shaft No. 2 where there is an apparent bend or change in the course of this vein, which affects the dip, and which would have to be shewn, if I shewed it at all, by buckling this pasteboard a little and not leaving it perfectly straight. Otherwise I must say, according to my experiences, it is a very remarkably regular fissure; I could hardly be able to cite a fissure which for so long a distance comes out so true to the geometrical calculations, so that a man could prophesy where he would hit it and then go on and hit it.

Now, we have in the other planes shewn on this model, the Iron Mask vein. This is shewn correctly at the surface, at which there are one or two points of



outerop which I have not examined. I know it comes through to the surface at the top of this stope, or nearly the surface, there being a small shaft there on the vein which drops right into the stope. I know the position of the Iron Mask vein by the position of this stope, and you see I have drawn here upon this plan the Iron Mask east drift for the distance which it runs upon that plane; this is the drift (indicating on large model); from this point the Iron Mask east drift is shewn here in the model. 5

Q. In the red level? A. In the red level. That drift is run in the Iron Mask vein. I do not say that now and then there may not be more or less of the vein which is irregular, it is not mathematically correct at all points, but the vein is there on the Iron Mask vein and runs through the dyke; and at this point (indicating) it proves the Iron Mask vein by the stope which goes clear to the surface and ends in that shaft. Therefore, I have proof of the position of that seam or plane. I have the proof in this level (indicating), and I have the proof in the outerop and shaft, so that I can fix both the dip and the strike of the Iron Mask, and when I have put that into the model with the proper dip and strike, I find that it intersects with the Centre Star No. 2 vein, as your Lordship said the other day, like the sharp prow of a canoe or boat. That is to say, they agree to one another in strike and agree to one another in dip; this dip (indicating) I have taken at 70 degrees, which I believe to be the average dip as it runs from 68 to 72 degrees, and assuming this (indicating) to be regular in dip and strike, and this (indicating) to be regular in dip and strike, and assuming the necessary form and thickness I find only this line of oblique intersection between them; and the question is then at once, if my observations are correct, what workings of this mine or in this ground, ought to intersect that intersection, and where. Over here (indicating) is the Iron Mask east drift on the Iron Mask vein, starting from the top of the Iron Mask east winze, started on that vein, follows on that vein, and according to the prophecy of this model, after putting it together, after putting these two veins in their proper positions, according to the prophecy of this model, when that drift gets to that point it ought to strike the other vein somewhere about there (indicating), it ought to strike the other vein, and beyond there if it is continued on that vein, it ought to take a little dip to the north, according to the model. Now, if your Lordship will look at the model, I will shew you how it happens. Here is the Iron Mask east drift which starts from the dyke, close up against the dyke and close up to the head or top of the Iron Mask winze and it is run wholly on the vein as is shewn by the fact that you enter directly from it into the stope: it continues on the vein until it comes to that point there (indicating), until it gets there, and there is the point where the intersection of the Centre Star begins to come in; it continues for some little distance along; there is a winze there which is indicated on the map below the large model; there is the winze (indicating on large model); that winze is sunk on the Centre Star plane and your Lordship will see that from this point— 10 15 20 25 30 35 40



The Court: Let me ask you this: would it not intersect as I understand it, or might it not intersect, out here somewhere, or to intersect more rapidly this would have to be turned this way (indicating)? A. It has intersected there.

The Court: It has intersected there? A. It has intersected at the vein. 5

The Court: That is, drawing an imaginary line here, from this point to this point, and that represents here the Centre Star vein (indicating on model)? 10
A. That represents the Centre Star vein, but I have not discussed the particular dip of the vein at that particular point; that is outside of my model. I call your Lordship's attention to the fact that the lower part of No. 2, that this upraise here on the vertical vein, is not a safe distance to take the dip of the vein, to get the data for the concessions I am making. I will discuss that afterwards. 15
I do not think it hurts anything, but I do not want to put a surface in there as part of that plane. The point is, that west of that region, west of the dyke crossing No. 3 upraise, there is this regular position of the planes, and according to this model that Iron Mask drift must intersect the Centre Star planes, and that plane must intersect the Centre Star plane in that Iron Mask east drift 20
just at the point under it here in the map, which is the one I shewed your Lordship in the red level; and from that plane on that work is still going on and this winze was sunk all as you see, on the Centre Star plane and the Iron Mask vein has gone away under it, keeping its own direction; it has gone east into the right hand side of the drift. 25

Q. You mean keeping its own direction before it comes to that elbow?

A. Yes.

The Court: And keeping its own direction it will run out here and intersect there? A. That is what it does exactly. But this pasteboard is too thin 30
to show how long it would take to do it. The two veins are together for some little distance on the drift, still, the Iron Mask vein is cutting across the Centre Star shaft. And I claim that that coincidence, when I have put those planes together with the proper dip and strike, which is all I started with to assume— 35
measuring these dips and strikes and surveys, putting the two together with the proper dip and strike, and then following that drift on it, I find it ought to connect with this drift at that point, and on going to the surveys I find it does. This I call corroborative evidence; it is the second point; it is like checking the survey. 40

With regard to the Centre Star and Iron Mask planes, which I have now described, there are three intersections of those planes. Of course, there is one intersection, as your Lordship will understand, which really runs right down



through here, through this model, obliquely, the most oblique line in the model, and comes out below; but there are three intersections made by that, or by the workings of the mine; that is, there are three points where the workings of the mine shew it; one I have already shewn where the drift crossed it, and it must shew in there. The second is in the Iron Mask east drift No. 69. That is this drift under here, the yellow drift No. 69, and it is the one to which our winze is coming through, the very place where the work is now being done as ordered by your Lordship. In that place also the two veins according to the survey, ought to come together—

The Court: Ought to intersect? A. Ought to intersect; one ought to cross the other. There is the line of intersection; it comes right through that east drift 69, and as a matter of fact, when I go to that drift and to that spot, there it is. That is another corroborative evidence of the accuracy of the planes which I have drawn. If those surveys are accurate, they do not contain the planes, but having once fixed the average planes and then set them over the map and then painted upon them exactly according to the map beneath the sections of the mine workings—a plan of the mine workings—wherever I find there ought to be an intersection there I find there is one. The third place of intersection between the Iron Mask and the Centre Star veins is in the blue drift down here at the bottom. That would come out here except for the difference in thickness of these things. The trouble is here, that could not be painted exactly; it should have been painted on the other side where it could not be seen, and therefore I had to put it here. As a matter of fact, they intersect in this winze. And then as was the case up here, the Iron Mask vein takes some time to get through because of the thickness of the other, and the result is that at the bottom, as I will have to shew you on this model (referring to the exhibit model) at the bottom the Iron Mask is seen just below the intersection; the intersection is over the bottom of the winze, and the Iron Mask vein is not visible in this blue drift anywhere, except at the very west end where it goes flat up against the dyke; then the Centre Star vein is shewn for a very small interval scarcely amounting to an interval—they are almost together, just separate. That comes out here and this cross-cut is right across the Centre Star vein and cut across there. The Centre Star vein is shewn here and the foot wall of the Centre Star vein is shewn in this cross-cut to the south; and in my opinion, the Iron Mask vein would be shewn a little beyond it, not far, but a few feet more beyond if that cross-cut were extended to cross it, but that has not been done.

The Court: What is the number of that cross-cut? A. It is 73 on the blue drift.

The Court: On Iron Mask drift 71, is it not? A. Yes, I suppose so. The cross-cut is at 73.



The Court: Iron Mask east drift No. 71, and then from a cross-cut in the centre of that southwards? A. That is it. And in that cross-cut the foot wall then separated; the other vein is still farther in now. The Iron Mask vein which was in front, or north, has gone through and come out in the south, and the cross-cut there will shew it. The cross-cut in here would if carried through 5 where it has already gone through the back of this one, through the foot wall of this thicker one, and if carried a little farther up, I have no doubt it would cut the plane of the other. So much for the intersections of these two planes as proving the correctness of the assumption of the position of this vein.

The Court: You had better mention the planes. A. Of these two planes as proving the correctness of my assumption of the existence and position of the Centre Star No. 2 vein. But there is another evidence, namely, from a point unquestionably in the plane of the Iron Mask, because it started 15 from the stope in the Iron Mask, a cross-cut was run which has been called the brown cross-cut and run as shewn in this model, and as shewn in the other model, to the south, and at the point where this plane should be intersected if it existed——

The Court: The Centre Star vein? A. The Centre Star plane and 20 the Centre Star vein should be shewn if it existed, at that precise point it is cut by this brown drift. It is 20 feet from the point where this cross-cut strikes the Centre Star plane, to the side of No. 3 incline at that level. And at both ends of this 20 feet a very large heavy body of pyrrhotite is visible.

The Court: Of the brown cross-cut? A. The brown cross-cut; there is a heavy body of pyrrhotite at the other end of the 20 feet inside of No. 3 shaft. I declare it to be my opinion without any doubt whatever that those two bodies belong to one another. They have the same dip, the same strike, the same characteristics and approximately the same thickness, although you can not tell 30 about that positively, because this drift may not have gone through the entire thickness of the body. The indication of this drift is still largely in solid drift; but I hold that corroboration is of a most remarkable character, and taken together with all the other intersections of this vein of the Iron Mask with the 35 Centre Star vein, amounts to an absolute demonstration of the existence and persistence and general uniformity of dip and strike, and general uniform character wherever exposed, of the plane containing the No. 2 Centre Star vein. But that is not all. We have next to observe the intersection of the Centre Star vein with flat fault.

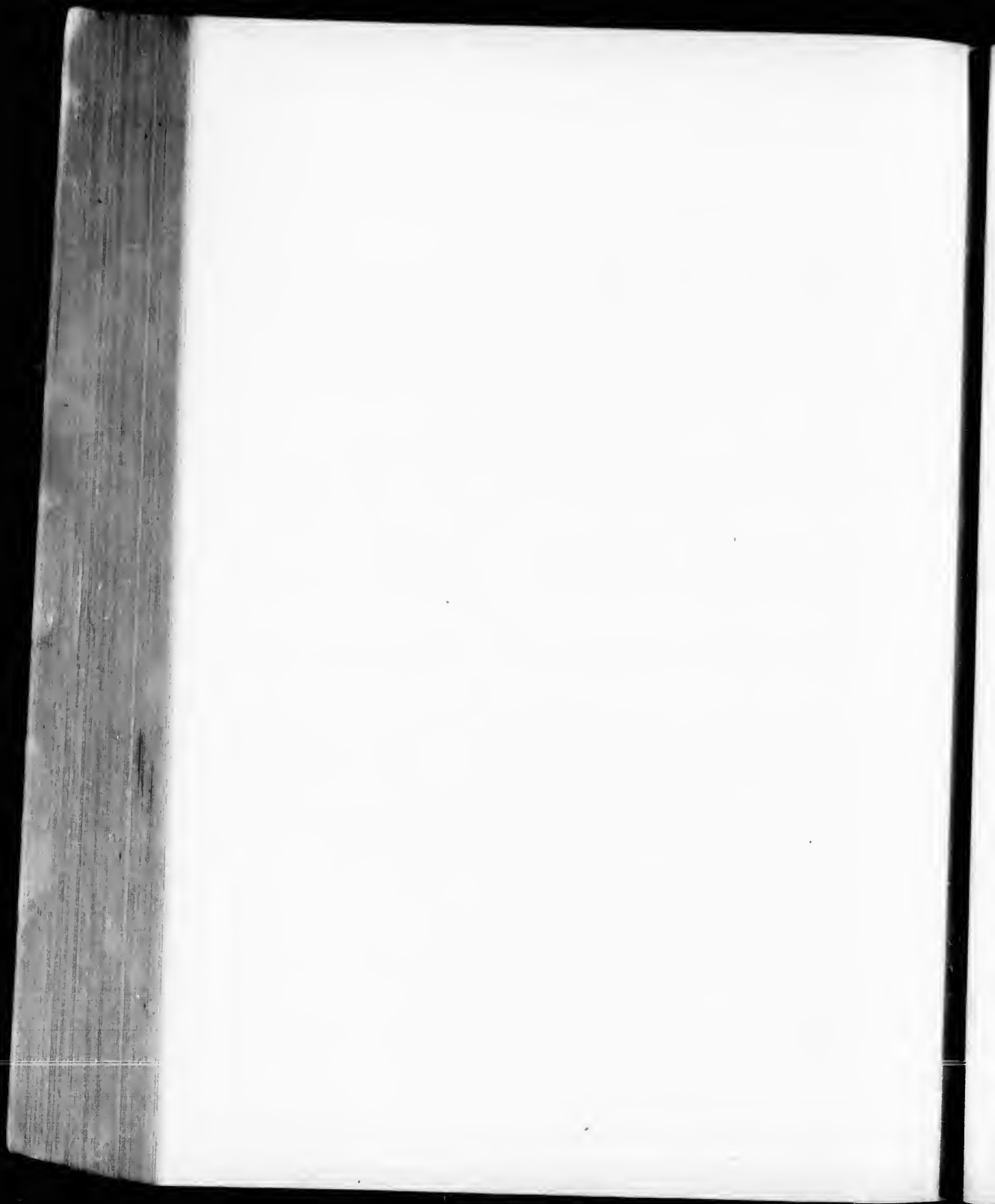
And first. I am not speaking now of the condition below the flat fault; I am simply demonstrating the existence of such a vein, and I have demonstrated it by shewing that it is found wherever it ought to be found according to the

theory I stated in regard to it, and according to the dip and strike I have given to it, provided the point has been exposed by workings of the mine. And I am willing to stake my reputation upon it, that at any point between these two lines—not in the disturbed eastern ground and not in the disturbed western ground, which I do not pretend thoroughly to understand—but between these— 5

The Court: Between the points of the outcrop? A. Between this dyke and the other dyke. I do not take in No. 2, because the bottom of No. 2 is doubtful, as I shall explain hereafter. At any point between these two, any exploration that either party may make in this case will everywhere and always inevitably find these two planes approximately in the place where I put them in this model: the plane of the Centre Star and the plane of the Iron Mask. The same is true with regard to the plane of the flat fault, which has no significance in this case except as a third way of riveting the theory. And the more planes there are that intersect the more chances you have of having some intersection shewn in the mine, and the more chances you will have of having some of your errors corrected. But in these planes in three different exposures— 15

The Court: You mean the Iron Mask? A. In these Iron Mask planes in three different exposures of intersection, it corroborates that theory entirely as to that, as to the Centre Star vein. If this vein corroborates in three places by actual exposure in the mine the theory of the position, direction and relation which it bears with regard to the Centre Star No. 2 vein, then the probability that we are correct as to the Centre Star No. 2 vein is raised to a very high degree mathematically. The three coincidences carry it to a point at which it almost amounts to mathematical certainty, because you cannot change planes in spaces if you have fixed three points. You could if you only had two points; but if you have anchored it at three points, there it is. Now, in the way of superfluous corroboration we take this flat fault. And first, as to how we come by its position. The flat fault is encountered by the Iron Mask tunnel, which starts from the gully here on the red level, and goes for a long distance without traversing any country. 20 25 30

The Court: Commencing at the east end? A. At the east end, starting at the portal at the east end and goes for a long distance without traversing any phenomena necessary to this case. There is a vein very near the portal. There is a shaft goes down upon the vein; farther along there is a cross-cut to the north, which I understand intersects a vein. Still farther along there is a cross-cut to the north, which I understand is intended to intersect a vein and at points farther east there are said to be more little veins, all of which with one casual exception I have not seen, certainly I have not examined, and I do not believe they belong in the case. 35 40



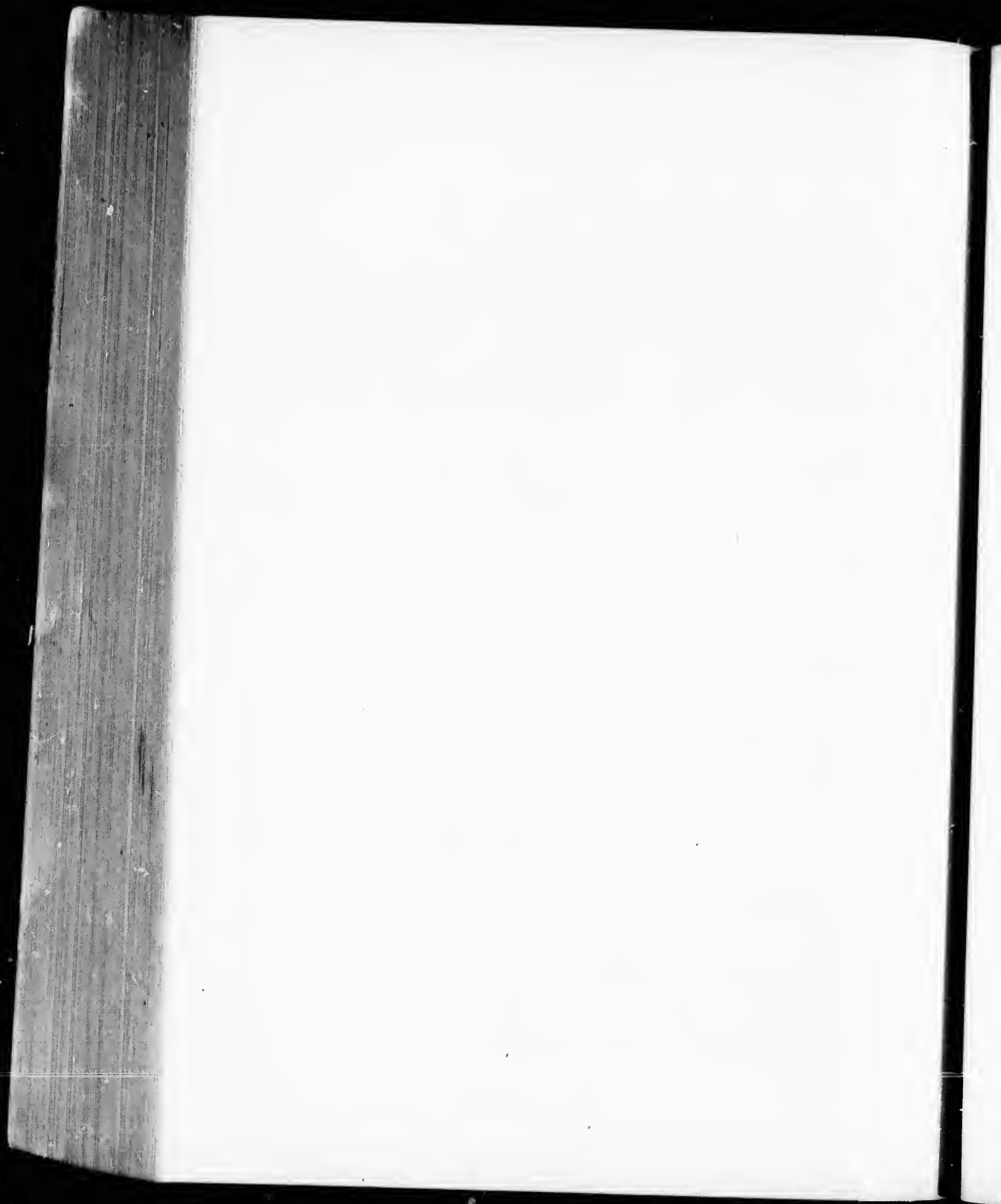
The Court: What is it farther west? A. Another vein which, so far as I know, has not been mentioned in this case; away out here in this ground (referring to the model).

The Court: You pointed over this way as being farther east. A. Further west, I mean. This was from the first cross-cut to the north end in the Iron Mask tunnel, the second cross-cut in the north to same distance beyond, 100 feet or more beyond, that Iron Mask tunnel is simply traversing country rock. There are dykes and interesting things there, but they have no bearing that I am aware of in this case. However, at point 45 in the Iron Mask tunnel, that tunnel strikes the water-course or mud seam or flat fault; I think flat fault is a very good name for it. It strikes and continues in the flat fault from that point until it reaches the dyke—the dyke which comes through on the west of No. 3 shaft. The flat fault runs up to that dyke.

The Court: At what point is that? A. No. 47 on the Iron Mask drift. From 45 to 47 that drift follows the water seam; it is on it; and you see the water seam all the time in one part or another in the walls or roof of that drift. Then from 45 for 60 feet farther east the drift is also on the water seam. I know nothing of the history, your Lordship, of this part of the work, but to a miner, to a mining engineer, it seems pretty evident that in running through the country here and finally striking upon an immense seam like that water seam, and possibly getting some assay here and there upon it, it was run upon it in the hope that it would prove to be a vein—a mineral vein of value. It was not, apparently, until it had been run upon and cut off by the dyke that the cross-cut to the south at point 104 was run, which intersected the real Iron Mask vein. That, however, is only the way the workings look. Meanwhile from 45 this tunnel or drift was run, not only on the flat fault to the west but also 60 feet on the flat fault to the east.

The Court: By the Iron Mask Company? A. From point 45 in the Iron Mask tunnel. At this point 60 feet east from 45 a small cross-cut of 10 feet or so is run to the south.

The Court: At the point marked "X?" A. At the point marked "X" a cross-cut was run to the south to catch the flat fault again which was lost at that tunnel there, out of the tunnel just before the cross-cut, near the cross-cut; and it is so lost by reason of the dyke which crosses at that point; and which has been testified to both by Mr. King and Mr. Lindgren as having faulted for several feet at point "X." Literally I think the dyke is a little short of the point "X," but that is of no consequence here now. That is the dyke at the right hand side (referring to his model), this is the limit as given to my model from that point to this one, some 100 feet. What I am after now is to shew



your Lordship the evidence on which I fix the position of this third plane with which I am going to check the intersections of the other two. I proved conclusively the position of the first, namely the Centre Star No. 2 vein. I have thus a distance of 225 feet from 47 to 45 and 60 feet from 45 to "X," or 245 feet as a total length of Iron Mask workings run in the mud-seam itself, or following it, holding it all the way. 5

That would naturally shew me the strike and to a great extent the dip of the mud-seam; I think to a great extent, because the workings may be, perhaps, 7 feet square—7 feet high, 7 feet wide, something like that—and the mud-seam 10 is in the corner of the drift, at the right hand upper corner as you proceed west, and appears again in the lower corner, or half way up; in the lower right hand corner, or half way up the left hand side you can get a dip there—it is a local dip, because the distance is not so great as to make you perfectly sure that it is going to be maintained—and may be a local variation. The truer way of getting the general dip is to survey, of course, from points, and include points 100 feet apart; when you get it as far apart as that, then you begin to know where the dip is; but these local dips, which are liable to error of one to five degrees, being taken on the average, and particularly the local dips along this Iron Mask tunnel, have been taken on the average. I assumed upon the strength of that 20 a certain dip and a certain course of that flat fault, but I put it in the model with that dip and course, namely, north 80 west for the course, and 33 south for the dip. (I think perhaps that strike is given on my model incorrectly, but I will not stop now to change it; I will have that looked up and corrected.) The difference in strike is not very great between the mud-seam and Centre Star No. 2 as 25 your Lordship will see; and for that reason the intersection of the mud-seam with the Centre Star vein is very nearly level. That is an error (referring to lettering on his model), but I will fix that afterwards. Now, taking that mud-seam, that is not the only evidence of the mud-seam. The mud-seam is exposed at 11 places in these workings. I will enumerate those places. 30

In the first place there is 225 feet of it exposed right along continuously in one drift, in the Iron Mask drift on the water-course—what is called the water-course drift. Then there is 60 feet to be added to that which is backward exposure; so there is 265 feet. Then, in the Iron Mask winze 24 feet below the tunnel it is shewn again. There is the winze coming down from this tunnel 35 here, and you will notice, your Lordship, here are two tunnels in the same level; one is the tunnel in the water-course; the other over to the south of it is a tunnel run in the Iron Mask to here, and from there switching over onto the Centre Star. They are shewn right here in this model; here is one of them; there is 40 the other. You see in all my planes the plane of the Iron Mask which comes down through them. The other plane or planes of the water-course goes through that (indicating on his model). And consequently if that is true this Iron Mask drift on the water-course—the water-course as shewn in the Iron



Mask drift on the water-course—must intersect that vein about 24 feet from the top; and we go there and there it is. Both sides admit that by their affidavits.

The fourth point of intersection is at the bottom of No. 3 shaft. This mud-seam if it is correctly placed in our No. 2 Centre Star vein, must cut the bottom of the shaft. There it is, sworn to by all the parties in the case. 5

The next place, the fifth intersection, is in a Centre Star east winze where it cuts the Centre Star No. 2 vein at the bottom. That is the winze that we are working on now. It comes down here, comes through here and is to be considered coming through, and should, as will be seen, cut through the mud-seam, has cut through the flat fault, and then continues down on the plane of the Centre Star east drift No. 59. That is what we call the east winze—the critical winze. 10

The Court: Yes, that is a good name for it. A. The sixth point at which the mud-seam is exposed is in the Centre Star north drift at station 38 to 39. That I do not think I can shew on my model; it is under here; but I will shew it to you on the map at the base of the model. Starting from where the mud-seam going down intersects— 15 20

The Court: That is at what number—I want it indicated in the record. A. Between 38 to 39 on the Centre Star north drift which has been testified to by both Mr. Lindgren and Mr. King. 25

The Court: And then beyond, that would be on the west side of the winze, the west side of what you call the critical winze? A. Station 39 is here, a little bit west. 30

Mr. Bodwell: I do not like to have that term used, your Lordship. 35

The Court: I used it only because he makes use of the term descriptive of the winze in dispute.

Mr. Bodwell: Unless Dr. Raymond is very much wedded to that term I would prefer he used some other. 40

The Witness: Not at all, not at all. It is the winze now going down on the Centre Star No. 2 vein.

A. (Resuming his answer.) This is the point underneath that drift; a little north of and directly underneath it. It is shewn between stations 38 and 39. It is in that region that Mr. King and Mr. Lindgren both testified to a body of pyrrhotite. Mr. King said he did not know whether it belonged in the Centre Star vein, or was a body lying just below the foot wall, or whether it 45



would be inside of the foot wall of the Centre Star vein. It is right there, and it is not in the direction of the dip from the winze at the plane of that winze of the Centre Star vein continued would go.

The Court: What is it you mean to tell me then? A. I mean to tell 5
you that at that point I see the mud-seam again. It is another revelation of the mud-seam, and it has cut through this body of pyrrhotite, which I will discuss afterwards when I come to talk about the effects of the mud-seam. I am now only pinning the position of the mud-seam in space.

The seventh exposure is in the Centre Star north drift in the No. 3 raise. 10
That is the point here, which I do not think is shewn on my model at all, but it is marked here as raise No. 3; and the raise west of station 43 on Centre Star north drift shews the flat fault again.

The Court: That No. 3 raise is the raise from here (referring to the 15
model)? A. The raise was made from there, yes, your Lordship, and it goes up about 20 feet on the incline of the Iron Mask vein.

The Court: You might as well have shewn it there if it exists. A. I 20
do not know why it was not put on the model. Everything seems to be a little late here. It is shewn there and it only makes a total distance, I think, of 14 feet above the roof of the tunnel, or 20 feet altogether.

The Court: Well, I see that it appears to be a prominent point with you. 25
A. Yes, it happens to be, because the dyke comes through right there and faults this country.

The Court: What I mean to say is, it is a disadvantage to me whichever 30
way the case goes, if these points are not shewn actually as they are.

The Witness: I should think, with your permission, that could easily be 35
remedied.

The Court: Yes, you can put anything on the plan you like. I will come 40
back to that by and by and will probably ask a good many questions there.

A. (Resumed). The ninth exhibit of the exposure of the mudseam or flat fault 45
is found at No. 4 raise; and it also crosses the No. 2 shaft; that is the tenth. The eleventh is found at point 48—point 47 in the Centre Star north drift where the mud-seam is visible and faults the Iron Mask. I have not stated in regard to this eleventh point of exposure what the mud-seam does at each place, because 50
that belongs to the next question. I have simply gone over these points, and I will take them up again from another point of view to shew that at eleven places I have fixed the locus of this mud-seam and therefore I know where it is.



The Court: Of this flat seam? A. Of this flat seam. The places I have been discussing—I began with discussing the Centre Star No. 2. I then shewed my proofs of the position of the Iron Mask planes. I have now furnished my proofs of eleven points absolutely fixed by survey of the position, 5
dip and strike of the flat fault.

Now, I will proceed to point out that wherever the flat fault has intersected the plane I have established for the Centre Star No. 2, it is just where it ought to be according to the survey. This flat fault going through the country 10
is exposed in intersection with the Centre Star No. 2. In the first place it intersects the Iron Mask in the Iron Mask east winze already shewn. Then it intersects the Centre Star at the bottom of No. 3 just where it ought to if this theory be correct. Then it intersects the Centre Star east winze—the uncritical winze—at the bottom just where it should according to its known regularity 15
and the regularity of the Centre Star No. 2. Then it intersects the Centre Star again in the No. 2 raise and in the No. 4 raise and in No. 1 cross-cut south, which I have not mentioned before. I think I have shewn it in 48, but in No. 1 cross-cut south it is again seen intersecting the Centre Star No. 2. That is the No. 1 cross-cut south from the Centre Star tunnel. Where the Centre Star vein 20
crosses that south cross-cut No. 1 it has been drifted upon for 30 feet, and during the course of that drift and at the intersection of that drift with the south cross-cut the flat fault is very clearly shewn.

The Court: Why not shew that drift on the model? A. It has been 25
done since the map was prepared and the suit begun. When I first went in it was only about 10 feet long. I have a larger drawing which I compared underground and I think it ought to be put upon this map: If we were not going to adjourn immediately we would have a great deal more to put upon the map.

The Court: Well, I want information, and undoubtedly they will give 30
me a great deal in the way of models. A. This particular south cross-cut has been continued a distance of 130 feet farther.

The Court: I would like to have that laid out on the model. There is no 35
difficulty about that, Mr. Davis?

Mr. Davis: Not at all.

The Court: Let the gentleman who plotted this lay it out.

The Court: The only use is to prove where the flat fault intersects, the 40
general course of it. A. That is all the use I have so far made of it.

The Court: That does not prove enough to affect one side or the other.
A. Now, that is a collateral evidence of intersection with the Iron Mask vein,



and of intersection with the flat fault, which checks and proves absolutely the correctness of the position I have given to this. I assume that it is utterly impossible to make 20 such coincidences if you do not have a plane of real existence. I say it is utterly impossible to have 20 such coincidences as are given by the intersection of the Iron Mask vein and flat fault with the Centre Star No. 2 vein unless the Centre Star No. 2 vein exists. 5

That covers my answer so far to the second question, whether there is a continuous vein, having a definite dip and strike, down to the flat fault. First, there is an apex. Second, from that apex there is a plane, with a definite dip and strike, continuing down through the flat fault, and it carries ore. The third point is: What is the effect of the flat fault upon that vein? Does it destroy its continuity or not? The flat fault is a fault. It has great regularity, and that is one proof that there has been movement upon it. There are other subordinate proofs that there have been movements upon it. But the existence of slickensides and of striations, such as have been shewn and such as I have seen under ground, and such as have been mentioned in court, are not proof of extensive movements; quite the contrary. Extensive movements will not produce them. They often occur along fissures, flat fissures, upon which there have been an extensive movement, but the extensive movement did not make the slickensides or the striations; it was the last end of them that did it, it was the little movements with which it wound up. If anyone thinks he can produce striation except by small amount of movement backward and forward, if anyone thinks he can, I will say, in any way, polish except by polishing in the same way as our ancestors have done and as we do, he had better try it. There is a different kind of corrugation and a different kind of striation produced by large movements, and a mining engineer knows the difference underground. So far as slickensides and small striations are concerned, such as has been exhibited here, and as I have found very beautifully developed in the mine, they are to my judgment always and very certainly, without any doubt whatever, produced by very little and even infinitesimal movements. As a proof of that I will cite to your Lordship that the finest I have ever seen—I was for a number of years in charge of anthracite collieries—and the finest slickensides I have ever seen came from the heart of undisturbed coal seams, where the roof and floor had not been broken through, and the slickensides were in there up and down, at right angles of the roof and floor. There was not a chance for any movement more than a very minute vibratory movement, with running water on both sides and the pressure, to polish on both sides the faces exposed. Consequently, I can't tell when I see these slickensides and striations whether there has been big movement or not, because they are only the last performances, and there might have been large movement before, winding up with such final vibration afterwards as to produce those places. They are no proof of large movement whatever. I must, therefore, look for other proofs. The other proofs are found by measuring critically definite dislocations, and those you can only determine in 10 15 20 25 30 35 40



the mass of rock like this eruptive rock, when you have dykes or veins or planes of some kind crossing that rock, upon the dislocation of which you can measure. If that flat fault had gone through a solid mass of this green stone country or that cyanite country, and there had not been any dyke in it and no vein in it you would never know whether it had been faulted or not; you could not tell because the matter is so nearly alike that you would have the same looking rock on one side as on the other. But, if those sort of seams or planes or geological signs crossing that rock and intersected by a flat fault, then you can measure your dislocation.

The Court: For instance, dykes or fissures. A. For instance, dykes or fissures.

The Court: At right angles to them, or at any angles to them? A. Yes, sir. We can almost measure it when any fault fissures has crossed through sedimentary rocks. Of course, sedimentary rocks may alternate, limestone, sandstone, clay, slate and so forth, and each point is likely to have a little different color and some planes usually as we cross, that the rock has been shoved, because we come across another horizon ended up in eruptive rocks, and the only measurement that we got would be some well established planes. Now, those are well established planes. This plane has been established by many exposures, the Iron Mask, and the Centre Star plane is established, this dyke is established, and the other dyke is established, the east dyke, the vertical dyke—what is called the vertical dyke—on the west of the No. 3 incline is established, and what is called the double dyke running through by the side of No. 3 raise in the Centre Star tunnel is established. Moreover, there is a small dyke established which runs down at the east end of the winze from No. 59 east drift, the winze now sinking. That dyke is recognized, established, seen at the surface near the railroad cut, and it is also intersected by the flat fault. We have therefore six different planes intersected by that flat fault, and we can steady it down to each one of them. They run in different directions. They are not all different planes, when you meet it, that is, the Iron Mask is one, Centre Star is two, the vertical fault dyke is three, to the west of incline shaft. The double dyke near No. 3 upraise is four, and the little dyke in the winze is five.

The Court: Which winze? A. The little dyke in the winze I have mentioned from No. 59 east drift down, at the right hand side of that winze, your Lordship will remember. The order of this court permits them to break through it.

Now, in all those intersections which I might specify more in detail, but I say in general in all those intersections, I think without exception, we are able to find the vein or the dyke or whatever it is that was intersected continuing underneath the flat fault; and we find it continuing in nearly all of them clearly



faulted. It is not as though you could not see any fault. We can generally see a fault. We can almost always measure it; sometimes there has been a difference in opinion among our experts as to the exact extent of it; those differences have never ranged over a few inches, less than a foot. But your Lordship will understand the difficulty of measuring such a throw sometimes is, that you recognize what you think is a certain wall in it, or a certain plane or streak of ore above the fault, and you try to find it again, and you find it below, and you say it is 6 or 8 inches, and another man says no, it is 12; it is according to their views. But in no case has the throw been great enough to dislocate the ore on itself, if it was a vein, or to dislocate the dyke beyond itself if it were a dyke.

The Court: Therefore the dislocations would not be complete there. A. That is exactly what I mean, your Lordship.

The Court: Now, that is the case, not merely on one plane which of course might deceive us, because the motion might be in such a direction that it would not shew on that one plane. A. A dyke might be dislocated by a fault coming down the vertical dyke, might be coming down and dislocated by a fault coming through it and moved directly up in the direction of the dyke itself, so that it would not shew any dislocation afterwards. Just as if I take these two books, if that were a book, and the throw should come down between the books and this book should slide up without any change, you would still come to this everything the same, and you would not know that it had slipped on itself, without any lateral dislocation at all. For instance, if this evidence only concerned the intersection of the flat fault with one plane, I should say I could not tell, but when it has intersected not only with a plane in that direction (illustrating), but with a plane running at right angles and obliquely to it, and all of the intersections shew a small dislocation only, then I have a moral certainty—a mathematical certainty—that the total movement upon that fault was small. Put this result in another way. Rather, to answer a criticism which may be made—which I believe has been suggested in former days in regard to this place. It may be said that the apparent continuation that I have found below this mud-seam at every point where it intersects either a vein or a dyke, the apparent continuation immediately below, a few inches out of the seam which I find is only apparent—a phrase used by Mr. Bodwell the other day and struck me as very felicitous. He said that he would be able to shew your Lordship that the apparent continuity is not real. That is just the point. Now, how do I know that the apparent continuity is real? I think that goes right straight to the ground of my opinion. If we take, say, 300 feet here, and if we take, say, three feet for the zone that I have of ore, not speaking about which is the vein at all, but the plane of ore; take three feet, in 300 feet, there would be 100 positions. They then could take each of them three feet, and if I should shove it along then another vein inch by inch, that space, by a fault, the chances that that other vein would come right over this one would be one in a hundred because

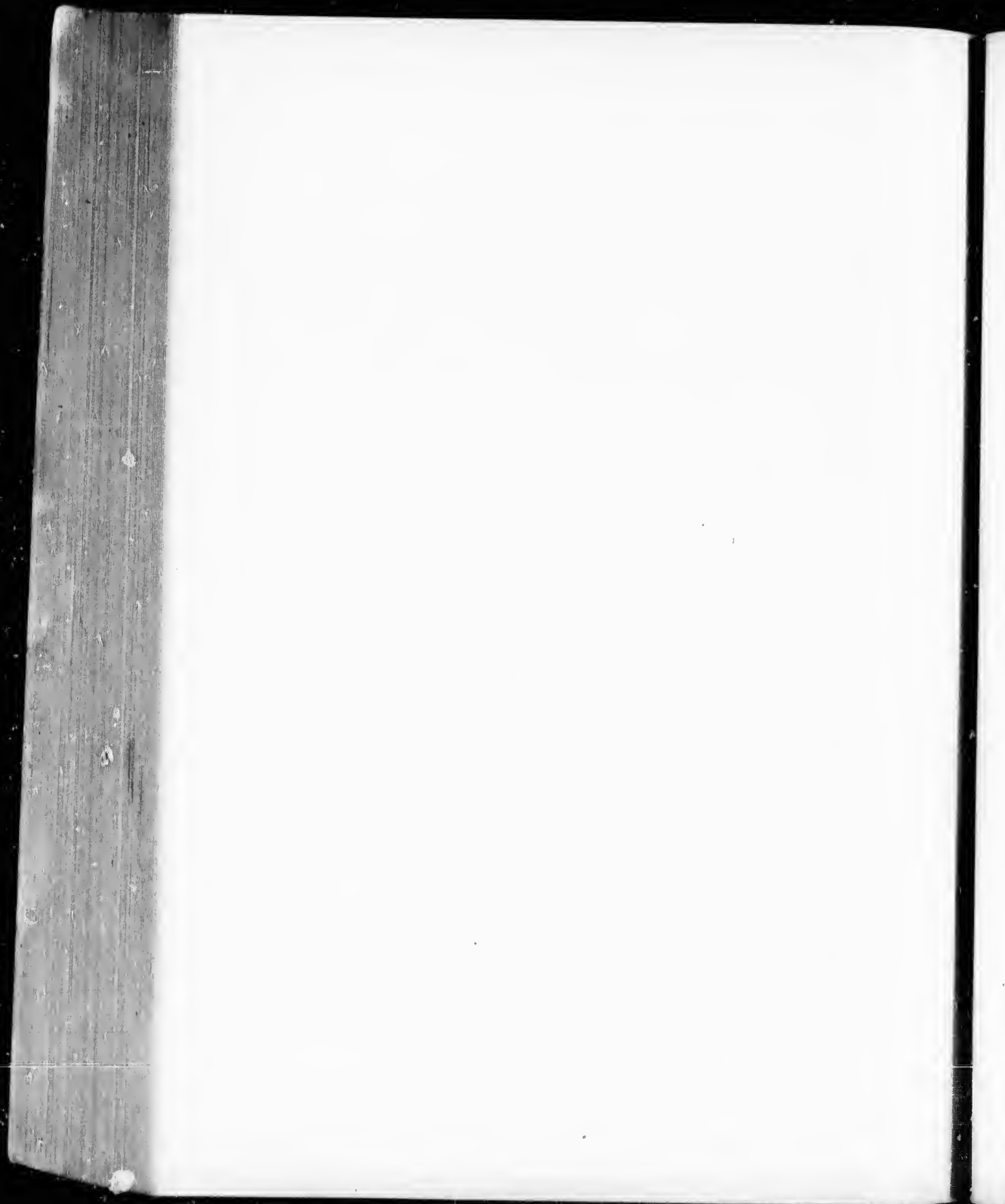


there are a hundred places for it. Now, if there is at the same time another thing like a dyke, or another mark that I find coming over it and you can tell it that is only a coincidence I say, merely what is a mathematical coincidence probably of that coincidence, a hundred times a hundred. That other development or dyke or what not might have a hundred different positions, and out of those hundred it might have a hundred for each of the hundred positions that the first one had; consequently, it is only one in ten thousand chances that the two independent things would come together. It is one in ten thousand, for instance, if we find in sinking the winze so often referred to—

The Court: Now, you are talking about the difference between the vein and the dyke or the fissures. A. I am talking about the possibility that the apparent continuity of veins and dykes and everything under this mud-seam is only apparent and not real. It involves a statement that by some fortuitous succession of coincidences these pieces underneath have been brought opposite to the corresponding pieces above, but it is not real, it is only apparently the same. It is really something else. Now, if it was in one case only, if I had come down in one case and found no mud fault and had found right below in going through 6 or 8 or 10 inches dislocated and continuation of the same line, I say the chances of that not being the same would only be one in a hundred as I will explain to your Lordship.

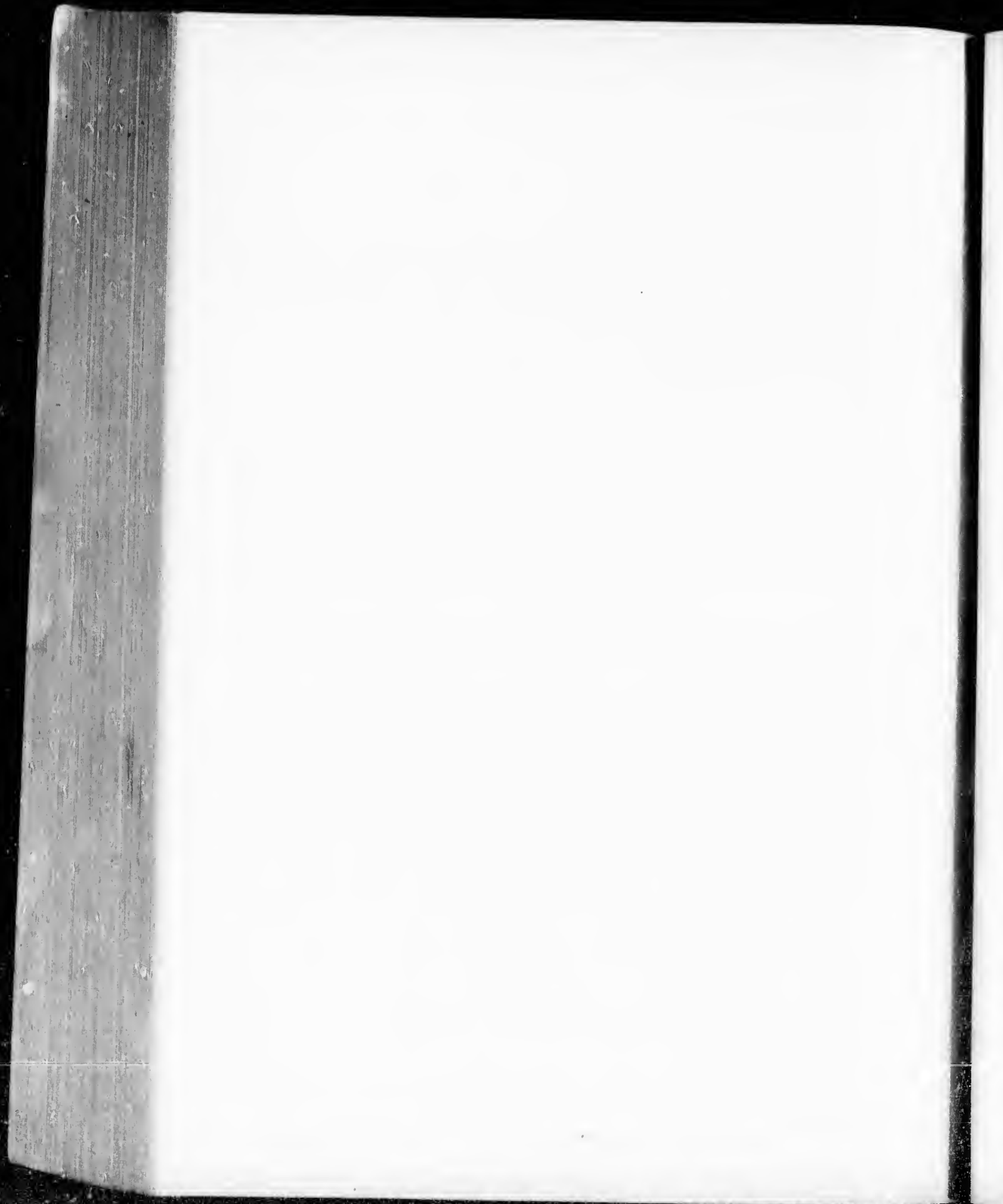
Now, if that vein was accompanied by a dyke, and I find below that the dyke as well as the vein reproduced itself, the chances that a vein would have a dyke alongside of it and accidentally connect and look as if it was the same vein, when it was not, would be one in ten thousand, because there were a hundred positions for the dyke, the same as a hundred positions for the vein. In addition to that if I have another vein faulted by the same plane, and that only shews 3 or 4 inches faulting, and that appears as has been said as an apparent continuity, which is alleged not to be real by virtue of a coincidence, that coincidence is a hundred on the others, and it is one hundred times one hundred, or one hundred times one hundred hundred, or a million to one that the coincidence at those certain points observed of that intersection, establish beyond doubt that the flat fault does not fault anything that crosses it more than a few inches, and does not fault any vein that it crosses enough to throw the vein out of continuity with itself.

That finishes my general statement. Of course, I will not load up the records of the Court with giving details, mathematical details. I feel bound to give them under question. They have been sworn to before the Court, they are present in the maps and surveys which are sworn to, and I have already explained that I cannot take measurements of this model because of the defects which were involved in its hasty preparation. But I will proceed now to give



some opinions and descriptions with regard to the character of the Centre Star
No. 2 vein.

Thereupon a recess was taken to 2 o'clock p.m.



AFTERNOON SESSION.

ROSSITER WELLINGTON RAYMOND.

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DIRECT EXAMINATION RESUMED.

By Mr. Davis—

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Q. Now, go on, Dr. Raymond. A. In addition to what I said this morning about the tracing of the plane of Centre Star No. 2 vein, I think it is necessary for completeness to add a few words to the ground outside of the limits of this model, which embraces, as I have already said the ground in dispute, but not the whole of the workings shown on the first model introduced in the case. With regard to the territory west of this vertical pair of dykes, the whole territory west of these dykes.

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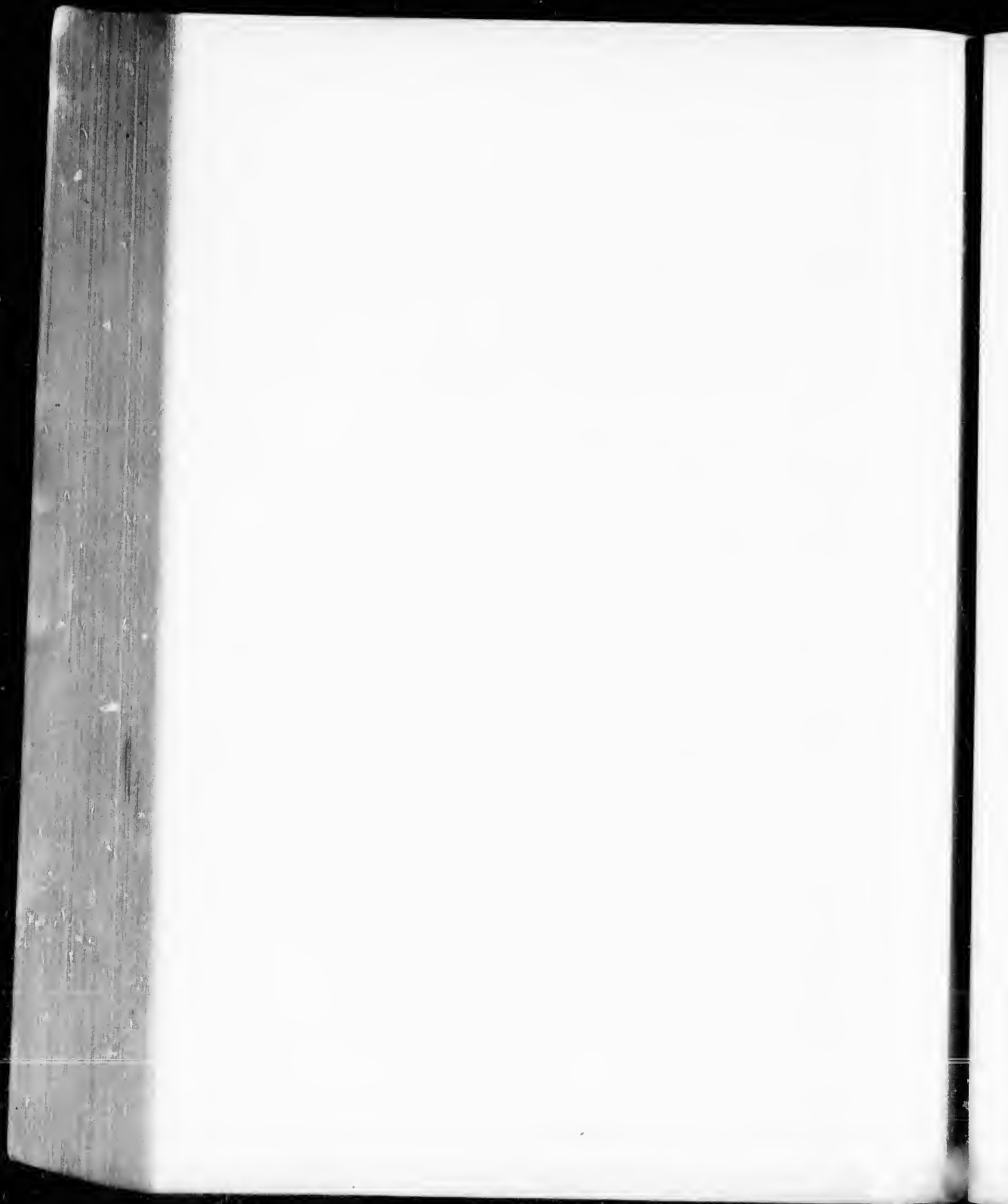
The Court: West of the big dyke? A. West of the big dyke or double dyke, there is a country rock between. I wish to say that that dyke evidently includes the line of a fault, or that pair of dykes evidently include the line of a fault. I do not think that the dyke itself occupies the fissure of the fault, or that either of the dykes occupy the fissure of the fault.

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The Court: That is an upward fissure, of course? A. Yes. I believe that the dykes were injected into a pair of fissures, parallel fissures in that place, enclosing between them a little of the country rock, a few feet and that subsequent to their injection and to their solidification, a similar strain to them, which produced the original fissures which they occupy broke another fissure which splits the eastern dyke. This can be seen particularly at the points where

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the flat fault, followed by the water-course drift of the Iron Mask in the red strikes against the dyke. At that point I think it is clear that the flat fault actually goes a little way into that dyke, but not through and stops against a fissure which is alongside of the dyke, so that the dyke itself has been faulted by this fissure. I do not think that this fissure faults the dyke absolutely all the way, but I don't think the dyke was mathematically split down the middle by it and then faulted; at that point it is inside of the dyke, and at other points it may be outside of it. I have seen some things that make me think that at the point of the bend in the No. 3 incline, where that incline on its west side comes in contact with the dyke and turns its course to follow it down, I say I have seen some things indicating that at that point the fissure had come out of the dyke and was right on the side between the dyke and the vein. But where the flat fault intersects the dyke it is clear it goes a few inches into the dyke and abuts against the fissure which is inside of the dyke at that point. That is of no consequence, your Lordship, in this case. We might for all practical purposes in the case, so far as now developed, assume that the dykes were the fault, for it is in there, and it is along that line that the faulting has taken place. On the west side the Iron Mask vein is shewn to be faulted laterally or horizontally, about 30 feet; that is to say, this being the Iron Mask vein, it would come through here, if there were no fault which is found back there 30 feet behind its position there.

The Court: The Iron Mask with the stope on it is 30 feet in front of the Iron Mask vein behind it. A. Each of them has a stope; this stope is 30 feet in front of that (indicating). The east stope is 30 feet further south on the line than the western stope, but the character of the vein there, and the dip and strike of the vein there are so plain or so obviously alike those of the Iron Mask vein east of the fault, that it is my opinion that this is the Iron Mask vein faulted 30 feet horizontally. How far it has been faulted vertically, we cannot tell without further exploration.

The Court: It has either been thrown back or thrown forward? A. Yes, it has been thrown back, looking at it in the westerly direction, looking towards the west, it will be behind the eastern stope. I have not examined the ground west of that fault (illustrating on model), or this ground in here, any further than to walk through it once, and to satisfy myself as to the strike and dip of this body on the ground, simple and brief examination, to accept the conclusion to which Mr. King and Mr. Lindgren arrived after many days of careful examination in that ground. They said they thought it was the Iron Mask shewing there, and I agree with them.

Mr. Bodwell: I do not think that Dr. Raymond can give as a part of his evidence the evidence of any other witnesses.

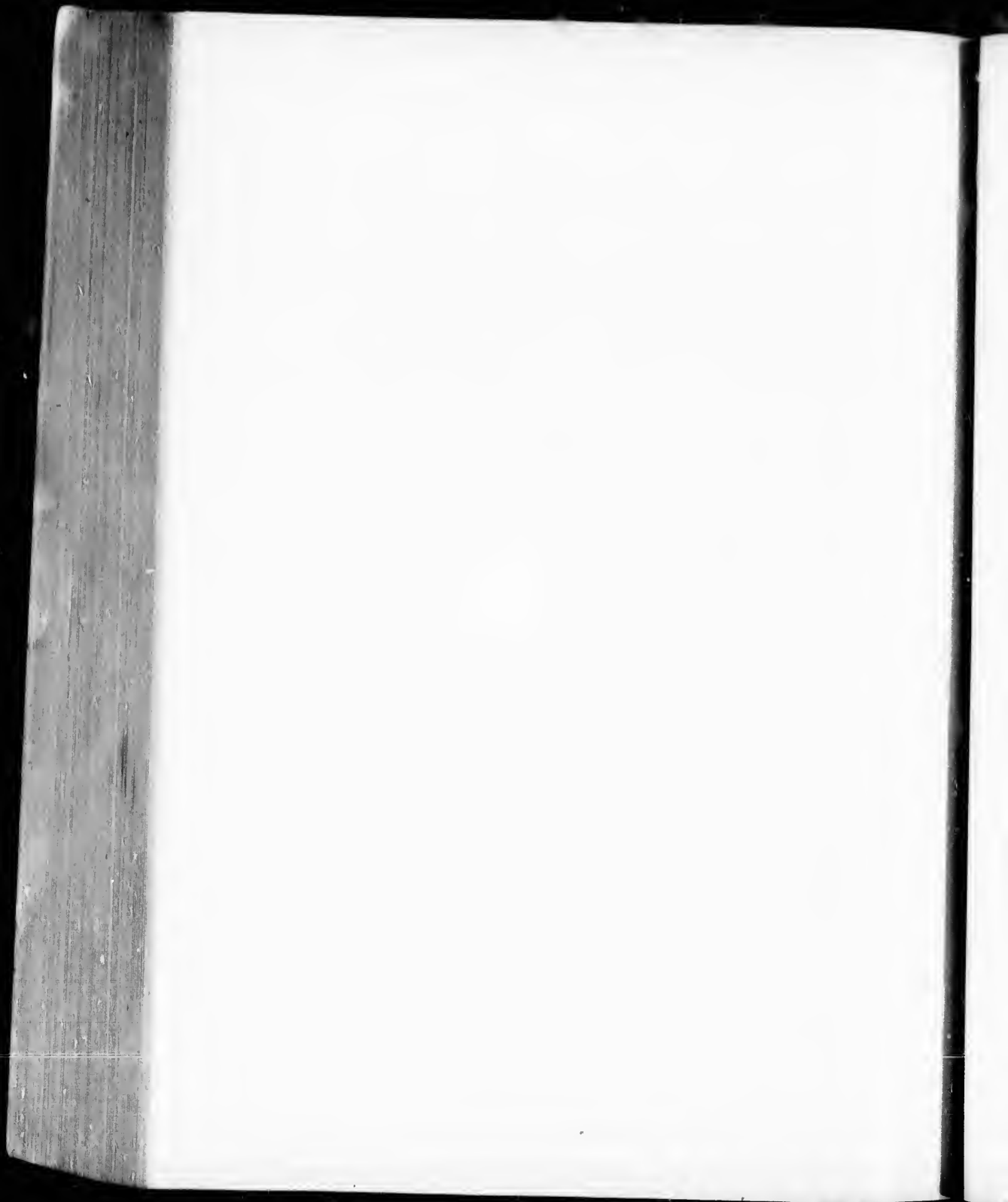


The Court: Strictly speaking he cannot.

A. I want to state then in any form agreeable, that I base my evidence on a simple examination of the strike and dip of that stope and the nature of the vein there, and that leads me to agree with the evidence that has been given in this case, more detailed in character. That is all I say about this end. I wish to put it frankly on record. It does not concern the case that I am aware of, except so far as it concerns one of the original issues of the case, which, so far as I understand, has been surrendered, namely, the issue of trespass on this vein committed below, but not acknowledged, as I understand, and as believed by me, at all events it has been done upon the Iron Mask vein.

Now, with regard to the ground east of the section covered by my rude model, that is to say, with regard to the ground covered by this raise No. 3, which has been now put upon the model as your Lordship requested this morning, now going further east we have, as I have already said, the apex developed all the way to the top of No. 2, and in a reasonably straight line, as straight as apexes are as a rule on the side of a rocky hill. I consider it a straight apex until we come within a few feet of the top of that shaft. At that point there is an indication of another plane running in this direction—running northwest and southeast—and at a point in the vein in the apex, which apparently is repeated in Centre Star the yellow workings below. There is not enough development to enable me to decide what the relation is between the Centre Star vein which, as I shall presently describe as disclosed in the Centre Star No. 2 shaft and this vertical No. 4 upraise. I am satisfied that No. 2 upraise, which is shewn here in the curving, and which has reached now a small dyke, was seen at No. 3 in the level, tunnel below, and has passed through that dyke and has found the ore on the other side—I am satisfied, I say, that from a point 40 feet up at least that raise is on the plane of the Centre Star vein. I am satisfied that the upper half of shaft No. 2 is on a distinct plane of the Centre Star vein, and the lower part of the vein—

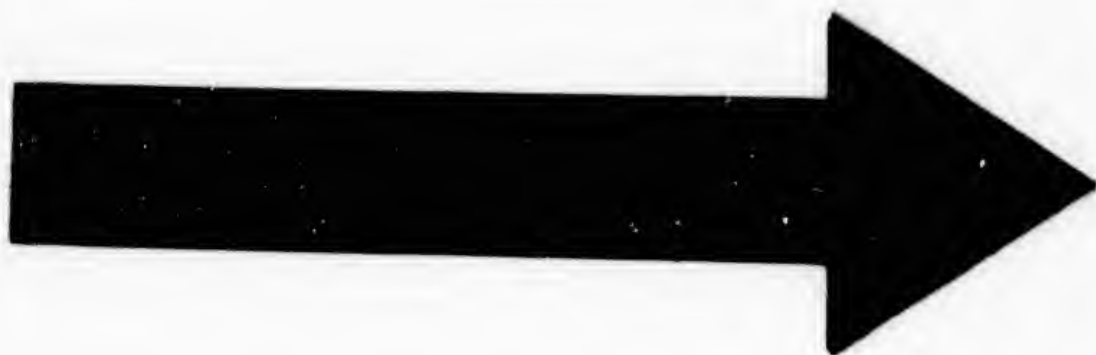
Q. Raise No. 2? A. No, shaft No. 2, the upper half of shaft No. 2 is distinctly down to a point originally numbered in the survey 82. It is here (illustrating) down to a point 82 on the Centre Star plane with a dip of 45 degrees and carries ore, solid ore, down to that point; at that point, however, the ore thins out to a point and appears to pass into the hanging wall; whether it does or not, I have had no chance to cross-cut and to discover, but in that particular seam of solid ore does not appear continuously below that point; that is, there is an interval below in which we have another seam of solid ore of the same general dip, and then we encounter that mass which has been spoken of in the testimony already,—the coarser grained rock, gabbro probably, in which we are able to trace, very obscurely indeed, and not satisfactorily, the planes, the bounding planes of the vein which we had above, but we trace with more



certainty and with more satisfaction lines of pyrrhotite and pyrites occupying lines so that they can be followed as guides down through the whole of that rock, and down to the bottom of the shaft. There is, however, between the S2 and the bottom of the shaft, a considerable quantity of solid pyrites exposed on either wall of the shaft. I should expect this vein in entering a coarse grained and tough country rock that did not shear as smooth as the other rock, would lose to some extent the very definite character which it presents at other points, and I should expect that there would be some thing yet to be discovered by further development in raise No. 4, and I don't undertake to say what it will be. I will say, however, that it has seemed probable to me from indications I have observed there, and I think it very probable, but I am not willing to swear to it, that that vein in No. 4 upraise will turn over to the south and prove to be a branch, a fork of the No. 2 Centre Star, probably leaving the No. 2 Centre Star at this point (illustrating on model) of the bend, half way down that shaft. In that case, it would simply be the fissure or shear in coming up to this large body of tough and coarse crystalline rock, but simply gone around and made around and made a horse of it. The vein has gone through it, but is very much secured in it, and I should not be surprised, if on development—which is now being pushed as rapidly as possible—it should not be found that there was a steady passage of pyrrhotite and pyrite, continuous seams, such as we have had above, going around that rock.

There is also a sign at the point where this rock is first encountered of pyrite, going down below. So that it is possible that there is around that body of coarse crystalline dark green rock a vein on both sides, above it and below it, making what miners might call a fork and a reunion of the vein, or what they might call a "horse" although it would not be strictly speaking a horse in the strictest and narrowest sense of the term, because a horse is usually a piece of the country that has fallen into a big fissure—which is primarily the simplest definition of a horse—but when the fissure divides and comes around a body of barren rock, even if part of the fissure goes through it, that sometimes is spoken of as a horse. Further on to the east, in cross-cut No. 1, to the south Centre Star tunnel the Centre Star vein is shewn at about 41 feet from the tunnel, and has been drifted on between 30 and 40 feet to the west. Here it shews its intersection with the flat fault at that point; and drifting further on, about an equal distance, making a hundred feet in all, a vein is encountered in the exact position which the Iron Mask vein would occupy calculated out to that point. That vein has already had opened upon for a foot or two only, to the west.

Now, with regard to the effect of the flat fault upon all of the intersections. I have shewn the Iron Mask, the Centre Star No. 2 and the various dykes, that it has never faulted any of the dykes.



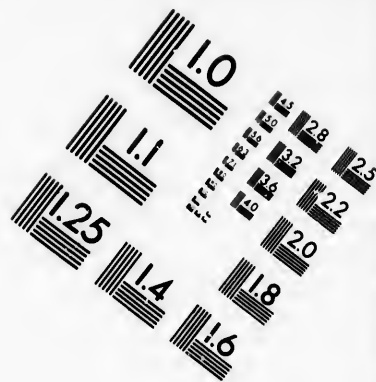
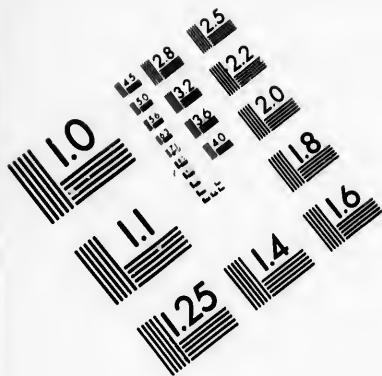
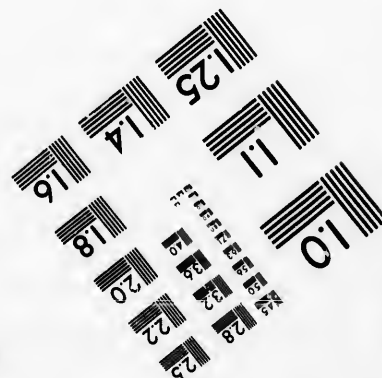
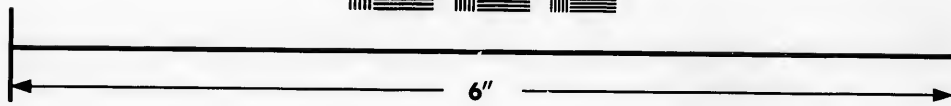
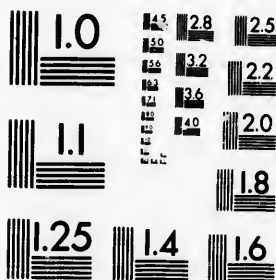


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The Court: It has what? A. It has never faulted any of the dykes or veins in the centre of dislocation more than a few inches, and never so far as to remove them beyond the continuity of ore. There is one case in the Iron Mask tunnel, at point 60 feet east of station 45 where the mud-seam is itself faulted, faulted for several feet, and that by a dyke, a double dyke, with a fault really in the middle between the two dykes. One dyke is moved up on the other, and we find the same fault carried on to the north at the edge of the raise No. 3 in the Centre Star drift. 5

The Court: Is it usual to find so many faults in dykes in such a small compass as that? A. I do not think it is, but these dykes were all there before the ore came there. 10

The Court: Oh, yes, I only ask if it is usual. A. In regard to that I am very glad to have that question asked, and I would not take the time of the Court to state the general structure here. Mr. King has explained it very well, but what he did not say, follows as a matter of course from what he did say, that if this locality here is a centre of a great series of igneous eruptions, these rocks themselves in cooling would make shrinkage cracks, and in the successive efforts of the eruptions would make cracks, and you would have over and over again in the general mass cracks made, and plenty of melted matter below to come up and fill them, and that matter coming up from below and cooling off under those circumstances and at different geological times, would give you different varieties of eruptive rocks. There is a difference in the rocks of these dykes. Some of them would take one name and some another; I don't think it well to burden the case with all the different names. Some of them are micaceous, and some are not; some of them are more augitic than others, and some of them are more highly siliceous than others, and some are more basic than others, as a matter of chemical constitution. But, whatever they are, whenever they were made, there is only one of them that we have been able to find—there is only two of them that we have been able to find which really fault or cut off the flat seam. There may be others, but the only two are, this large one on the west, and this double dyke on the east—which constitute the limits of my rude model. I think that covers all that is necessary to say as regards that especially—no, there is one more thing. There is one more point that might be mentioned, and that is that if the flat fault does not actually throw any of the veins which it intersects to any considerable distance, has it not some other influence upon them? Does it not impoverish them? Does it not change the character of the ore? There is in shaft No. 3, below the intersection of the flat fault in the great sump there, some difficulty in tracing the absolute continuous heavy body of pyrites which comes down. We have got it five feet below the fault, and then from that point on it seems to be more scattered, and through the bore-hole and in the 15 20 25 30 35 40

seam below, the testimony has shewn—and I agree with it—that we have assays of value, and scattered pyrites. The assays in that case, as have been presented here, include one of 12 feet in length, taken right across the bottom in the hanging wall of the No. 3 shaft, which shews a very good value, eight dollars.

Q. Something over \$8.00 in gold alone? A. Something over \$8.00 in gold alone, and the copper assays are sometimes \$5.00 and \$6.00 extra, so that the average in the No. 3 shaft already placed in evidence is shipping ore from top to bottom.

With regard to other intersections I found, for instance, and I now speak of the results of assays made by my direction, from ore samples taken by my direction, as it will be proven later in the case—I find they have not been put in (they belong to another batch, but I suppose it is proper for me to say what my opinion is on the result) and the proof can come in afterwards—I find in this intersection ore in No. 1 south cross-cut, Centre Star tunnel there, the mud-seam, intersection of Centre Star; the assay is very much larger below mud-seam, immediately below, than it was above. That vein is the same in appearance, but there is a very much larger value in speaking of the gold alone than there was above. (Referring to memoranda.) Above the mud-seam in No. 1 south cross-cut, sample across 12 inches of ore gave gold \$3.20 a ton. The mud-seam at that point is 4 to 6 inches thick. The ore is faulted or thrown a very few inches, not certainly over 6 or 8, it is difficult to prove, it has been thrown, it comes so near matching. Below the mud-seam there at the same point, taken from solid ore 12 inches, the assay in gold is \$24. In another place, station 48, where the mud-seam in station 48 is, in Centre Star north drift is, where the mud-seam crosses the Iron Mask vein, there the assay of the ore above and below the mud-seam is exactly the same, namely, \$4.80.

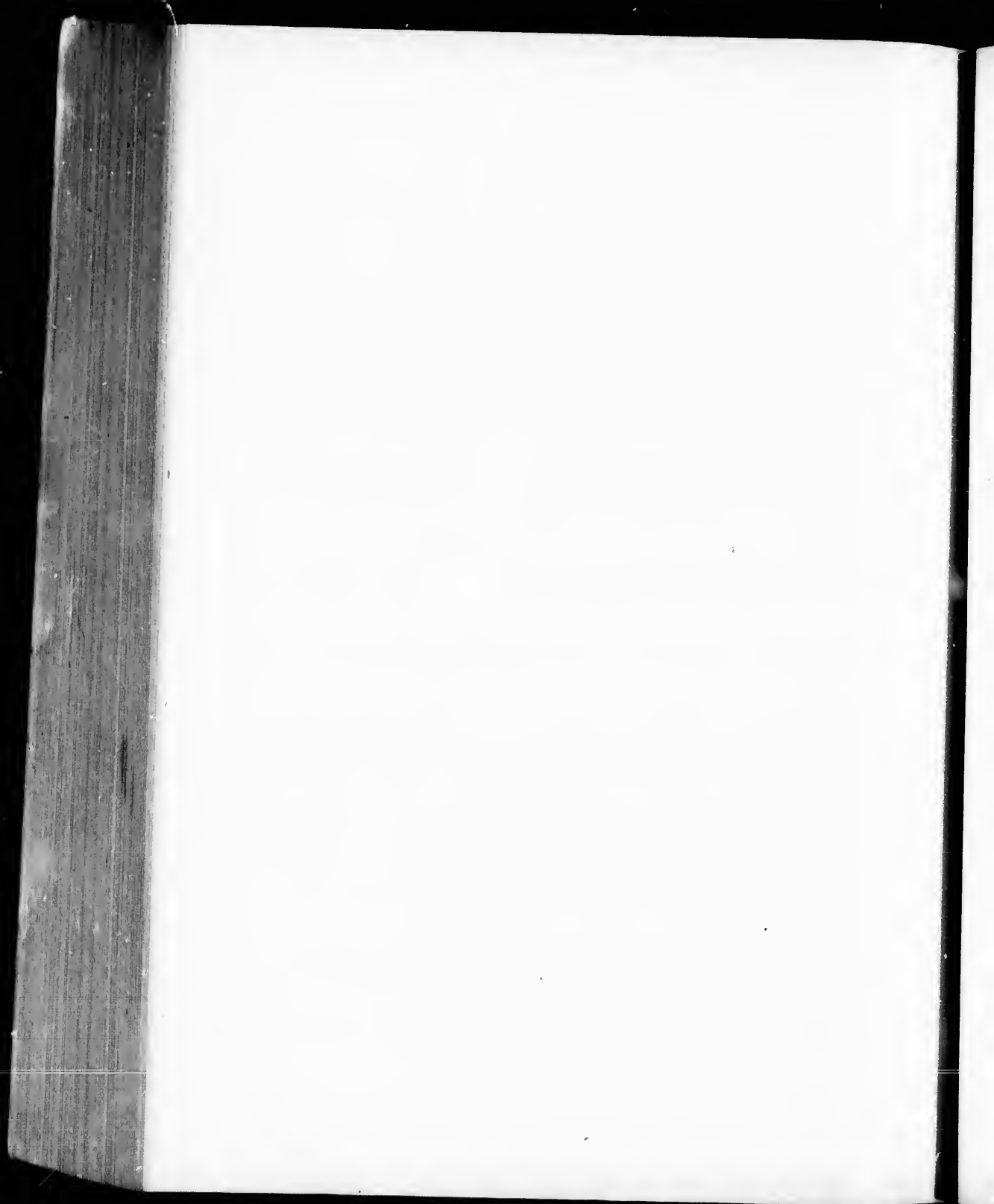
The Court: Where did you say that the Iron Mask vein was? A. The Iron Mask vein comes right through here, and is intersected by the mud-seam at this point, from 47 to 48 Centre Star north drift.

The Court: The Centre Star drift there (illustrating). A. The Centre Star drift there, and it is run on the Iron Mask vein.

The Court: In other words, you say this agrees with what was said before I suppose, that that is the Iron Mask vein. A. That is the Iron Mask vein.

The Court: And where that upraise comes? A. That upraise comes on the Iron Mask vein; it is altogether under the plane of the Centre Star. The plane of the Centre Star vein will come down over it there (illustrating.)

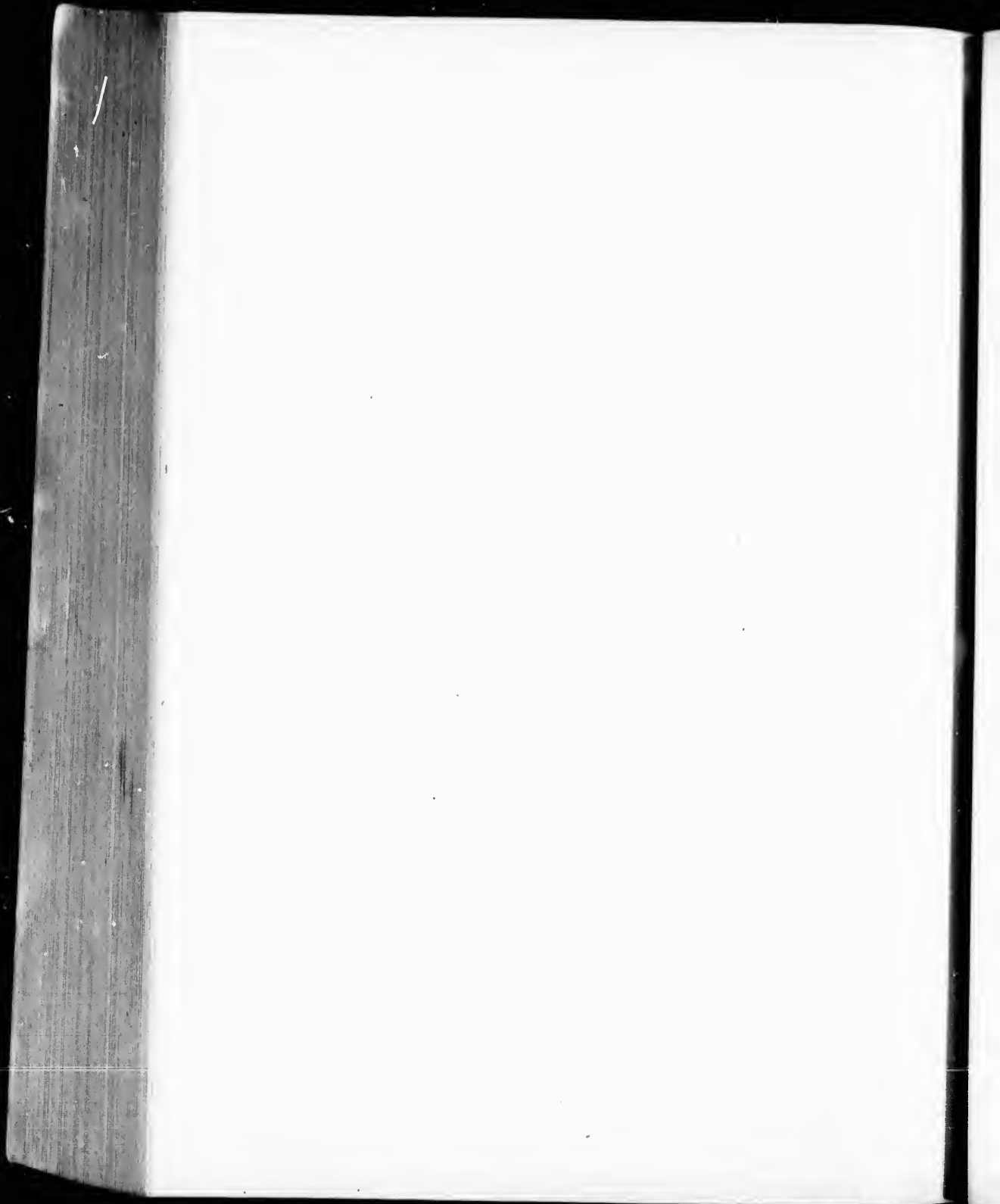
The Court: I wish that was differently marked. A. Those colors were put there, I believe, to shew the different levels. You will find it on the



model here (referring to pasteboard model); the model does not go far enough; the Iron Mask vein carried out there (illustrating) is intersected down there, and the only point mentioned here is that the tenor in gold above and below the mud-seam is absolutely the same. We have, therefore, cases in which it is poorer, cases in which it is richer, and cases in which it is exactly the same; by which I conclude that the flat fault does not affect in any regular way the value of the ore below as compared to the value of the ore above it. It is quite conceivable that for a large flat fault, or a large water-course running there and permitting water to go through for a long period, it would be quite conceivable that that should at the intersection of various veins deliver water into those veins, and produce any change into those veins that the general circulation of water would produce. Now, the effect of such a change is sometimes to impoverish and sometimes to enrich. It may dissolve and carry away base metals, and that would leave the gold in a higher percentage, or it may in the case of ingredients like the sulphides, actually dissolve and carry away some of the gold, in which case I think you would find the richer places on the vein below than those above that has been leached out; but I do not regard the influence of the flat fault in any respect as being clearly more general, or being worthy of consideration practically.

That completes, I think, all I need to say to shew completely my opinion in regard to the essential issues of the case; but I suppose it would be entirely proper and I suppose I am called upon to say something about what I consider the nature of this vein to be and its limits—the character of the vein and its formation. I repeat, I do not consider that point involved in the case. I do not see how it is at all. I never have known that it was important to know how a vein was made, if you had it and could follow it. Nevertheless, and above all, I have always known as a miner, that if you were following ore you must be in your vein, if there was any vein at all. You have no cause to cross-cut every day or every week or at any regular intervals to find where the walls were, as long as you are satisfied that you are inside the cheese, and it makes no difference where the line is. And I say in this case also that it is not important at all to fix where the ultimate limits, as they have been called, of this vein are. It is sufficient for me to follow the zone in the vein which has carried pyrrhotite, chalcopyrite, quartz and gold, and as long as I am in that, I know that somewhere there is a hanging wall above me and a foot wall below me. At the same time, I am perfectly willing to give any theoretical information beyond that that may be desired or that may seem interesting in connection with this issue.

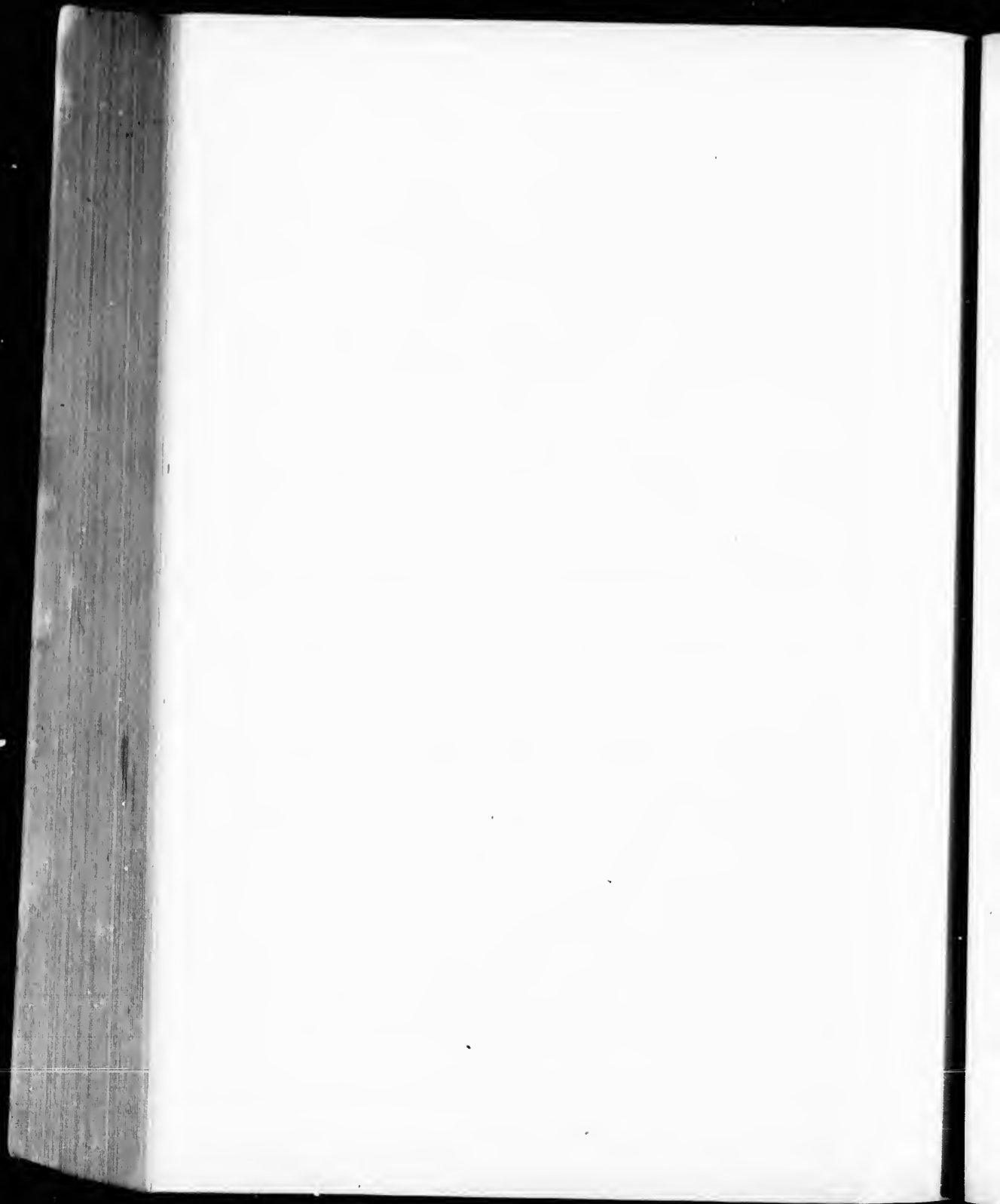
Now, I think this vein is a fissure vein. There are two kinds of fissure veins, simple fissure and a compound or composite fissure. The class of compound of composite fissure veins is rather later in origin, or recognition than the older class of simple fissure veins, under which was generally understood a



single rent in the rock which stood open or was held open by a horse falling in it—by blocks falling in it, or was left partly open and partly closed by a shifting of the walls so that the bulges came opposite each other, and one which had originally wavered sometimes in its downward course, if the hanging wall slipped down would catch on projections on each side, and that would make it a more or less compound; there would be pinches in it, and wider patches in it. That was the old theory of a simple fissure vein, and that was the theory of a fissure vein which was laid down in Professor Cotta's classical work on the subject. Professor Cotta was the teacher on that subject at Freiburg when Mr. Janin and myself were students there, and Professor Cotta's manual has been translated, and it was written in '50 something, and has been translated into English, and has been a standard work among us; but before Professor Cotta died, in fact not very long after the publication of that book, he wrote an article in which he said he felt it necessary to make a new class of veins. This article was published in the German Mining and Metallurgical Journal.

Mr. Bodwell: Give the date of that. A. It is cited in Groddeck's treatise on ore deposits, and a new class of composite veins included in that treatise. I cannot help regretting extremely and feeling very much mortified to do a thing, that I have never done that I know of in a court before, that is, to state an authority without producing it; but I have been put on the stand here ten days before I anticipated, and I have not got from San Francisco or from New York a copy of Groddeck. I heard there was one here in Roseland, and I have spent a week trying to get it, and I cannot produce the book. I will do anything I can do hereafter, or my mention of it must go for what it is worth. It is in there, and it would not make any real difference whether it is or not, because the whole subject has been investigated in later times. I only mention the fact that it originated as far back as that.

A composite fissure vein is simply a fissure vein that involves more than one fissure. Now, under that class of composite fissure veins, there are two divisions, and one is where the composite fissure vein was still a zone, with fissures running in all directions in it, and simply breaking up the rock intervening and then mineralized through those open fissures, in which foreign matter ascended, as in the theory of the common simple fissure vein. The other class is the shear-zone vein, which we have heard about in this case. It is a variety of composite veins, and the whole difference is that the fissures are parallel. They are parallel because they are caused by shearing. Your Lordship understands it very well, as indicated by the illustration the other day with a pack of cards; that is the shearing action, in which each plane of the rock having reached its maximum tension gives way and slips on the next plane, and they slip in continuously decreasing ratio until by and by the stress is relieved from the central upheaving force. Such zones, shear-zones, have been known and spoken of fre-



quently in geology; but the shear-zone vein is not necessarily the same thing as the geological shear-zone because that action may lead to parallel fissuring through a whole mountain, for instance, and that would make it a geological shear-zone; or it might go on on a small scale where, by bringing the planes closer in certain parts of that zone, that would make shear-zone veins. The term, "shear-zone vein" is not one that I have been accustomed to use, simply because it is so easy to confuse it with geological shear-zone. It is perfectly easy to define the shear-zone, that is without giving it that name, and it is described and defined in a great many works without having that name given to it.

The Court: Just as a fissure vein. A. A compound fissure vein, or a composite fissure vein, or a fissure vein accompanied with parallel fissuring, or a fissure vein containing walls within the vein. All of those expressions are simply paraphrases which indicate the shear-zone vein. When a shear-zone vein is under such strain or is subsequently, if after the strain producing shearing has been relieved, if the vein itself after a general upheaval, if the rock itself was set along one of those planes, you may still get an open fissure within a shear-zone, and then you may get the ordinary effect of water coming up from below, and you may get a clean filling of that fissure with foreign matter, and you may still have the parallel planes outside, and they may not mean anything, but if the shearing had taken place under great side pressure so that the fissure could not open to be a wide crack anywhere, then if it has become mineralized so as to become a vein, that process has necessarily gone either by impregnation or by replacement. The difference between impregnation and replacement is very simple. Impregnation takes place when foreign matter is brought into the pores of existing rock and the rock itself is all there still; none of the rock is taken away, but there are pores enough in it—it is open enough, though perhaps not to the eye, but in fact they are open enough to be percolated by capillary force, by the mineral solutions which often deposit all through the rock and impregnate it without having taken away any of it; if there were quartz, feldspar and mica in it before and silver ore comes in, or gold ore comes in, there is still the quartz, feldspar and mica; they are not altered by the ores having come in. That is an impregnation. Replacement involves removal of one or more of the constituents of the rock and putting in their places, atom by atom of the new material that comes in. Replacement cannot take place by mere alteration of the rock.

The Court: Substitution. A. Substitution. There may be, for instance, a rock containing angite and plagioclase and quartz, and it may be altered so that it shows hornblende and kaolin. You would not call that replacement, because that is mere alteration of the stuff that was there before. But replacement is, in addition to such chemical change, the interjection of something actually new from outside which is not in the material between the shear planes.



I think I will very rapidly cite a few authorities to show how much attention has been given to this subject lately. And I may say that in this particular case, I think that this fissure vein, composed as it is of several parallel fissures, has been mineralized by replacement; that is, that mineral solutions have come into it, either at one time or successively, which have produced the effect of dissolving out some of the ingredients of the country rock, and putting in their places ingredients which constitute the ore, and chiefly pyrrhotite, chalcopyrite and the gold, and to some extent the silica. 5

During the last 25 or 30 years there have been three men in our country—in the United States—who have done more with regard to the investigation of the forms and origins of ore deposits than any others, I think, and they may be considered as the leading authorities. 10

I will say with regard to the former classifications that they were, so far as they have proceeded from Professor Cotta in Freiburg, they were based on a very peculiar district in the German Etzgebirger or ore mountains, which presented fissure veins of a very simple type. They shew faults a plenty, but they do not shew—almost without exception, they shew open fissures that have been filled from below without reference to the country rock, and had gotten nothing from the country rock, and had filled up their contents from the two walls, leaving sometimes an open space through the centre and leaving a cone or troostite, and quartz and ore crystals filling on either, shewing that it had been filled by the interior of geode. That was the basis therefore of a technical classification, entire classification of fissure veins for some time, because of the eminence of the school at Freiburg, basing his classification upon the local phenomenon. The great development of mining in this country and on the Pacific Coast brought to light so many veins of a different character that it became necessary to revise and extend that classification, and all later books in Germany have taken account of the new types which we have presented in the Cordilleras,—in this range of mountains in which we now stand. 15 20 25

The question has been asked in this case what were typical veins known at the time of the passage of the United States mining laws in 1866, and again in 1872, and I will reply with regard to that, that outside of the Comstock, which had its peculiar features and was not understood, and outside of the mother lode in California—also peculiar—there was a great development at that time in the state of Nevada in what is called the East River district, and the time is within my recollection. 30 35

At the time of the United States law there were in East River District a large part of what might be called old-fashioned typical fissures; they were very narrow, and they were very rich. They would not often go over 6 or 8 inches 40



wide, and would be as sharply defined from the country as possible, and they would contain ruby-silver and horn-silver and native-silver and the richest of ore, so that they could afford to pay twenty-five and thirty dollars a ton to mine them and one hundred dollars a ton to mill them and still make large profits out of them. That was the basis of the idea under our law as to the fissures. Of course, such a conception as that would have to be enlarged when you come to the practical conditions of mining, and our miners have enlarged it. I do not propose to say anything about legal definitions; but our miners have enlarged it so that to our miners of the Pacific Coast a vein is understood to mean a continuous vein of mineral or of mineral bearing rock within a wall.

The Court: Have those crystals anything to do with finding gold? A. No, sir, the crystals only shew open spaces, only shew there was room. Quartz has a good deal to do with it, but the formation of the crystals does not affect it one way or the other. I have seen gold twining in and out of such crystals, and I have seen oceans of such crystals where there was no gold. The quartz itself, whether it assumes the crystal form or not, is encountered almost all over the world as a companion of gold; and when I come to discuss the ore laws presently I shall say a word about that.

The three men I refer to are G. F. Becker, of the Geological Survey of the United States; S. F. Emmons, of the Geological Survey of the United States, and Prof. J. F. Kemp, professor of geology, successor to Prof. Newberry, and professor of geology and ore deposits in the University of Columbia, New York City. Prof. Kemp of these three has published a treatise on the ore deposits of the United States, published in 1893, New York City. I read a paragraph from page 14:

"A phenomenon which is especially well recognized in metamorphic regions and which is analogous to those last cited, is furnished by the so-called 'shear-zones.' (Those last cited being the formation of open fissures and cracks and caves by movements of the earth's crust.) A faulting movement, or a crush, may be made apparent by changes in mineralogical composition and structure." * * * "These crushed strips, or shear-zones, may be formed with very slight displacement, but they afford favourable surroundings for the formation of ore bodies. This conception of the original condition of a line of ore deposition is a growing favorite with recent writers, and combined with the idea of replacement is often applicable, (See example 17, Butte, Mont.)"

Again on page 55 of the same work in the classification of ore depositions under the head of Class 2, "Deposited from Solution," Professor Kemp gives two varieties, Variety 7:

"Occupying shear-zones, or dynamically crushed strips along faults, whose displacement may be slight, closely related to No. 3. (Butte, Mont.)"



"8. True veins filling an extended fissure, often with lateral enlargements."

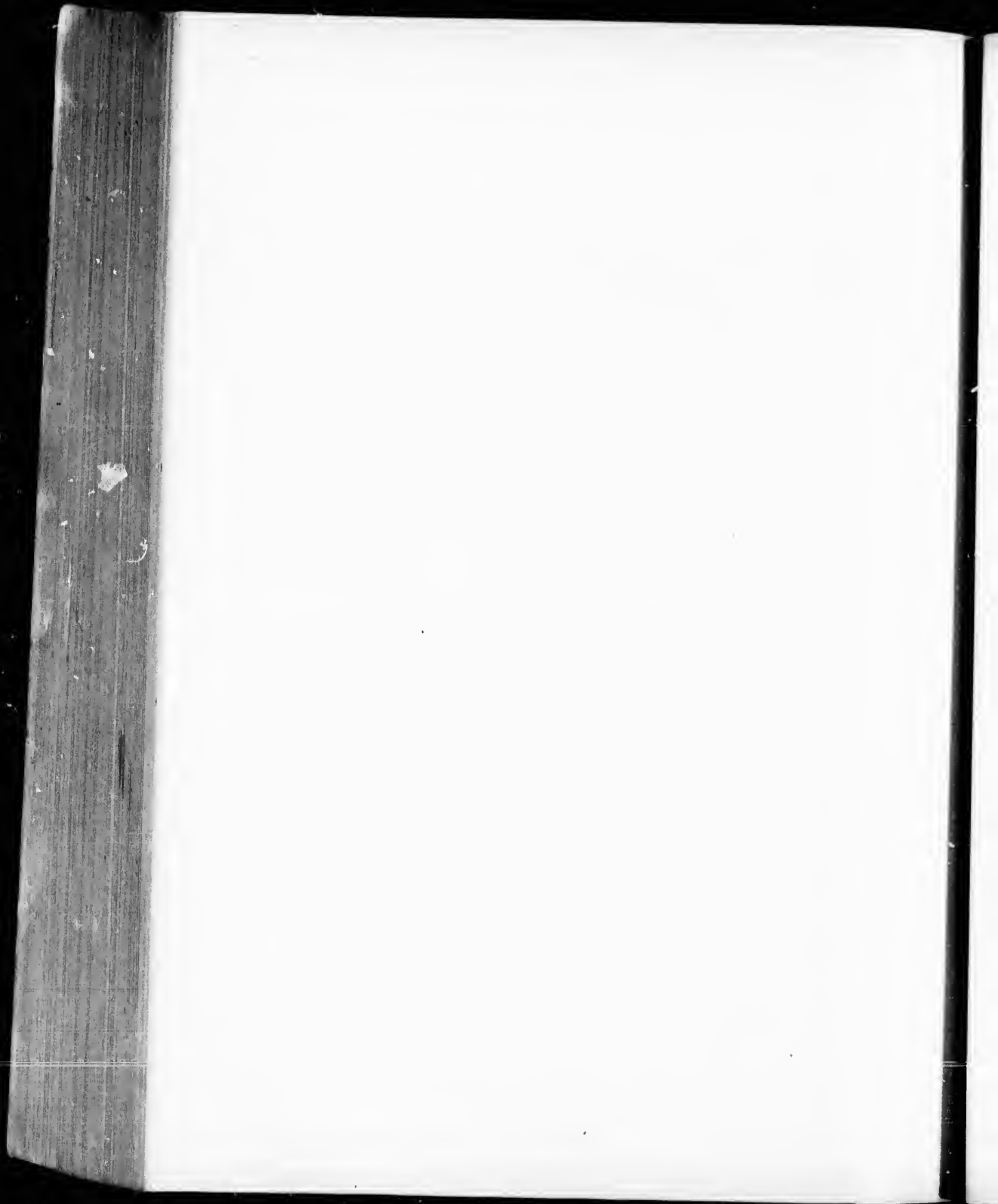
Elsewhere Prof. Kemp recurs to this subject and says that in connection with the replacement, with the filling of the veins by replacement, the shear zones constitute a very applicable theory of vein formation. 5

Mr. Becker in his work published as "Monograph Three of the United States Geological Survey, Clarence King, Director, on the geology of the Comstock Lode—— 10

Mr. Bodwell: Is that the volume number? A. It is not any volume; it is a series of monographs published. That is the only definition I can give you: Monograph Three.—Gives an elaborate discussion of the shear zones accompanied by mathematical discussion of the relative amount of movement which took place in each zone. I will give your Lordship the page. For instance, on page 173: "If the rock on both sides of the fissure is the same or possesses the same physical properties, and is divided into plates of the same thickness, the energy brought to bear on the fissure will be distributed in both directions on the contacts between the plates, and the cross section of the country will shew two logarithmic curves with a common tangent at the origin in figure 8." 15 20

That allusion to the logarithmic curves is simply an allusion to the fact that in such a shear-zone the successive fissures as you get away from the sources of power, of movement, will go up less and less, will slide up, be dragged up, less and less so as to make a straight edge, but on the contrary will make a curved edge just as Mr. Becker illustrates it by saying that he has often noticed in a printing office that the foreman having a pile of sheets on the press, runs his thumb over the top sheet to bring them out so as to get at the edges, and they never come out in a straight line, they will always curve out. Just as that book, while the straight line curves that way when you shut it, though not from the same cause, but that is what he meant. And he determines that curve theoretically. In the case of ordinary mining operations where the whole surface has been denuded and carried out so that you cannot find his logarithmic curve, his delicate discussion of it becomes of no importance to us; but he has made a very extended discussion and has given us a picture of the way in which geological shear-zones may be produced in the rock parallel, like the movement of a deck of cards which your Lordship alluded to the other day. 25 30 35 40

The Court: Some other gentleman referred to that, not myself, though I thought it was ingenious. A. It is not of any importance to us except that the matter was taken up and discussed at that time.



The Court: Why do you style these monographs? A. Our geological survey has published three or four different kinds of books—different sets. First they have their large annual reports; second, they will have reports which are not periodical or annual, but some one man has had a work given to him, and spends five years on it and the published result of his work is called a monograph; and still another smaller set is published called bulletins, which are small looks, smaller works. Mr. King's work on the Comstock was a monograph; Mr. Becker's work was a monograph. 5

The Court: A monograph means an article? A. It is an article, yes; a single article devoted to one subject. Mr. Emmons has had charge of the geological survey in the mining districts for a good many years and has published several monographs, among others, one on Leadville, which was cited here the other day. He has also written a great many scientific articles on the subject of ore deposits, and I now quote from a paper by S. F. Emmons, of the United States Geological Survey, read in February, 1888, before the American Institute of Mining Engineers, of which I am secretary, at the Boston meeting. It is published in the 16th volume of the transactions of that society. It is very interesting; the subject is "Structural Relations of Ore Deposits," therefore it is exactly the subject before us. I will simply read a passage or two in which the subject of shear-zones comes up, beginning at the bottom of page 821: 10 15 20

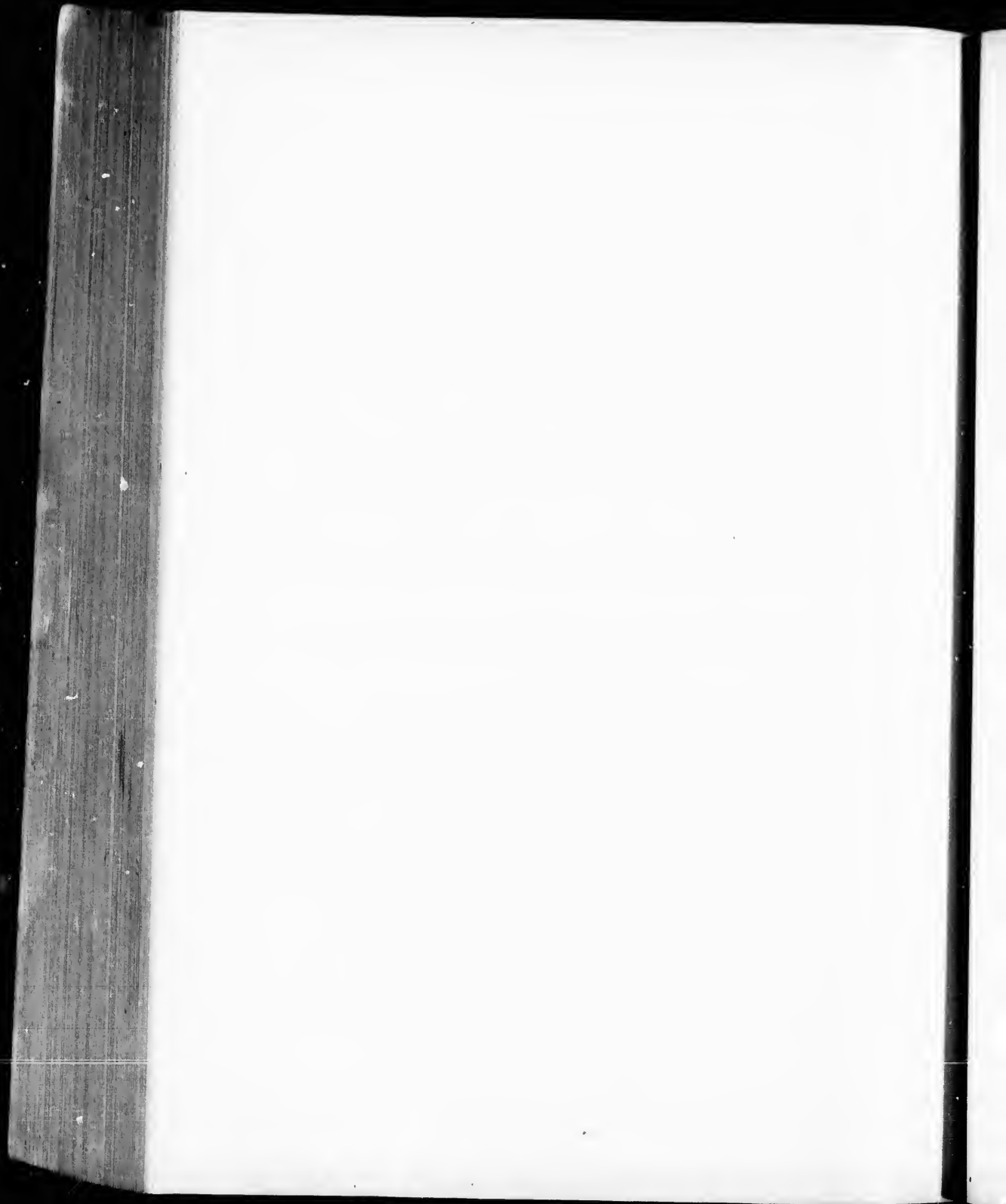
"Common Characteristics of Compression-Fractures. (That is, fractures on which there is strong pressure on both sides besides the one which makes the break.) "There are three phases of structural evidence of rock fractures and displacement resulting from compression, one or more of which I have found to characterize the various types of fissures carrying ore deposits, which have come under my observation. These are: 25

"First. Striations and slickenslide"surfaces. 30

"Second. Breccia or fragmentary material in the fissure itself, or zones of crushed or broken rock material included between intersecting systems of fissures." (That would be composite fissure veins of the first class.) 35

"Third. A sheeting of the country rock parallel with the main fracture: in other words, the occurrence of a system of minor fractures which divide the country rock up into a system of approximately parallel plates or sheets. The distance between these parallel fractures, or the thickness of the sheets may be reckoned by inches, by feet or by hundreds of feet, according to the varying texture of the rock masses involved, or the different dynamic conditions which have produced the fracture. 40

"It will at once suggest itself that these are all phenomena characteristic of faults. But they are also found, at times, where there may be no recogniz-



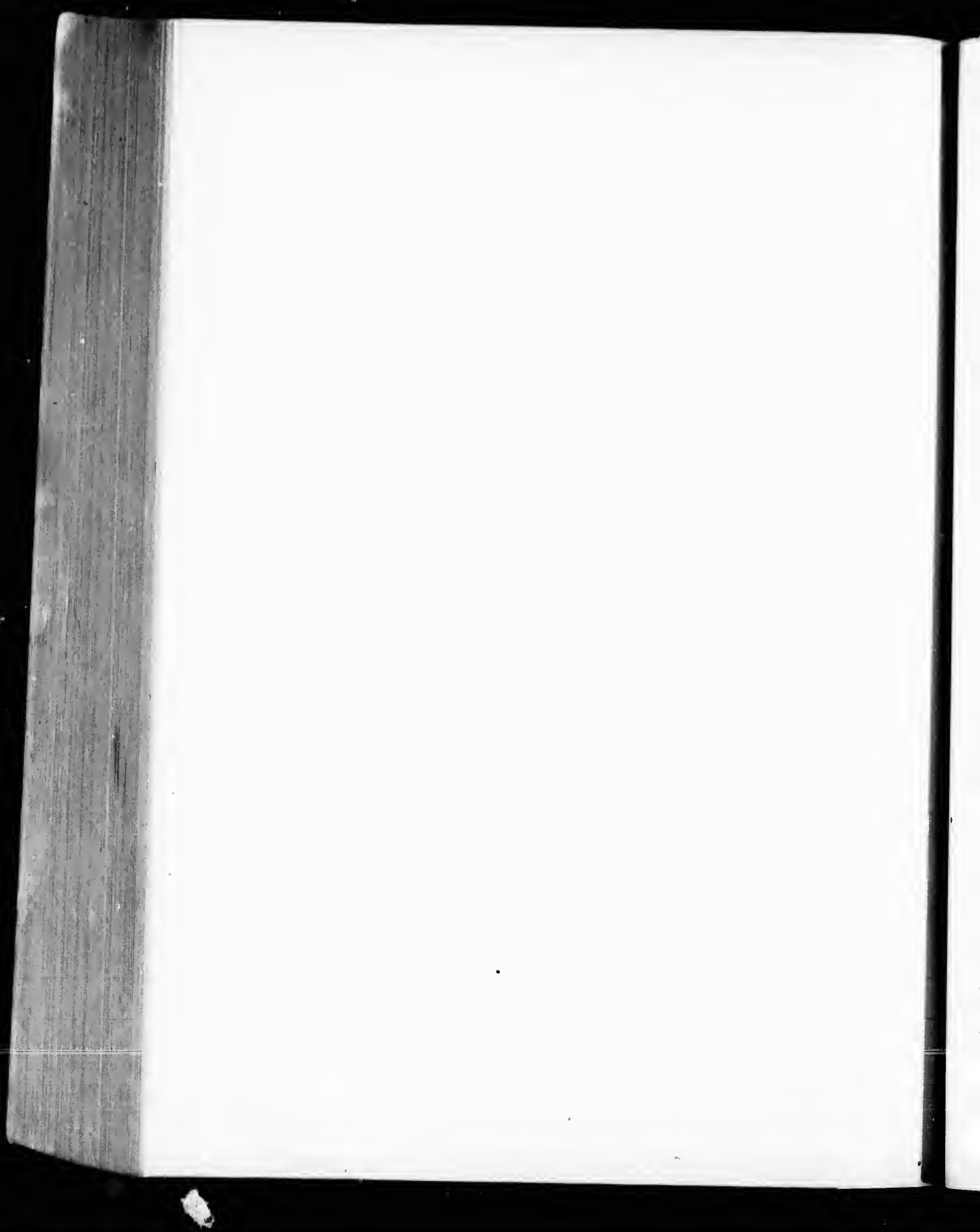
able evidence of actual displacement of the rock masses on either side of the fissure or fracture. On the other hand, it will be equally evident that fissure characterized by these phenomena can hardly be the result of contraction, or shrinkage cracks."

That is to say, if you find a fissure with parallel sheeting in the rock along- 5
side of it you can not say that it is done by shrinkage. There was a force there
that made that rock large, therefore it is a real fissure and these parallel fissures
constitute the best representative of a true fissure vein, because it may be a
mere shrinkage crack and not go into the lower forms at all, but stop when that 10
particular rock stops, if it has no parallel sheeting and is so perfectly simple as
the old type of the so-called true fissure; but if it is sheeted, then you may be
sure that there has been a real fracture, for there is nothing else that will make
the sheeting in an igneous rock or crosswise in a sedimentary rock. Going over
to page 823 I read these paragraphs:

"The sheeting of the country rock in faulted or fractured regions where 15
ore deposits abound, is a phenomenon to which hitherto too little attention has
been paid. Its importance as a feature of fissure veins is, however, great both
from a geological and from a practical point of view. That it has hitherto
escaped due recognition, is probably due to the prevalence of the old idea that 20
vein deposits are necessarily the filling of open fissures, and to the failure to ap-
preciate to how great an extent they are actually the replacement of rock ma-
terial rendered more readily accessible and attackable by the dynamic move-
ments which produced the fissure. This feature will be more fully illustrated in
the practical examples given later." 25

The Court: With regard to these shear-zone veins, they are formed by
lateral compressions? A. No, your Lordship, they are formed like any other
fissure by some force of upheaval, but the lateral compression alone, mere pres-
sure without movement, would not form anything; but they are uplifted under 30
great lateral compression.

The Court: That is exactly it. I did not understand and do not now.
What is there to compress if there was lateral compression? A. There is
this. For instance, in the contraction of the earth's crust, or the side thrust 35
which comes from the slow raising of mountain ranges, they may give a thrust
or pressure extending through the rocks laterally, so that all the rocks may be
under an intense horizontal pressure from both sides. Then if by another force,
for instance, that pressure as long as it is received by a rock perfectly at right
angles to the rock structure does not cause the rock to buckle; but suppose that 40
rock begins to buckle, to lift up: you have still the lateral pressure but a verti-
cal component, as engineers say; an upward movement, but all the time this
tremendous lateral pressure besides, and you may get a fissure to be sure, be-



cause the rock gets greater pressure than it can stand, and its cohesion gives way, and produces a fissure. But it can not be opened, and as it does not open it does not relieve the strain, but to drag the rock on which the sides give way, when you get a system of parallel fissures until the strain is removed. Now, Becker's abstruse mathematical discussion is intended to show theoretically—not, of course, for any given place, but theoretically—on the supposition that the fissures are all alike and the plates are all equally thick and that the upheaving force is like a string tied, as it were, to the surface and pulling on one plane alone. Then he undertakes to show how far that will go before the pressure is released, which is purely a theoretical discussion.

The Court: The law of this question has been applied to other things in nature outside of rocks; I suppose it applies to rocks, too. A. That is, expansion by heat.

The Court: By heat. A. Up to a certain point it does.

The Court: It does not lead to pressure, of course. A. There are a great many ways in which pressure comes. One way is supposed to be by this shrinkage of the earth, the slow shrinkage which makes it in cooling necessary for the crust to shrink and wrinkle, because it gets too big for the earth as it shrinks away, and that naturally wrinkles and crusts. That is one idea that has given reference to the rising of land out of the sea; but it is recognized now that there is considerable alteration going on, and some parts of the earth's crust are shrinking and others rising as the circulation varies. All these motions give rise to strain. You cannot tell how they will come exactly, but we do find on all our great continents, for instance, long, longitudinal mountain ranges: the Appalachians on the Atlantic coast and the Cordilleras on the Pacific coast. They are all produced by crumpling on the inside of the earth's crust. They have not been built by piling up masses of material, but they are produced by the crumpling of the crust. In the State of New Jersey where I live, we have that side-thrust and crumpling shewn in the most tremendous way. All the gneisses and granites in that part of New Jersey are folded and then cemented together again so that when you go underground you can not find the walls; you can not find the planes of the folds (faults) because the alterations of the rock have obliterated them, and what we do find are great iron mines in layers that used to be in beds, and the seams are folded and thrown in echelon, as we say, and we come to them here and there and it has all the evidence of this side-thrust. That is where the side compression comes from. In this case there is also compression that comes from the simple weight of the rock overhead. It is true in a certain sense, rock piled up would only have a vertical pressure, but when the rocks are in a solid mass like those igneous rocks there is a distribution of pressure analogous to that of water. A pail of water presses in all directions, and rock will do so too. I have known, for example, your Lordship, in the sand-

stone rock in the Shawangunk Mountains in New York, where a tunnel was being driven through the mountains, in a large section—a big double track tunnel, the contractor of which was a relative of mine—the following occurrence: It was a pure sandstone, nothing volcanic, no gas, no water, pure, dry, hard sandstone that had been resting there undisturbed for years and the tension all through the rock had got equilibrated. And one Monday morning after the men had been out of the tunnel over Sunday, having gone away that Saturday night leaving the face of the tunnel that had never been exposed before; where they stopped work there was a face of rock that had never been out or exposed before, and the rock that had previously supported it they had blasted away. When they went back Monday morning, as they entered the tunnel this peaceful face of sandstone rock exploded and fired a big chunk at them, and they ran, of course, in great terror, and could not be got to go back for several days. The case was referred to me. It was simply a case of change of strain in a big mass of rock and the action of that mass of rock in analogy to the way in which water would spurt. There was a pressure taken away and it made lateral pressure and actually broke a piece of rock out and threw it a distance to the drift. We have had cases also in North Carolina that made great sensations in the newspapers, where mountains have blown pieces of rock out and people thought they were going to have volcanoes. In other words, very large masses of rock several thousand feet thick, with tons of weight on top that under great strain all through, and you don't know how the strain may be affected by either release or addition that may be made at any point. Mr. Emmons in the same article, on page 830, says:

“These walls and selvages are a frequent accompaniment but by no means an essential characteristic of the ore-bearing fissure. It is quite conceivable that one or both may be wanting, and such occurrences are not uncommon in nature. Take, for instance, the veins of Butte, of which I gave a brief description at a former meeting. These are a series of co-ordinate fractures or compression fissures in a remarkably homogeneous mass of granite. Apparently there has been little or no displacement on the walls of these fissures relatively to each other, hence but little attrition material has been produced, and for this reason—and probably also on account of the character of the rock and because it was not much decomposed along the fissure planes before the advent of the ore-bearing solutions—no clay selvages have been formed and the ore-bearing solutions have eaten into the wall rock to varying distances, replacing it more or less completely by vein material, and leaving no definite boundaries or walls to the deposits. There is no reason, however, for considering them any less true fissure veins, or less valuable ore deposits on this account. * * * *

“In the Gunnison region above mentioned for instance, where owing to the plasticity of the country rock it has been divided along the main fracture planes into a series of very thin parallel sheets. The space between these sheets



has frequently been filled by quartz which thus forms a thin sheet often so completely reproducing the forms of the fissure as to prevent a cast of the striation surfaces. Such a sheet of quartz when the joining bands of country rock have been replaced by vein material, forms a hard, well defined wall to the ore-body which delights the eye of the honest miner, and enhances in his mind the value of his property.

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"Ore may be formed as well on one side as on the other of such a wall, and not unfrequently is apparently confined to one side for a considerable extent along the length of the vein, and then is found almost as exclusively on the other side. Thus in one prominent mine in this district I found a drift run for several hundred feet in barren country, but following what was apparently the direct continuation of the vein which had been yielding a large amount of rich ore. After a change of administration in the mine, it was found by cross-cutting that there was a continuous ore-body only four to six feet to one side of this drift and parallel with it. In another mine in the same district which had produced a great deal of very rich ore, I found that although there were frequent cross-cuttings into the country on the hanging wall side disclosing the usual systems of parallel fissures, none had been made on the foot wall side. The reason given was that this foot wall was so uniform and well defined throughout the mine that it was considered useless to explore beyond since it must necessarily be the limit of ore in that direction. An examination shewed that there was no geological reason for this assumption in the character of the rock, and that it was simply one of a number of quartz fillings between two sheets of country rock. On visiting the mine a few weeks later, I was told that in the southern portion of the mine where the vein had seemed to be running out at the time of my first visit, a new body of rich ore had been struck by cross-cutting into the foot wall country. The moral is, that judicious cross-cutting forms a very important part of vein mining," etc.

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On this subject of shear-zone veins and structures, not to multiply authorities, and particularly not to refer to those which I have not with me, which I am very reluctant to do, I will present a paper by Peter MacKellar, Fellow of the Geological Society, of Ontario, Canada, which came to me from the members of the Canada Society of Geological Survey some months ago, and was presented at the meeting of the American Institute of Mining Engineers at New York City, February, 1899, on "The gold-bearing veins of Bag Bay, near Lake of the Woods in Canada." I got a copy this morning by accident from my office in New York, with other pamphlets that had just been issued, and I happened to find in it this passage concerning the veins: "Vein Characteristics," beginning on page 8 of the paper, title of which I have already given.

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"These veins consist of small quartz sheets with comparatively large quantities of altered granite (mikadoit) which shews a schisto structure next to the



quartz and passing by gradual transition into massive granite. It is generally charged with fine iron pyrites, etc."

On the next page: "Principles of vein formation."

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"In my examination of these veins I was for a long time unable to understand the nature of their formation, nor did I find the conditions present to agree with the ordinary fissure vein theories of which I had any knowledge. I came at last to the conclusion that during the movements that caused these rents a sufficient pressure was exerted to prevent such a compression of the walls as would leave an opening or gap for the silicification of vein matter. Therefore the opening must have been created afterwards."

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That is, the opening must have been made by the solutions dissolving out part of the country rock. "There can be no doubt that the rock masses which were involved in creating the fissures must have been enormous, and that the granulation and lamination of the walls would be a natural consequence, consequently the heated solution that would surely percolate among the fissures and interstices would be likely to dissolve and create granulated portions for the reception of the silica or other vein quartz, while the other crushed portion would be metamorphosed, as is well represented by Prof. C. R. Van Hise in his admirable paper on Metamorphism of rocks and rock flowage."

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Prof. Kemp in his treatise on ore deposits cites a number of deposits which were replacement deposits in parallel fissures. I have so far spoken, however, only mainly of the structure of the fissure. I want to state now about the manner in which it has been filled. It might have been filled by infiltration—conceivably, at least. One thing that has been suggested is that it was filled by lateral secretion, and might be followed by replacement. The Canada Geological Society in its summer report for the year 1896, sums this matter up very well in regard to this Trail Creek District. Mr. McConville's report was published in 1897; from it I read the following:

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"The classification of the Trail Creek ore bodies and sulphide deposits, and generally of the igneous rocks of the district, is a difficult problem, and one which has given rise to considerable differences of opinion. They may be original segregations from a cooling magma like the Sudbury pyrrhotite ore, or secondary segregations from the basic rocks which enclose them, or replacement veins along lines of fissures, or as a majority of miners are inclined to believe, true fissure veins. Isolated examples might be cited in support of any of these views; but as a rule the theory which fits in the best with the prevailing conditions is undoubtedly that they are replacement veins along the lines of fissures."

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That statement I agree with entirely, except so far as it makes a distinction between true fissure veins and replacement veins along lines of fissures. They



are just as true fissure veins as the other; they are composite, not simple, but they are just as true fissure veins, because they were not produced by alteration of their original contents alone, and they were not produced by lateral secretion from the rocks enclosing them. They were produced by the intrusion of foreign and new matter through the fissures, therefore, they are fissure veins. They may not be as simple, they may not be as small; but they are true fissure veins.

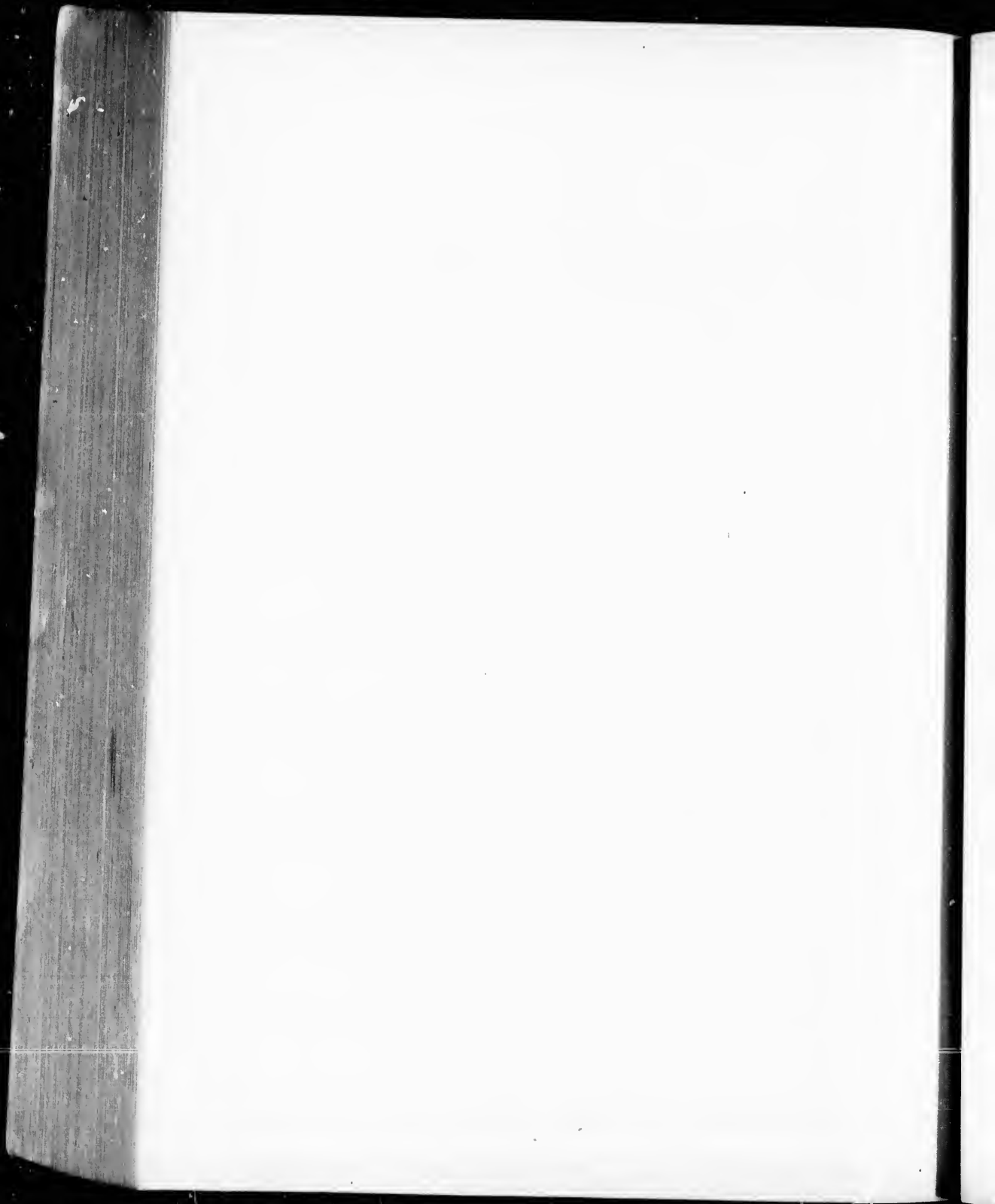
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Now, with regard to the two other theories, first, magmatic segregation, that is to say, the theory that the veins of these ore bodies—that these bodies of continuous pyrrhotite and chalcopyrite—were produced by a compression in cooling analogous to what we get down here at Trail at the furnaces where they run into a pot in front of the furnace a mass of melted matter: when it stands a while and gets cool and they dip it out of the pot there remains at the bottom of it a matte, and the matter being sufficiently heavy separates from the slag. This is magmatic segregation. The matte being specifically heavier has sunk. And in the cooling of a large mass of melted rock there might very well be parts that would cool first or would go to the bottom or would go to the sides for some reason and would be found in various masses afterwards. When the whole mass was cooled those parts would be separated from the rest in the process of cooling. I am not at all certain but that coarse rock at the bottom of shaft No. 2 is a specimen of that kind; that is to say, that the coarse rock at the bottom of No. 2 shaft in this case may be nothing but a coarse face of the country rock. The difference is very plain; it comes down from fine-grained rock into a coarse one, and it may have been cooled in that way and formed a ball or sphere of very fine rock when it is cooled. It may shew up to be a dyke when it is developed further. That is, to have come in later altogether, into the fissure in the country rock. The idea that pyrrhotite ores, particularly nickel pyrrhotite ores, nickeliferous (the ores of nickel), the ores of pyrrhotite, have been thus reduced in great masses of molten matter by simply cooling and separating as they cool, has been very thoroughly discussed of late, and it is established with a few deposits, and absolutely rejected and disproved by all the rest—for the greater majority of pyrrhotite deposits, there are a few in which it is recognized. They are absolutely unlike these deposits here. No man that has any experience with them would ever undertake to say they were the same, and I will support that opinion if desired. I won't waste the time at present but will simply say so. There are characteristics which conclusively forbid that theory.

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Now, as to the question of lateral secretion theory. This is a sort of scientific fashion of fad that comes from Prof. Saundburger, of the University of Wurtzburg, Germany, some 20 odd years ago, and has been very thoroughly threshed out. Prof. Emmons has been cited here as representing and advocating that theory; and therefore I will read the latest thing from Prof. Emmons on the subject, in which he shews that the theory he represents is not

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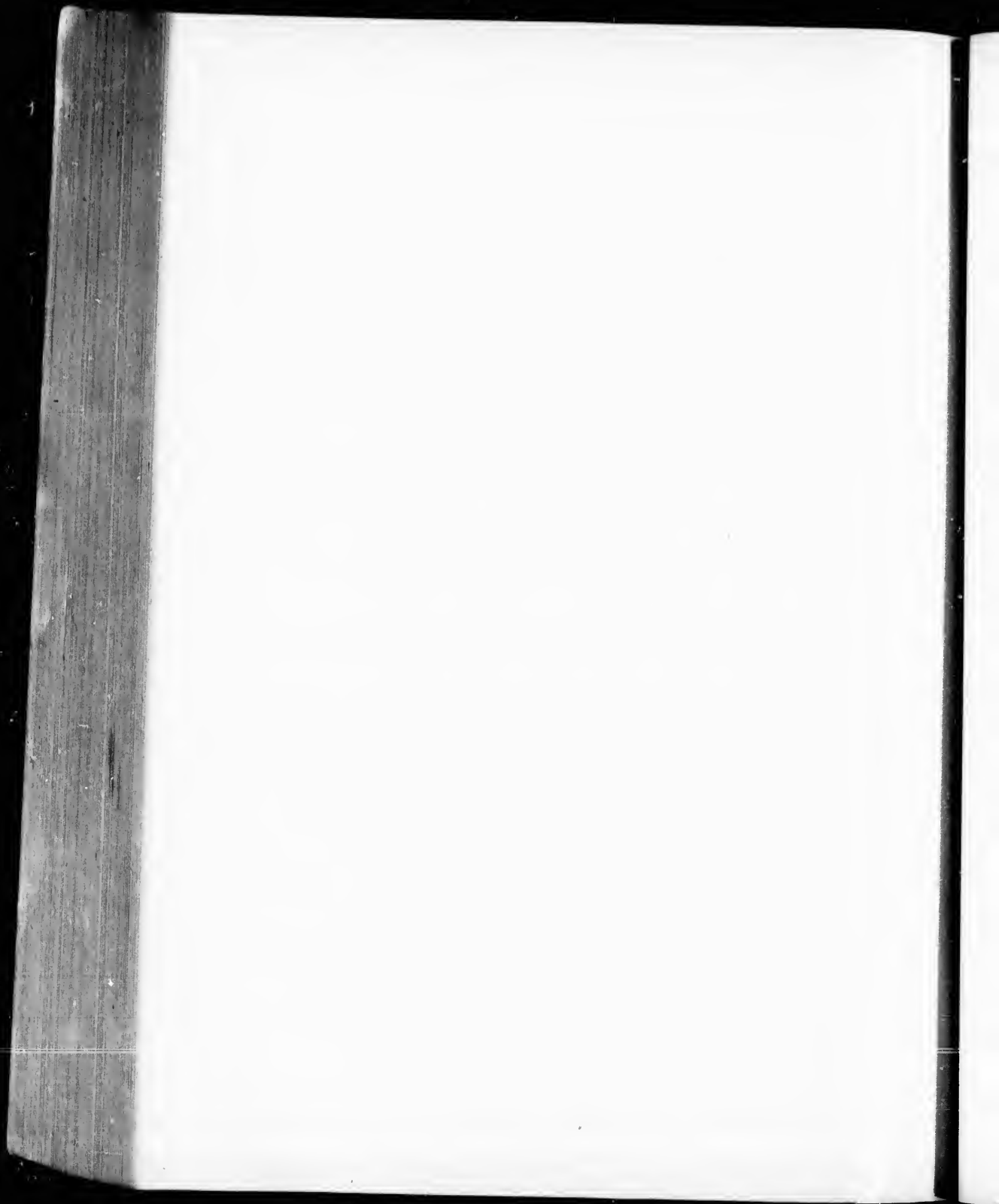
that one at all. As to the Leadville deposits, Prof. Emmons never has advocated lateral secretion as the origin of those deposits, but has always said, and says to this day that in his opinion the minerals of lead and silver, tin, zinc and iron contained in the Leadville deposits came down from above. But he never said, and he does not say to-day that it came from the adjacent rock. The Leadville deposits are based on limestone with quartzite under them, and then there is a limestone, and then a white porphyry; and in the limestone and at the back of the limestone and quartzite occur the principal composite bodies. Now, the great contact bodies of Leadville gently dip about 10 or 15 degrees. The white porphyry is the rock over them, and Mr. Emmons distinctly declares that he does not say that the ore comes from the white porphyry, so that it is not a lateral secretion in Sanndburger's sense. I read from the discussion of the paper of Prof. Prosepný on the Genesis of Ore Deposits, which is a paper and discussion plinter in Vol. 23 and 24 of the Transactions of the American Mining Engineers that have been re-printed in separate volumes issued by that society in 1895, which contain discussions to which Mr. Emmons contributed; and Prof. Prosepný, as is well known, has attacked the secretion theory of Sanndburger. On page 185 of this volume Mr. Emmons says:

"The lateral secretion theory, which Prosepný ascribes to Sanndburger, is much narrower than that which I, and I think most American geologists, hold. It confines the derivation of the vein contents to the wall-rock in immediate contact with the deposit."

This is the theory which Prosepný ascribes to Sanndburger, but Sanndburger in fact said "It is the only later secretion theory." I have the exact quotation from Sanndburger.

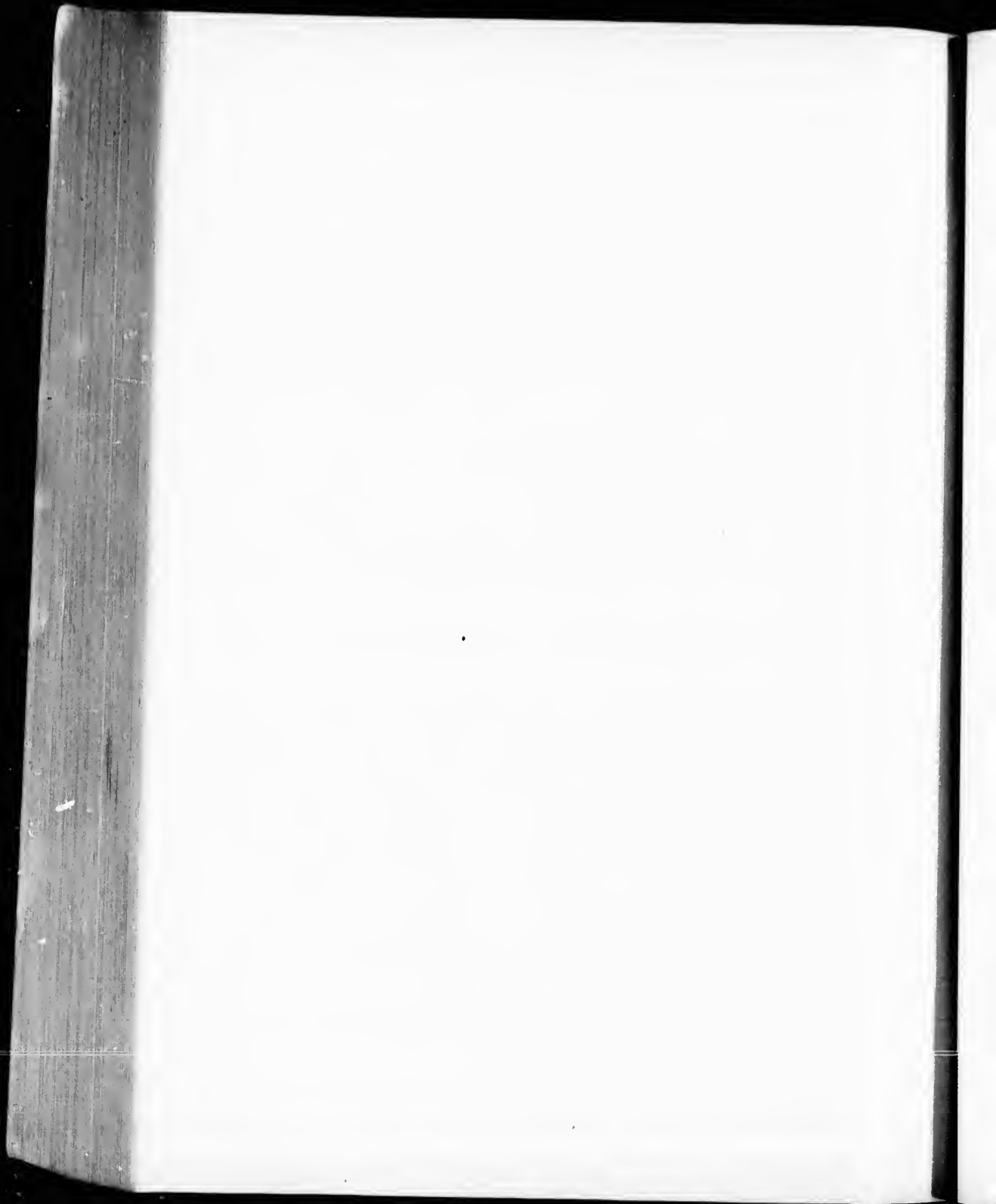
Mr. Emmons continues: "Whereas, in my opinion, the derivation from rocks within a reasonable proximity, as opposed to a source of unknown depths ('in the barysphere'), would constitute lateral segregation and ore bearing currents may in such cases have had an upward and downward or lateral motion, according to differing local conditions of rock structure."

In other words, Mr. Emmons' lateral secretion means upward or downward or sideways—or any ways, only, he will not grant that the ore-bearing solutions have come from the centre of the earth, or from any very great distance down. He thinks it was not far away, he does not know in which direction and he does not know how far, but he says it has got to be a reasonable distance. In my own comments, which I will not read here, which are of no importance, I pointed out that Mr. Emmons was on the same ground that the rest of us was, and he says it comes from the country rock, except not the country rock adjacent; it may be for all that, that his theory involves the country rock



away down the whole thing, where the origin was of volcanic force, and that would be the country rock. The bottom of every fissure ends in country rock, and every fissure of mineral bearing solution comes from country rock. The only difference between the ascensionists and descensionists and lateral-secretionists is, that the ascensionists say that these minerals came up from below, they 5 do not know how far, because they find them in the country rock, as far as they have examined them, where we contend they came from below, deeper than we mine in the bottom of ore deposits—which means that we still find them below; the descensionists say, No, they came from above, and the place they come from we do not know, but it is all ore going down. While the lateral-secretionists say 10 we do not know whether that came from below or above; it came from most anywhere, only it must be reasonably sure. The theory of the lateral-secretionists has entirely evaporated: it has no definite value any more. Prof. Sanndburger, as he announced it, gave it a definite value, because he said distinctly—and he proved it very plausibly from a single vein in a single rock—that he examined, 15 that went through a rock-fissure, that went through two kinds of rocks; he proved that when it got into the other kind of rock it had other minerals, and he took the rock and analyzed it microscopically, and found little bits of those minerals there. The same test has been applied over and over again to other districts, and it does not work. Consequently, Professor Sanndburger has 20 proved lateral secretion in only one single solitary case, and it has utterly collapsed as a theory for any general formation of ore deposits.

Very well. Now, there is a single proof here, but there is all of the rest put together absolutely, so far as you can see, absolutely conclusive as to those 25 deposits, as to the method of their formation. I myself do not believe that, do not feel sure that there has been absolutely no open fissure in this shear-zone which is now filled by the Centre Star No. 3 vein. I don't know but where these big beds of pyrites came from; there may have been a great accidental crack big enough for some solution to come up in the ordinary manner, not by 30 capillary working, and by replacing every atom, but it is proved first, in the occurrence of pseudomorphs, that is of crystals having the form of other minerals, which go to shew that the pyrrhotite has been formed in these veins, and has taken the form of the original country rock—has taken the form of the crystals, of diallages, and the crystals of augite, and that could only be done if there 35 was the crystal of augite there, and the pyrrhotite has gone into the same. There is pseudomorph, if general pseudomorphism is proved, but I cannot find that pseudomorphism except as to occasional handsome specimens. The general look of this pyrrhotite I confess looks to me a good deal like the pseudomorphic replacement of rock. In other words, to put it in homely phrase, when I look 40 at the edge of this body in No. 3 vein going down, this solid continuous body of pyrrhotite, it looks to me like other parts of the country rock torn to pieces, just pyrrhotitized right where they were, shewing their original structure rather than a deposit of pyrrhotite on the walls of a fissure, which would be shewing a dif-



ferent structure of crystals growing together. But I would consider that rather vague, and I do not consider that conclusive. I think it may be true enough, and yet it may have been the last stage in a succession of metamorphoses which obscured and obliterated what had gone before. So I will not deny that there may have been, and what would occur, but when we come to the characteristic origin on a large scale of these deposits in the Red Mountain here, the microscope tells the theory without any manner or shadow of doubt. I have seen under the microscope in slides of this rock, which I suppose will be hereafter put in evidence (because they are thoroughly identified, they were cut from this rock, sent to Washington, prepared at Washington, and kept under seal, kept and sworn to, and delivered here), and I have followed it with the microscope and I can see the crystals of augite and pyrrhotite eating them out.

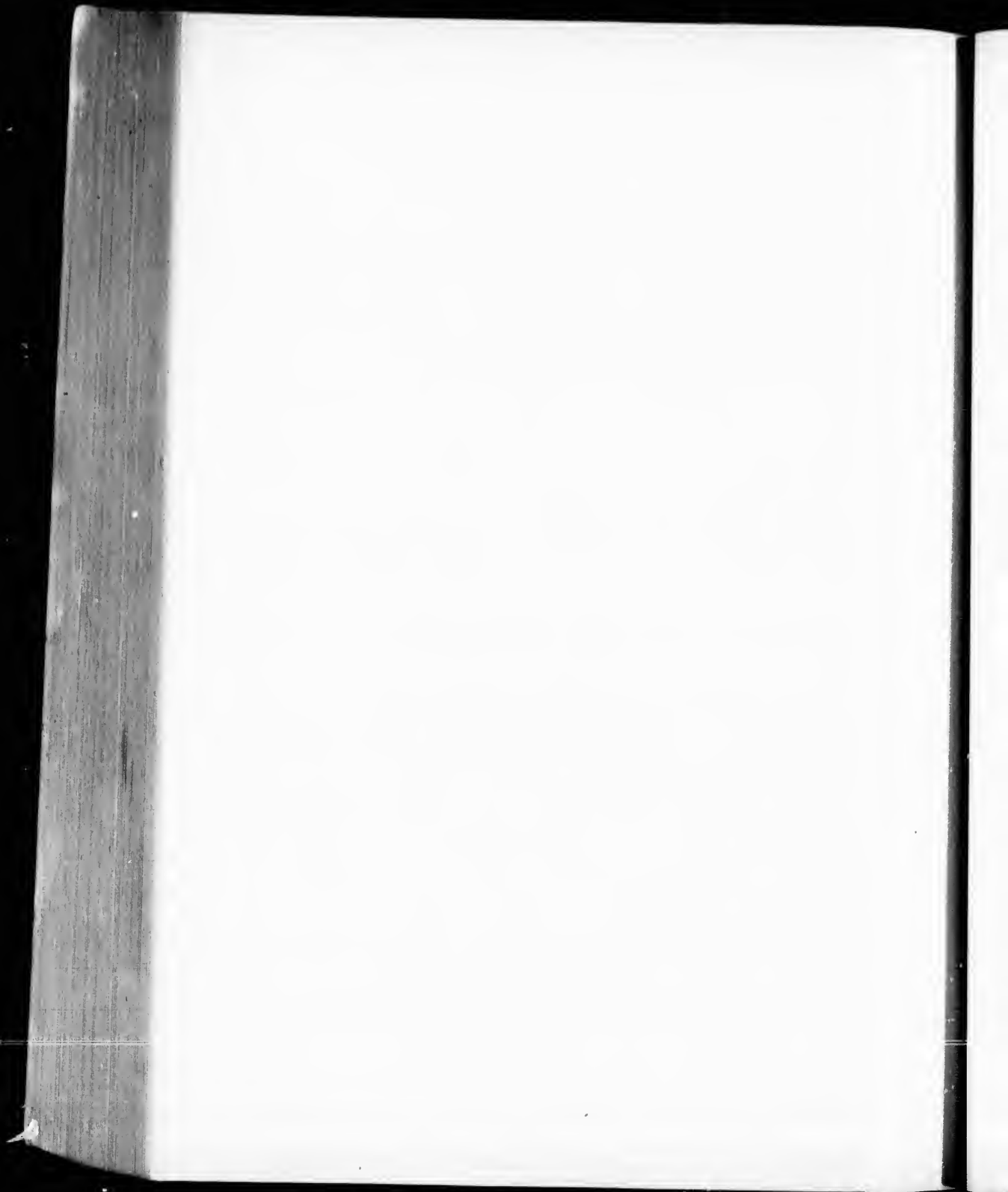
The Court: You can see it? A. I can see it with my own eyes. It can be inspected. Had it not been for this little matter of adjournment, we could probably have got our apparatus in order here so that it could have been seen on the screen, but what I have seen and can swear to is the process of the replacement of the crystals of the country rock in this case by pyrrhotite, actually caught in the act, some beginning, some of them half way done, and some of them just finished, and that settles it. Therefore I say that this ore has been deposited by replacement, certainly, and possibly, to some extent, by infiltration, also, in the minute spaces formed by shearing, shear-zone.

The Court: You say it has been so deposited? A. It has been so deposited by replacement, because I have seen the replacement going on.

The Court: Would that be merely a process varied from the ordinary process? A. It is a varied process, simply because the ordinary process brings in the new material into each hole which is made, from below. This process starts without any large hole, starts with a little hole, and makes it big enough to get in, and makes it bigger by eating it and sending it out into solutions.

The Court: Melting it up. A. It is an exchange of material. The only question now is as to the alteration produced in the shear-zone, mineralization so-called. To my mind as a miner, mineralization means impregnation, or filling in some way with ore matter, but still there are vein materials with vein minerals that are not connected with ore. We do not say that quartz is a metallic ore, and yet quartz may be characteristic in a vein, as vein matter.

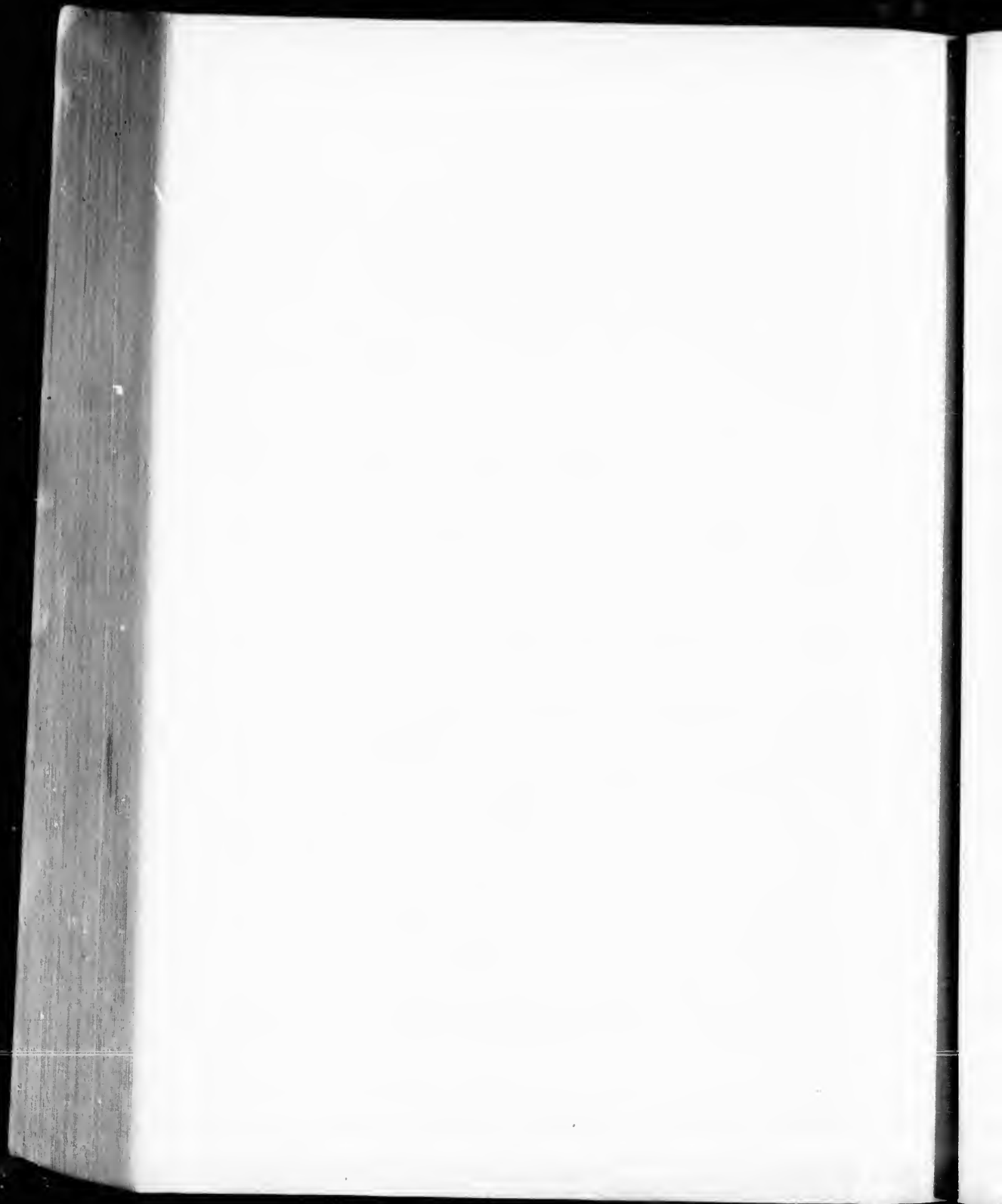
Now, we find in this vein, besides pyrrhotite and chalcopyrite and pyrite and gold, we find brown mica which is no doubt made by original alteration *in situ* of the ingredients of the rock. That is a thing that the rock will develop; you find it in the vein and in the country rock, only the action is more intense



inside of the vein, and fades out gradually in the country rock. Now, the ingredients of that mica were in the country rock before it was altered at all; the alteration that has gone on makes the brown mica in the rock, and you can see it in a number of these specimens, a little brown rusty looking rock, and we find it very frequently and sometimes highly developed in the immediate vicinity of these planes. 5

In addition to that there is what I call a silicification; that is rock, no matter what fine distinction may be drawn about it, or what name may be given to it, is a basic rock. Everybody will say that. It is characteristically a rock without quartz in it. The rock of this mountain belongs to the quartz free or quartz poor classes of rock. 10

The Court: I think silica is equivalent to quartz. A: It is characteristic of this rock that it is very low in silica; that is why these gentlemen have called it a variety of cyanite, because cyanite is hornblende and feldspar without any quartz, and if there were quartz in it it would be granite. This is basic rock. All of these basic igneous rocks are usually dark colored or gray brown, shading very black according to circumstances, but in this case we have primarily a rock which would be low in quartz, which is not as low in quartz as some basic rocks, a sort of very dark rock. It has been called monzonite and augite and cyanite and augite-diorite, but in any case it is a basic rock and low in, but not absolutely without silica. I think that the mineralization of that rock has involved the segregation of more free silica in it than the rock itself would have furnished, that is a mere impression, but I have examined it a good many times and I think there is some fresh silica in it, besides that which was in the rock before, and it might have been reformed by alteration of the rock. The rock reforms and you get mica out of it, and you get free silica out of it, and various ferro-magnesian minerals appearing there, but the ingredients were already there; that is, ordinary alteration of rock in place, that might happen, and that re-arrangement existing in this land might happen. The question is here, would you get as much silica as I find in the rock, and I think it would be apparent everywhere, it would not be possible without a very long sampling and very complicated and long analysis to get at a definite idea; but I would not mention that at all as a mere theoretical curiosity, but I mention it for this reason, that the contents of this ore did not vary with the amount either of pyrite, of chalcopyrite, of pyrrhotite, or either of the two classes of pyrite. You may take any one of those tests you like, and you can't tell by examining the ore what it is going to assay; one piece will be richer than another. I have tried it, and you come to grief over and over again, and I have been told time and time again by captains of mines here that that is their regular experience, that they cannot tell beforehand, that there are rapid alterations of value, that they get \$1.50 in value per ton from one place and \$20 from the next, and more, too, in the same continuity apparently. On the other hand, neither has it always ear- 15 20 25 30 35 40



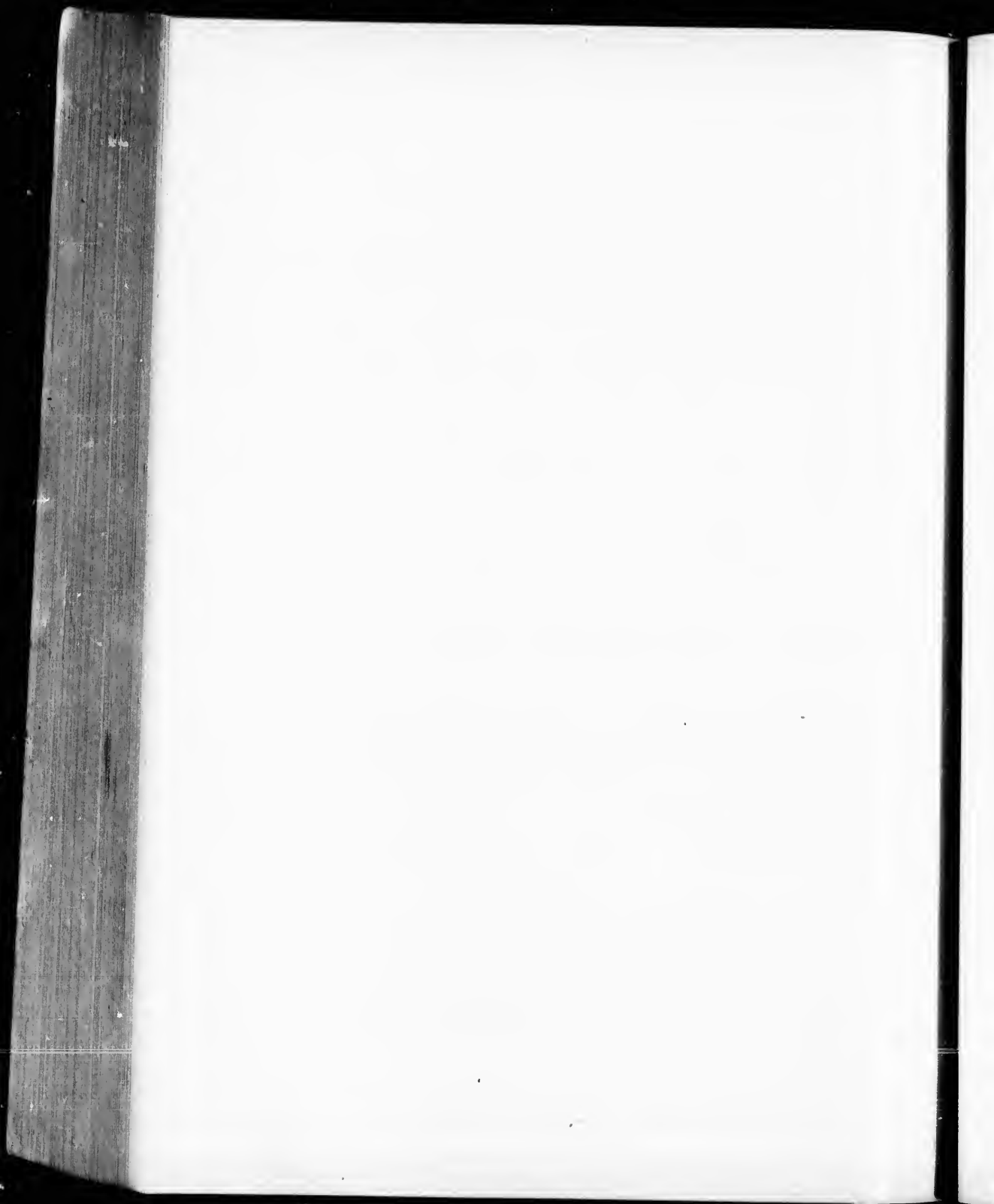
ried quartz. I thought when I came here I could help them out, and I suggested that the value was in proportion to silice, but I found that was not true. Now, I am crowded myself to the theory that the gold values here are dependent to a considerable extent on the proportion of a certain class of silice—not of the total silice, because the total silice includes what was originally in the rock and some which might have come in with these solutions; I think silice came in from the outside, as one of the replacing minerals. 5

The Court: Is the presence of this pyrrhotite and chalcopyrite a sign of its being gold. A. They carry gold in this camp. Everywhere they are not necessarily signs of carrying gold. Chalcopyrite is with us a very good carrier for gold, better than pyrrhotite, and pyrites is very good, and arsenical pyrites is better yet; but quartz is the best of the lot; that is, quartz is the most abundant generally of the lot, and we hardly ever find gold without some quartz. I am merely speaking now of the fact and what seems to me to be the explanation of the fact that these ores vary so largely in their tenor of gold. The tenor of copper of course goes with the chalcopyrite. There is nothing else there that 10

over but gold sometimes runs very high in the rock where you cannot see any chalcopyrite or any pyrrhotite. I have taken samples and seen samples from these veins, from the seam above the solid sulphides, where to my mind, sulphide would be the best ore of the lot out of cracks, and yet the seam above did not shew any, and it assayed a great deal higher. The gold had got in there with the quartz. So you cannot always tell the value of a given piece of ore from these veins from its looks, or as to solidity from chalcopyrite or pyrrhotite. I say with regard to the formation of the veins this vein, this Centre Star No. 2, is a vein occupying a shear-zone, occupying a shear-zone, occupying several parallel fissures, which I think it occupies down to the point at which I have examined it; chiefly one fissure with, however, a couple more on top and one more underneath, and that is all I can find at the apex. At the railroad cut I have measured what I considered to be the fair width of the vein formation— 15 20 25 30

The Court: What you mean is that there is a superior wall as in some cases that Mr. King mentions. A. Yes, sir, one beyond it. 35

The Court: Do you suppose there would be one of what he meant as a superior wall? A. From some questions that were asked Mr. Lindgren, I supposed the theory was that there might be any number. I don't know what there might be, but I think I know what there are, and I say that the maximum width is 20 feet, and the width shewn at the apex is 15 feet, and the width shewn at the top of No. 2 shaft is somewhere between 15 or 20 feet, and then I know places where I can see the walls, and I do not believe there is any place where there are any walls to that particular shear-zone vein that are wider than 40



20 feet apart, in the part so far worked. What the width of a vein may be somewhere below nobody can tell until he gets there. Is there anything I have neglected?

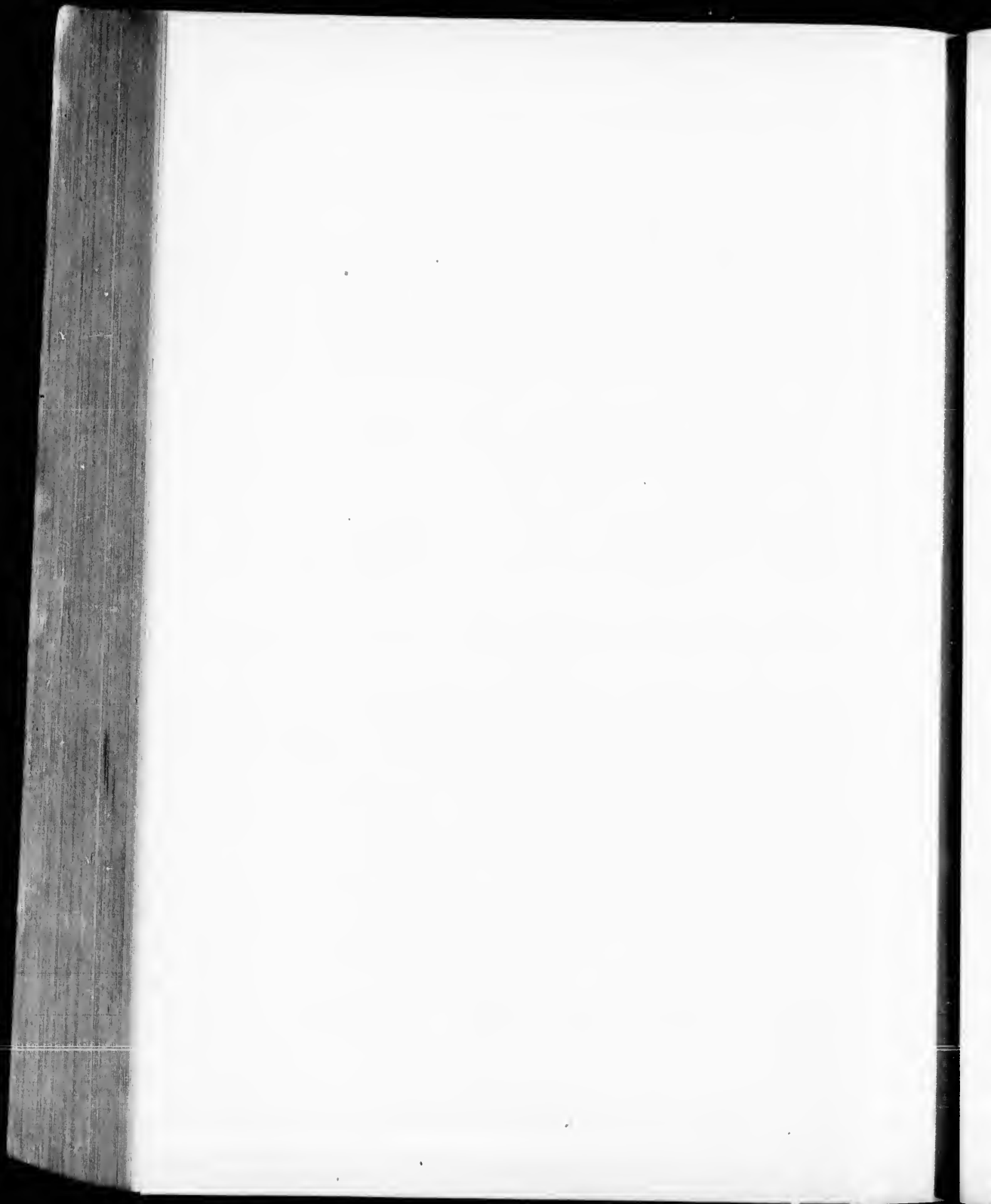
Mr. Davis: I think not.

The Witness: Could I have the privilege in the morning, if I have forgotten anything, to add to it?

The Court: Certainly.

Thereupon an adjournment was taken to to-morrow, May 4th, 1899, at 10 o'clock a.m.

Q. Dr. Raymond, you said something yesterday about the winze below the bottom as it was prior to this new work being done—the Centre Star east winze from drift 59. You might state now what you have to say with reference to that. A. According to my recollection, I said that the vein of solid ore, pyrrhotite, pyrite and chalcopyrite, which was seen in the Centre Star winze above the flat fault properly began below that fault in the bottom of the said winze, having been dislocated a few inches, about 18 inches at that point, I believe. I have since examined the bottom of that winze at a point some three feet farther down, that was exposed the day before yesterday by the work in progress there. At the time of my examination the broken rock had been removed from the winze and was lying in a pile in the drift at the top of the winze. I found a seam or body of solid sulphide ore containing chalcopyrite and pyrrhotite, having the general dip of the winze and proceeding from the bottom into the rock in that direction. It had also the general strike of the Centre Star vein as shewn in the sides of the winze or in the west side of the winze above the flat fault. It also came up on the east side of the winze to the same small dyke which constitutes the east side of that winze practically all the way down except at one point where it has been broken through in working and shews ore behind it. The new work had not broken through that dyke at any point, but had gone down on the side of it. I took the heap of rock that was



lying at the top, this piece, simply because it was a piece of convenient size and shape to carry. I do not know that there were any pieces that I saw greatly larger than this, but this is not particularly larger than a good many that were lying there, and it was not selected with any particular care except for its being a pretty size and shape for an exhibit; and I identify it as a piece which I took at that place and at that time. 5

The Court: You took it from the dump at the top of the winze? A. From the dump at the top of the winze, from the new material taken out by this work. All I can say as to its certainly being new material taken out of this place is, that my visit was unexpected to anybody there, the last time I was there there was nothing in this drift in the way of new ore. This was perfectly clean and I have no doubt, and there is no moral doubt, that this stuff—a number of tons of stuff lying there—was the fresh product of that work. It was freshly fractured, it could not have been mined long before at any point. This piece shews chalcopyrite, pyrrhotite and quartz, and indicates by its weight that it is what we call practically solid ore, though seamed with quartz. 15

This piece of ore was tendered by Mr. Davis as an exhibit and was marked Defendants' Exhibit 141. 20

The Court: You say this contains chalcopyrite, pyrrhotite and what? A. Quartz.

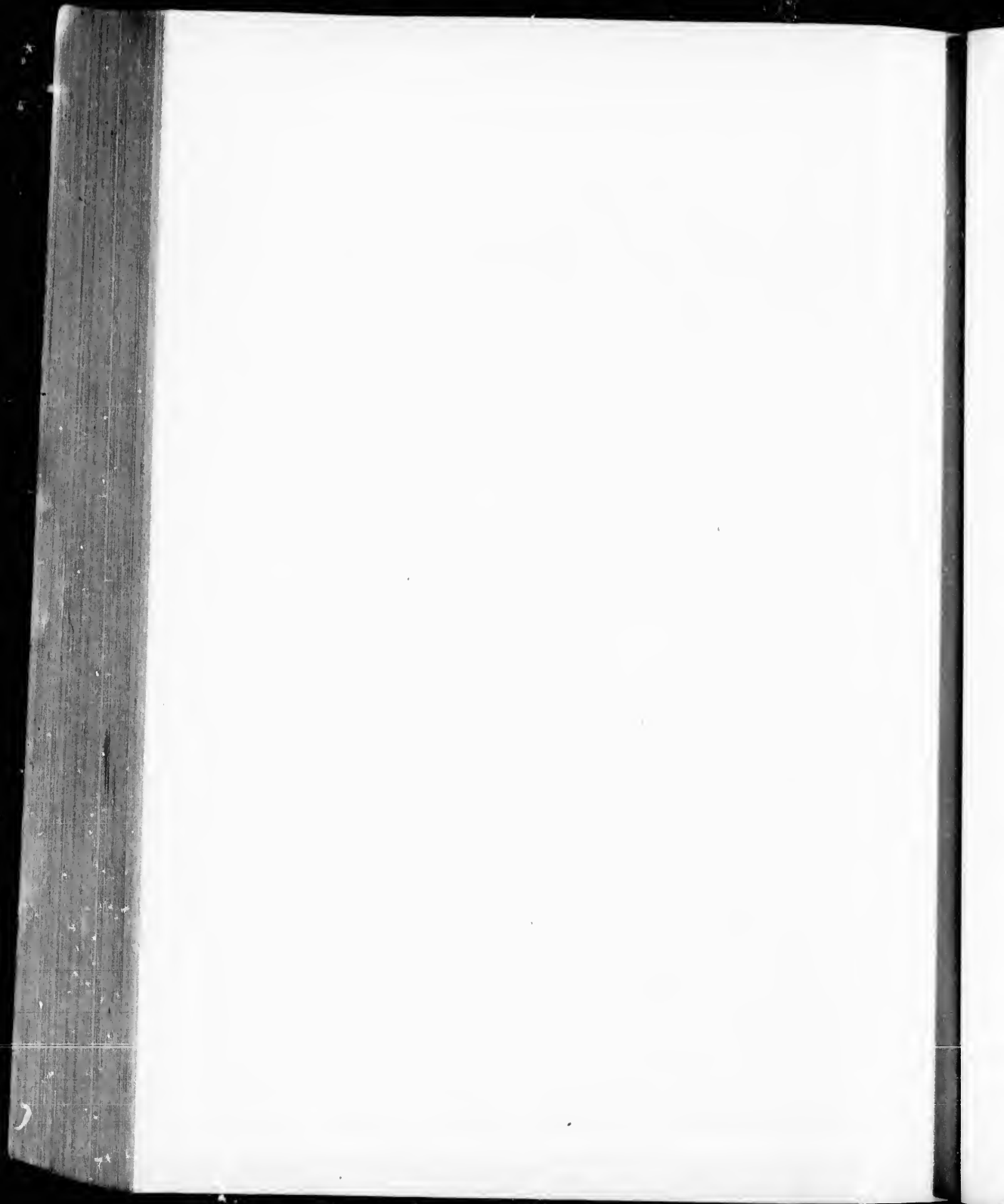
The Court: What is called silica? A. Yes, free silica, not silica in combination.—I find, your Lordship, in thinking over what I put in yesterday, that I omitted to read one passage—I wish to cite one more authority in this connection, namely, "The Mineral Industry, its statistics, technology and trade, for 1895," being the 4th volume, edited by R. P. Rothwell and published in New York in 1896, which contains a number of scientific essays from different authorities, and among others, an essay by Prof. J. F. Kemp, whom I mentioned yesterday, who is professor of geology and ore deposits at the Columbia University School of Mines, City of New York, and is considered our leading professional authority, that is, college authority, on this subject. This was his outline of the opinions held to-day on the origin of ores, and that being the subject, I consider it very appropriate and an important authority to introduce, because there are so many theories at different periods that it is interesting to know what a master on the subject would say is the general view in which geologists unite, not a single theory, but the general point on which they all unite, as to the origin of ores. I read from the first page of that paper, which is page 755 of the volume named. I will read a single paragraph: 30 35 40

"So far as the standpoint of geologists to-day may be briefly summarized they are as follows: If we understand veins to imply filled fissures with more or less



attendant impregnation or replacement of the walls, and if such occur in stratified or massive rocks that have not been so much disturbed or metamorphosed as to obscure the relations, we practically all believe that they have been filled by solutions which, in most cases, have ascended from interior and probably more heated parts of the earth. Thus if an ore body is found in what is clearly a filled crack, either along an important fault line, or in one of a series of them, or along a crushed strip (shear-zone), or some such line of fracture that indicates a previous movement of the walls, there seems slight, if any, doubt that these veins hold true."

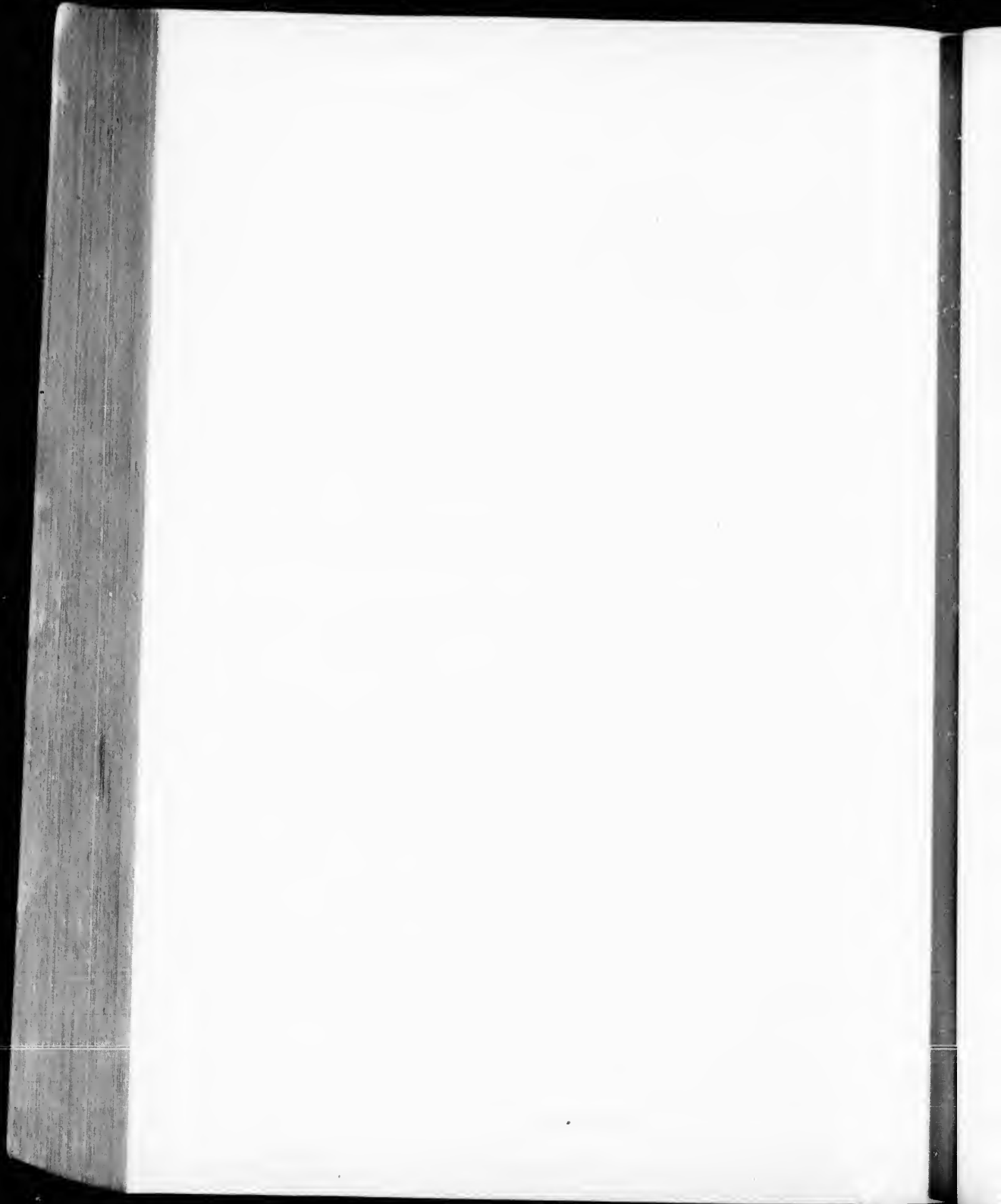
That is, that the views here referred to are the views just stated, namely, that they have been filled by solutions which in most cases have ascended from interior and probably more heated parts of the earth. Prof. Kemp continues: "Some may think that the solutions have seeped into a standing pool in the fissure from the walls,"—that is, lateral secretion—"but if such solutions are assumed to have been at the time anywhere near the surface, the conditions are so unfavorable for dissolving in cold natural waters such insoluble minerals as are most ores that the explanation has small claims to credibility. If the walls are assumed to have been at great depth, we have practically the same conditions as in the other views." That is to say, the assumption of lateral secretion or lateral flow from the country rock at great depth into a fissure, then it becomes the same as the ascensionists' theory, because we do not deny that at great depth the rock from which the mineral originally came would be a country rock; that is, it has got to come into the vein from something that is not the vein. It is not necessary to read any more; that simple statement of consensus of geological opinion at the present day in regard to that subject is sufficient. Let me say in conclusion that it does not exclude the admitted fact that in certain special cases a form of lateral secretion, or lateral influence by the country rock in supplying minerals to the vein has been established for a single exceptional case. As a general theory it is not accepted, and in this particular case, as I have already explained, it is not tenable. One final sign which I omitted to mention the other day, that the contents of this vein of the Centre Star, or similar veins in this rock, did not come into the vein as a concentration of pyrrhotite and chalcopyrite disturbed through the country rock. For instance, we should find that country rock to a very large extent, for a considerable distance, 50 feet and more from any recognized and supposed vein was to some extent mineralized, was altered by having had quartz put into it, and brown mica developed in it, or chalcopyrite and pyrrhotite disseminated sparsely in it, the question would arise whether that is the proof that the country rock originally had all those minerals in it and has been supplying them to these concentrations in the vein; or on the other hand, whether the minerals having come up in the veins in mineral solution and been chiefly deposited where those mineral solutions ate out a sufficient space by replacement to hold the solid ores, and then by the same mineral solutions working through the pores of the



rock without any definite fissure to guide them, or any symmetrical fissures to guide them, had got impregnated and partially altered and partially replaced the elements of the country rock for a considerable distance. That condition of the country rock we might conceive to be due either to the fact that the country rock was the origin of the minerals, that when it originally cooled they were all in it and has since supplied them to the fissures where they are more concentrated. That is one theory. The other would be that the fissures are the source, so far as the country rock is concerned, of minerals which have come up from below and impregnated the country rock, so that whenever you find impregnation of the country rock you will find that the most intense or thickest or richest part of it—the centre or heart of it, so to speak—was a fissure from which it proceeded and not a fissure to which it proceeded. Now, the clinching argument in this present case, or the clinching proof that the impregnation or infiltration or replacement proceeded from the fissures out into the country and not from the country into the fissures, is the fact that secondary pyrrhotite, so far as we know, does not occur in nature; at least, we cannot invent or devise any process in the laboratory by which we can bring it to pass or conceive that it could come to pass. That statement of mine would not be true in a certain sense of the word secondary. For instance, the pyrrhotite of these veins to-day is secondary pyrrhotite in a certain sense; that is to say, we suppose it has been something else somewhere else and has been formed here as secondary pyrrhotite. We do not say, for instance, that it was melted pyrrhotite in the bowels of the earth and come up without any change and here we have it. That would be primary pyrrhotite, but there is such a thing as primary pyrrhotite in several mines in this country, and in several in Norway and Sweden. But what I mean in this connection by secondary pyrrhotite is pyrrhotite that has once been deposited somewhere in the rock as pyrrhotite. For instance, pyrrhotite scattered all through these rocks in little crystals, as you can find it anywhere in this out here where it is seen a great deal. Now, supposing that that were held to be originally in the melted rock and to have been formed there when the rock cooled. What I mean now by secondary pyrrhotite is that that pyrrhotite after being solid in the cooled rock has been dissolved and carried somewhere else by currents of water in the rock, hot or cold, no matter which, and had been reprecipitated somewhere else as pyrrhotite again.

The Court: Reprecipitated, do you say? A. Reprecipitated; it was dissolved—

The Court: Chemically speaking? A. Chemically speaking and appeared reprecipitated somewhere else so as to make pyrrhotite. The trouble is that the moment we dissolve pyrrhotite in anything that we can dissolve it in, and then try to get it out again by precipitation, it comes out as pyrite; it does not come out as pyrrhotite. Pyrrhotite is a very peculiar combination; it is one of the extraordinary chemical formulas, namely: it may be 6 proportions of

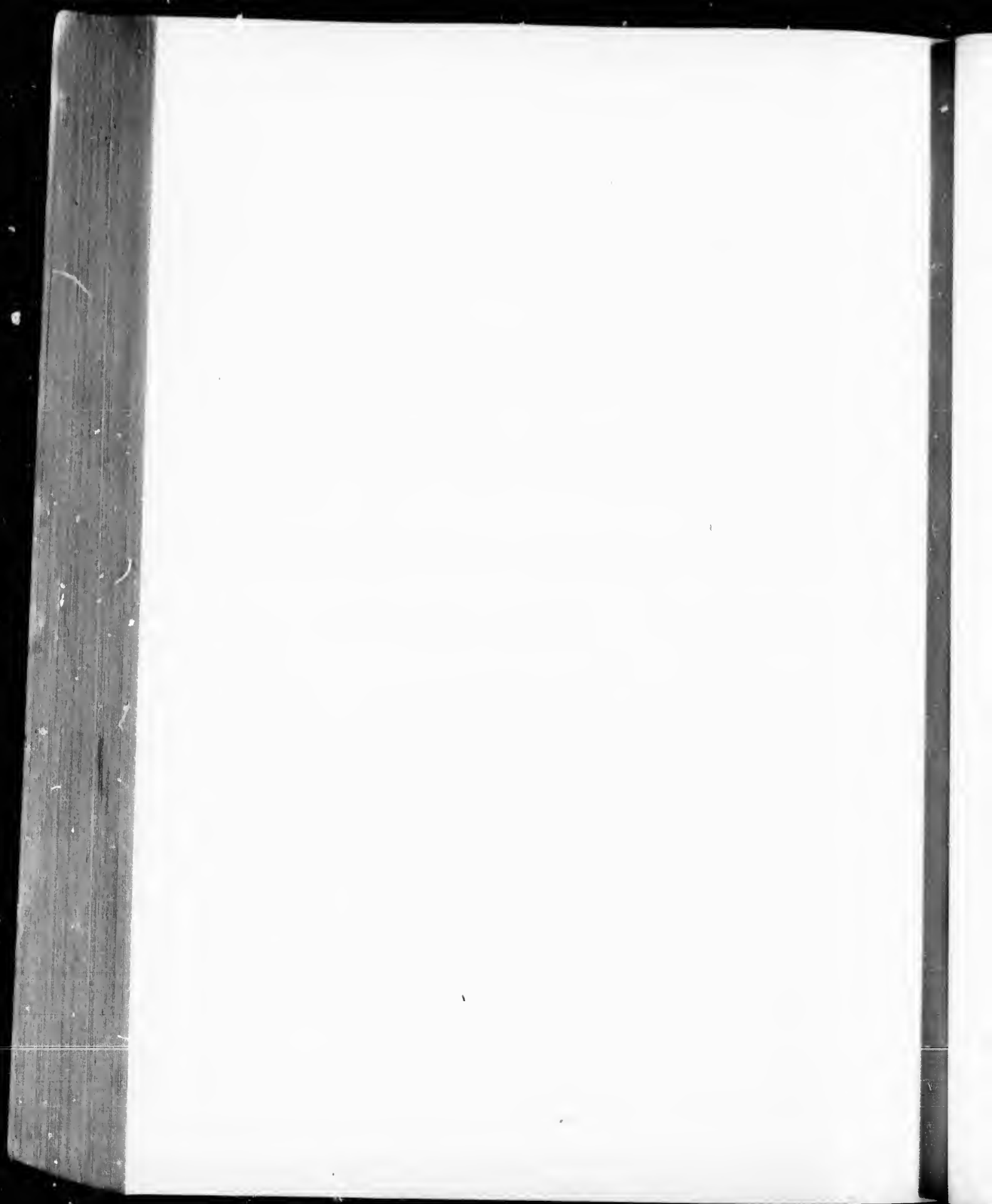


iron (that is 6 atoms), and 7 proportions of sulphur; or it may be 7 atoms of iron to 8 atoms of sulphur; or it may be 8 atoms of iron to 9 of sulphur. It ranges through a very vague series of chemical proportions, all of which indicate that it is simply a variable sulphide of iron with an extra atom of sulphur tacked onto it, and that is, of course, loosely held, and the moment you come to re-constitute it by dissolving it and precipitating it and manipulating it in any way chemically, away goes the extra atom of sulphur, and you are sure to get that iron of sulphur and in some cases you will get secondary pyrrhotite by any action upon the pyrrhotite already formed. And that is why I say that pyrrhotite in the country rock would not leach under any circumstances into the veins, but would turn up in the veins in some other form such as iron pyrites.

Q. You spoke about pyrrhotite in country rock. Have you found any pyrrhotite in the country rock here at a distance from the veins? A. Not beyond the range of 40 or 50 feet or so.

Mr. Davis: That is all.

A. (Continuing.) I have one more point, if I may be pardoned; it will only take a second—no argument about it, but a fact which I forgot to mention as to this apex. The question has been asked about the interruption of the apex, and I do not know whether Mr. King said, but Mr. Lindgren said, he had found the apex continuous except where it crossed the railroad track. Now, he evidently had not examined, what I have examined, a little trench which is cut for the purpose across the railroad track under the rail, and in which I found the chalcopyrite and pyrrhotite of the apex. The trench is narrow and it is not wide enough to shew the whole width either of the apex or the vein between the walls, which I have already said I measured at that point in the embankment itself at about 15 feet; but there is continuous pyrrhotite and chalcopyrite right under the railroad track, which therefore constitutes no interruption at all to tracing the apex. That is all.



CROSS EXAMINATION.

By Mr. Bodwell—

5

Q. You said, Dr. Raymond, that you have found pyrrhotite in the rock as far as 50 feet away from a vein?

Mr. Davis: Forty feet, I think he said.

10

A. I said 40 feet—or 50; 40 is the largest distance I now recollect.

Q. And that consequently it must have impregnated that rock through a fault of the vein in the neighborhood, according to your idea? A. Accord- 15
ing to my idea, that is the result of impregnation from a vein.

Q. So that we have positive proof here that the filling which is within the vein will sometimes be found in the country rock 40 feet away from the vein? A. No, it is not positive proof for this reason. The nearest vein I 20
know is 40 feet away; but what there might be in the rock nearer,—I can only say there is pyrrhotite in the country rock here; and the nearest vein I can get at from any workings is 40 feet away.

Q. You would not be surprised to learn that the crosscut from that point 25
to the vein shewed that that was the only vein in the vicinity? A. I would not.

Q. It would be quite consistent with all the rest of your observations? 30
A. Excuse me a moment. I will measure at that place and tell you exactly the distance—the point I am speaking of. (The witness makes measurements on his model.) That point I was speaking of is a point at which I found pyrr-

hotite in what I considered to be clear country rock at a distance outside of the vein of 40 feet, in a right angle from the nearest vein. It can not be shewn in the cross-cut, and therefore I think it is 40 feet from the vein that supplied the pyrrhotite.

Q. Was it any considerable quantity? A. No, it was sparse, but enough to see with the glass. 5

Q. I suppose the quantity would be dependent altogether on local conditions under which it came into the country rock? A. The quantity depends very decidedly on the distance from the vein. It diminishes rapidly as you pass the walls. As you pass the walls of the vein the quantity drops suddenly and then it diminishes rapidly until you find country rock in places without any. 10

Q. At a distance of 14 or 15 or 20 feet from the vein you might find a considerable quantity? A. No, in no place a considerable quantity. The point at which I consider it to be the wall of the vein the quantity is considerable, but at a point beyond that wall the quantity has dropped decidedly. 15

Q. But you do not know any particular instance in which that has happened here? A. I do, I am speaking of a particular instance. 20

Q. Yes, but you are 40 feet away from the vein there? A. I am 40 feet away from the vein where I said I found the minimum quantity of pyrrhotite. Now, I said at the wall of the vein I found a much larger quantity, and at a foot from the wall there was a drop so great—it was not a gradual shutting off from the wall of the vein to that place; there was a sudden drop at the wall of the vein, and then a shading off. 25

Q. At what particular vein did you make that examination? A. That examination was made in what is called the brown cross-cut from the Iron Mask stope. 30

Q. And that place where you say it was 40 feet away, away from what point? A. The nearest vein, say from the middle of the brown cross-cut running south from the Iron Mask stope. 35

Mr. Davis: You are speaking of the middle of the brown cross-cut? A. Yes. 40

Q. The middle of the brown cross-cut is the point from which you went 40 feet? A. The end of the brown cross-cut is the heart of the vein, not the wall of the vein.



Q. The middle of the brown cross-cut is the place you took as the point of departure? A. I found solid pyrites at the end of the cross-cut, with a minimum at the end of it; but there is no regular gradation; the drop takes place about 13 feet from the end of the brown cross-cut, 13 to 15 feet from the end of the brown cross-cut where I consider that the wall exists, and on one side of the wall there is a good deal more than there is immediately on the other side. 5

Q. What do you fix as the average width of the Centre Star vein? A. I don't know as I could give a satisfactory average of it, but I fix the maximum width of it where I have been able to find it, as about 20 feet. I find it about 15 feet very plainly exhibited in the embankment of the railroad cut at the surface. Then I find it about 13 feet in the brown cross-cut to the north of the solid pyrrhotite, and at that point I did not see a foot wall along the pyrites. 10

Mr. Davis: Pyrrhotite, you mean. A. Pyrites is a general term for both pyrites and pyrrhotite, but I will say pyrrhotite. 15

Q. So you would fix the vein as being 13 feet in width in the brown cross-cut? A. No, I do not. I fix the width of the vein from the hanging wall to the end of the brown cross-cut as about 13 feet, and considering the position of that pyrites, and the fact that the wall below it is seen elsewhere, I have to make an allowance as the width of the vein is not there in the brown cross-cut completely shewn;—if the brown cross-cut could have been continued, it would have cut the foot wall and we would have had the width clearly shewn. 20

Q. What do you say is the width of the vein in the winze at the end of the green drift? A. I do not know. That is going down in the solid pyrrhotite and chalcopyrite; I can state the width of the solid ore, but where the outside boundaries of the vein would be there, I could not tell. 25

Q. Do you think you know where the hanging wall of the vein is at that point? A. No, sir. 30

Q. Nor the foot wall? A. No, it is inside of both of them—the winze is. 35

Q. The ore is inside? A. The ore is necessarily inside. The existence of a solid body of ore vein implies the boundaries, whether you have found them or not. The winze is not big enough to shew them on that point.

Q. I am not on that point. I am asking you if you had seen the hanging wall or foot wall in the winze? A. I have seen descending planes in the winze having the general strike and dip of the planes I have put in here to represent the Centre Star vein. I could not be sure that I have seen in that winze the top or bottom, that is, the hanging or foot wall of that zone. 40



Q. Do you think you saw it in the green drift, the Centre Star No. 95 drift?

The Court: That is the one leading to the winze? A. I am inclined to think that I did see—no, I cannot be sure even there. There is a hanging wall plane there, but I am not sure, but I have no cross-cuts to shew it. 5

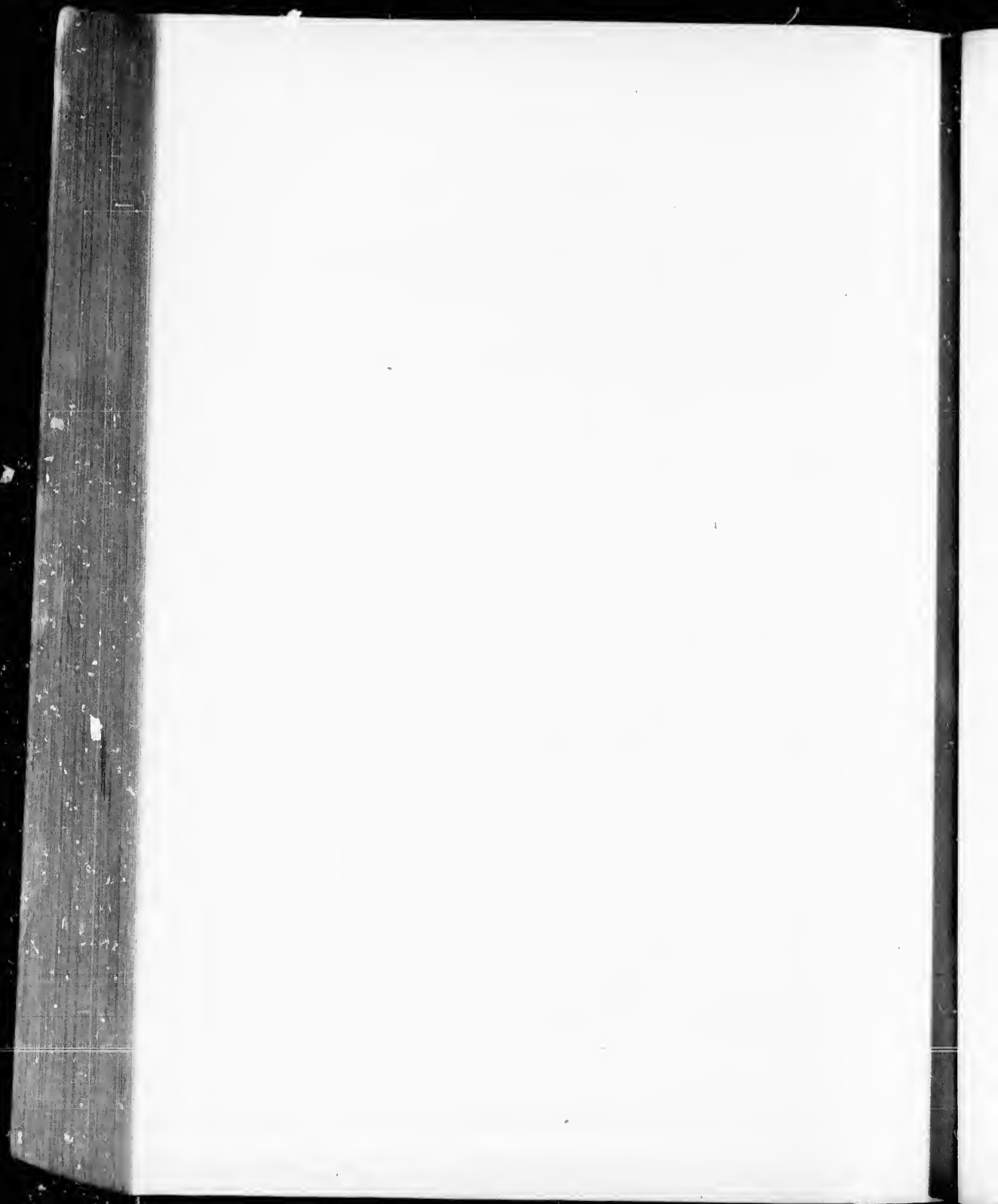
Q. When you say you follow continuous ore in that drift, Doctor, you mean that you find, to begin with, a very small, narrow seam of ore, don't you? A. No, sir. 10

Q. How wide is the ore at your starting point? A. At the starting point the side is blasted away, but the first solid rock I get on the right hand side in going in, I find some two or three feet of pyrites, of chalcopyrite, and when I say continuous, I mean that I hammered right straight along and could get out chalcopyrite all right. But in a miner's sense of continuous, or what I would say is practically continuous, would be a defined seam in blasting which, in drifting in which or sinking in which a miner threw out ore every time he made a blast. Continuous ore in a miner's sense is not derived from the use of these large power drills that drill six or seven feet, but from the use of small hand drills. When the miner drilling with a small hand drill gets ore every blast, he thinks he is in ore and calls it ore. That is not what I mean when I say continuous. I mean literally continuous; I mean every time you take a hammer and knock out a piece you will find ore. 15 20

Q. What I want to get at is the width of that ore at the starting point of the 95 incline shaft? A. If I have it in my notes I will give it to you; I can not give it to you now from memory. (After examining his note book.) Well, the nearest measurement I have to the thickness of the ore in the side of the incline shaft No. 3 just at this wider place where it turns, striking the dyke, inclined down a few feet; I haven't any record at that corner, at the corner of the green drift which I suppose is what you mean. 25 30

Q. Don't you remember there is a narrow seam of ore running along there a short distance? A. I do not recollect the width of the ore at that point. I was following the ore along, but I may not have noticed it at that point, or might have noticed it and forgotten it, but I do not find it at this present moment. I have another set of notes which I will examine. 35

Q. I won't trouble you about that. Suppose there was a seam there of half an inch, or say, one inch in width. Would that represent one of the planes of the shear-zone vein? A. I could not tell without examining it whether it did or not. It would not represent one of the planes of the shear-zone vein unless it had a different strike from the others. The planes of the shear-zone vein 40



are parallel; that is, the so-called planes of the shear-zone vein. But the shear-zone veins are full of little cross fissures not extending beyond the walls but simply making communications from one down to another within the walls, interlacing the other fissures.

Q. Have you any data to shew what the average width of the shear-zone veins in this plane are? A. I have no data that I could produce and swear to. The data on that subject are constituted by impressions derived from going over and over and over places where the shear zones have really been obliterated by the replacement, but from the looks of the replacement I judge that they are very small, and judging also from the looks of other places in the district which I have accidentally seen in passing where I found shear-zones very well marked, but not mineralized to any great extent, at least on the surface, in which the laminae or different plates ranged down as low as one-eighth to one-sixteenth of an inch, and then up as high as a foot or two apart. In my judgment it is very hard to say, and I said the other day in my direct examination that I could not be sure that there had not been a real open fissure to some extent where this heavy body of pyrrhotite comes off, but if it is not an open fissure then the fissure planes are very close together; so that I should expect in a large body coming down the No. 3, the planes of shearing might have been an inch or less apart, and that is the reason why they got entirely eaten up, because they can be attacked from both sides, and the narrow planes are eaten up and give rise afterwards to solid bodies of ore, while planes farther apart do not get as much attack, they get impregnated to some extent, but do not so readily form large bodies.

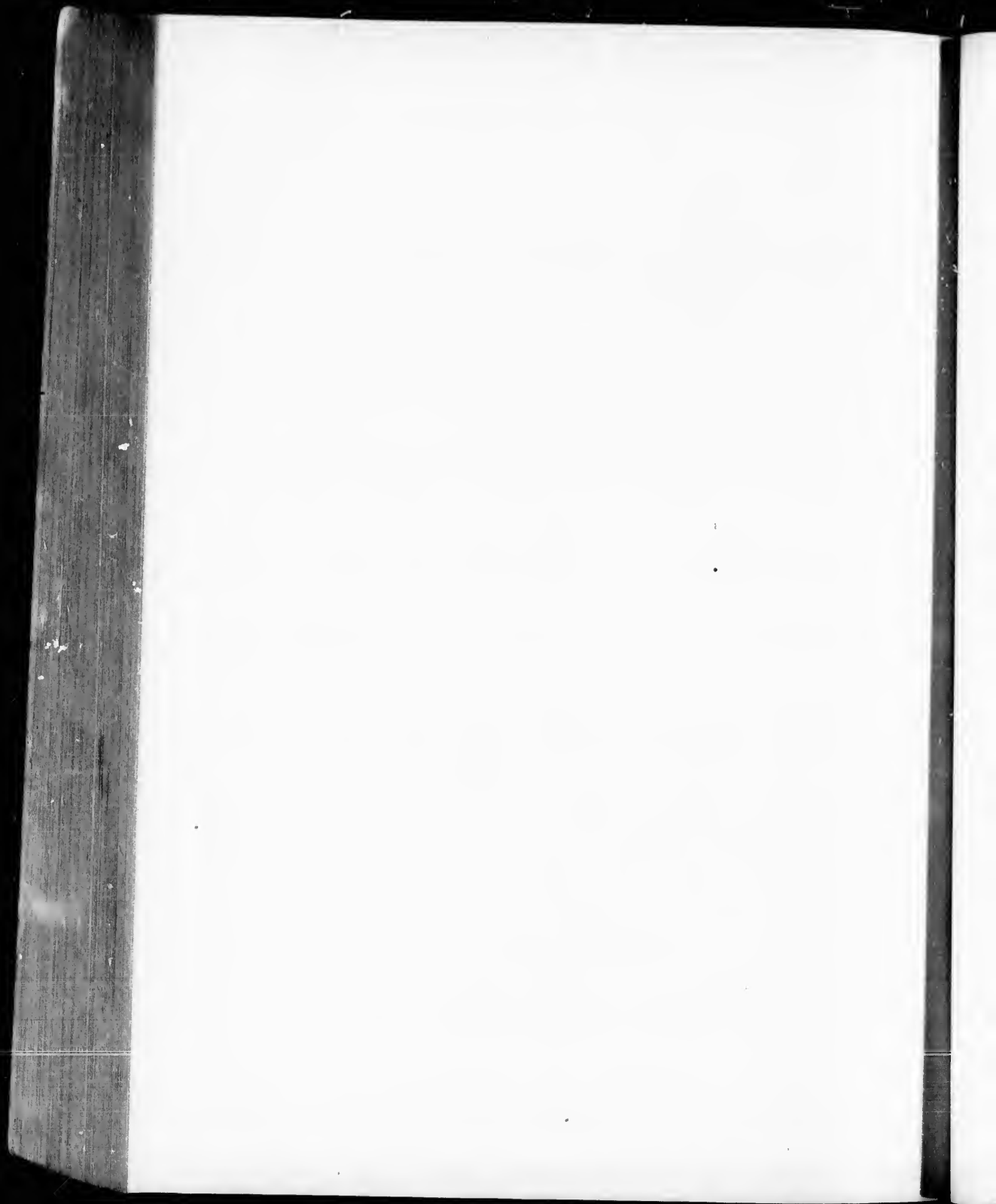
Q. There in the No. 95 east drift, the green drift, there is an exposure of the vein there for nearly 100 feet on its strike, is there not? A. Yes.

Q. Do you find evidences of a shear-zone in that vein clearly marked, or in that drift, I should say? A. I have not examined anything in that drift except the solid pyrrhotite, just to trace that. That was my work here, to see whether there was a solid tracing in ore.

Q. It ought to be seen there? A. The planes?

Q. Yes, the planes of the shear-zone? A. Parallel planes are seen better, I think, at the winze, but they can be traced in the roof and floor.

Q. You think they are seen better at the winze at the end of the green drift? A. I think they are, because there you go right down with them. You have them in the west end of the winze. There is a distance of them in the winze. To see a plane of that kind in the drift which is run upon the plane you can only get a trace of it marked above and another trace below; but below it is



apt to be trampled under foot and covered with dust and has to be picked off, while it is out of reach of destruction above. I found the ore without any difficulty, but I did not notice the planes in that particular place.

Q. You assumed, of course, that they would be there or you would not have ore? A. The existence of ore implies boundaries. 5

Q. Yes, but in this case, of course, you would find a boundary that you could see with reference to this vein? A. Yes, I might find one, but not necessarily. 10

Q. Have you found a boundary that you could see with reference to this vein outside of what you refer to in the brown cross-cut? A. I think there is a hanging wall shewn in my section of the east winze, entering the east winze near a point—— 15

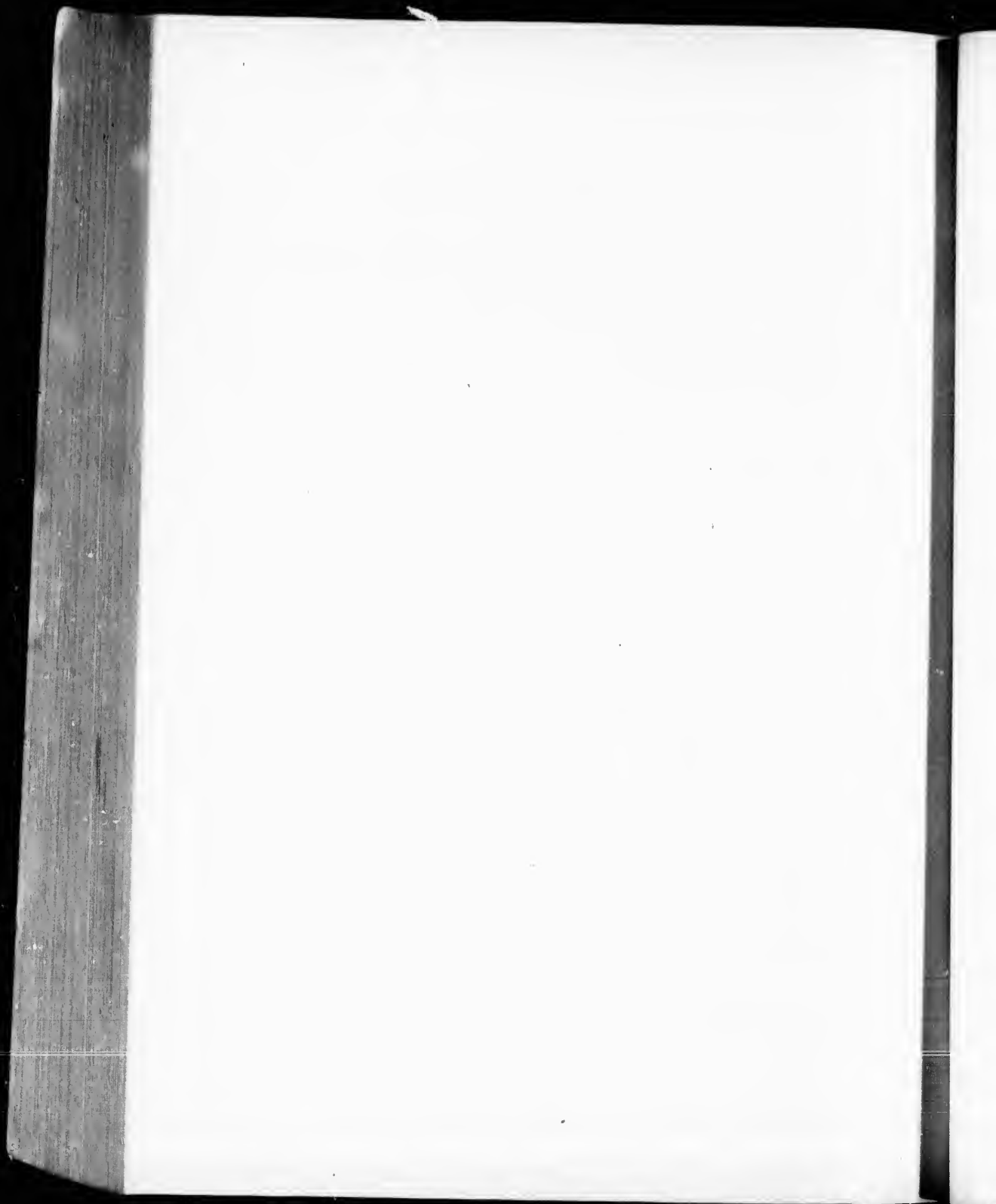
Mr. Davis: The Iron Mask east winze? A. The Iron Mask east winze: entering the Iron Mask east winze near point 69 in the yellow level. The point 69 is country rock in the winze where it intersected the winze, descending obliquely through the winze. 20

Q. You spoke yesterday of a geological shear-zone as distinguished from a shear-zone vein. You said a geological shear-zone might extend through a whole country and a shear-zone vein, I suppose would be a part of the zone which was mineralized? A. Excuse me, I did not mean a whole country; you do not mean the United States of America. A whole district or a whole mountain? 25

Q. A whole mountain, yes. I suppose you would call the shear-zone vein a similar formation which was mineralized? A. Yes, a shear-zone vein may be included in a geological shear-zone, or it may contain the whole of it; and the geological shear-zone may be a small affair with only a piece of a vein; or they may be shear-zone veins within one and the same geological shear-zone. 30

Q. But if there was a geological shear-zone in a mineralized country there would be a shear-zone vein corresponding to the extent of mineralization? A. Not necessarily. Corresponding to the localities of concentration. The extent of mineralization might be such that the whole of the rock of the whole district would be more or less altered; but under certain fissures or groups of fissures as constituted shear-zone veins, there would be concentration. 35 40

Q. Where would you draw the line? When the mineralization ceased to become commercially valuable, would you say that was the end of the shear zone vein although the formation went on? A. Yes, we should have to, I



think, apply the test in mining. It is the same difficulty with regard to all veins. It is not a peculiar—

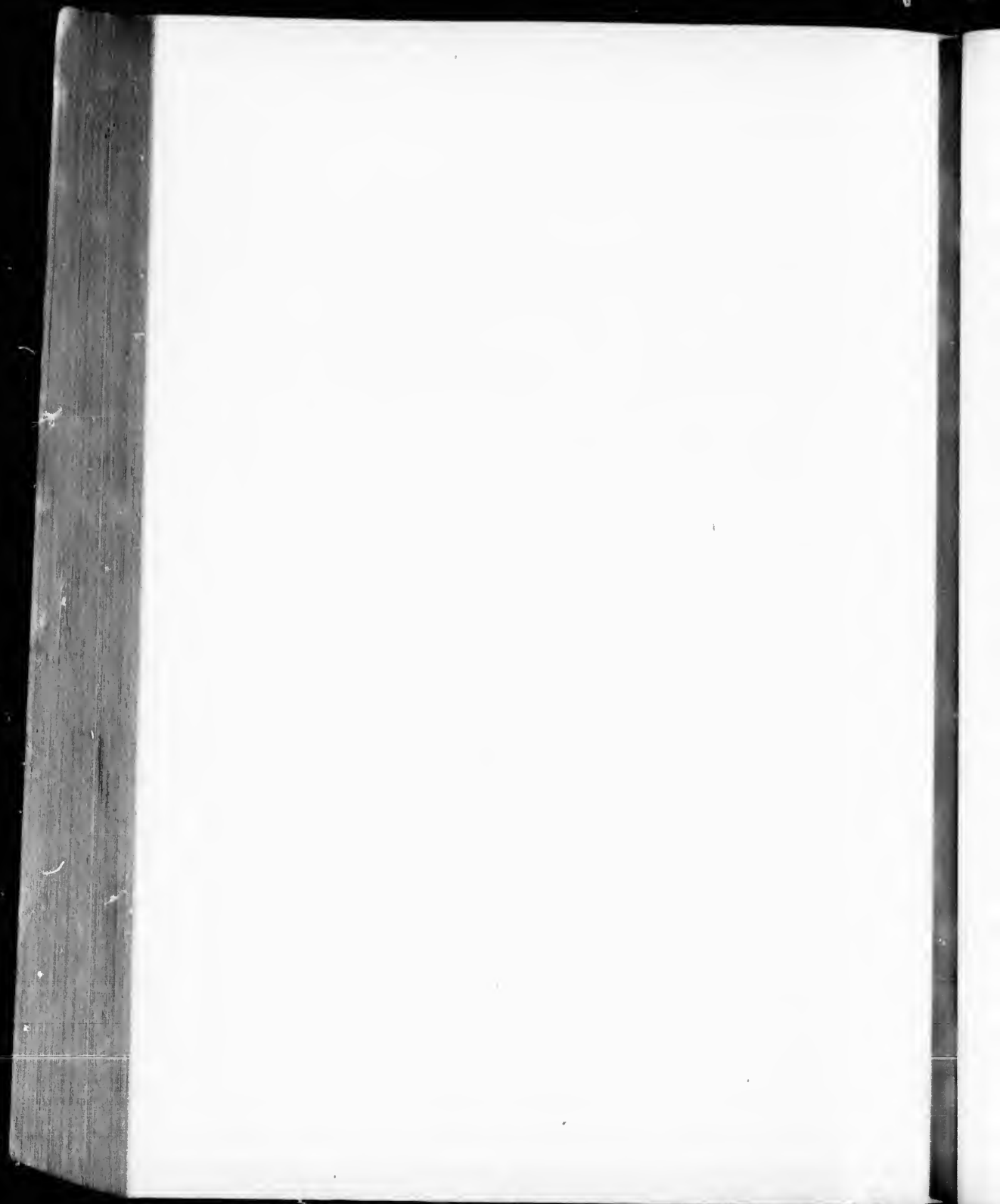
Q. (Interrupting.) That would not be the logical result from the geological standpoint? A. Excuse me. It is not a peculiar result—it is not a result peculiar to shear-zone veins; it is common to all veins—that miners consider that a vein will go into the walls as far as it pays, and they have a right to take out of the vein as belonging to it whatever is within the walls that pays. It is the same with shear-zones as any other. Now, as a matter of theory it is impossible to state the precise definition. But as a matter of fact it never has proved impossible to get a practical difference even if there was a little mineralization between the veins, because the mineralization fades out from each vein towards its next neighbor.

Q. Yes, but according to the definition you would have to limit the vein geologically at the end of the mineralization, would you not? A. Geologically I would limit the vein with the plane that started it; that is the geological vein. The commercial vein has come afterwards. The impregnation of a vein with value is not a geological effect at all.

Q. Well, the commercial, or at least the miner's idea of a vein began on a geological definition, didn't it, Doctor? A. No, sir; that is just what it did not do. The miners have been working for centuries without geological definitions and the geologists based their first definitions upon a small group of mines that were at that time known; but all over the world there were other mines, and people talked about veins that were not geological veins at all.

Q. You wrote the preface of this "Genesis of Ore Deposits" by Prof. Prosepy? A. I did.

Q. I find this language there: "As a personal friend, diligent student and hearty admirer of Bernard Cotta, and no less as a professional critic of his views, I feel myself bound to say that his theories as stated more than 30 years ago are still to a surprising degree valid and comprehensive. There is scarcely a single modern modification of them for which he did not with intuitive impressions leave a place. On the other hand, it is a fair criticism of the whole Freiburg school that it gave too much prominence and attributed too much typical importance to the fissure veins as represented in the Erzgebirge. Such writers as Groddeck and Grimm have undoubtedly aided to modify this disproportionate emphasis. But it is not useful to influence the conceptions entertained by miners and even by legislators, as the United States mining law, evidently based on the true fissure vein as a general type, abundantly demonstrates." Now, I understand from that quotation that your idea was that the United States mineral acts were framed on the theory of the typical fissure vein? A. Undoubtedly they were.



Q. At that time the quartz veins of California were known, were they not, Doctor? A. Yes, sir, but they were not known as true fissure veins.

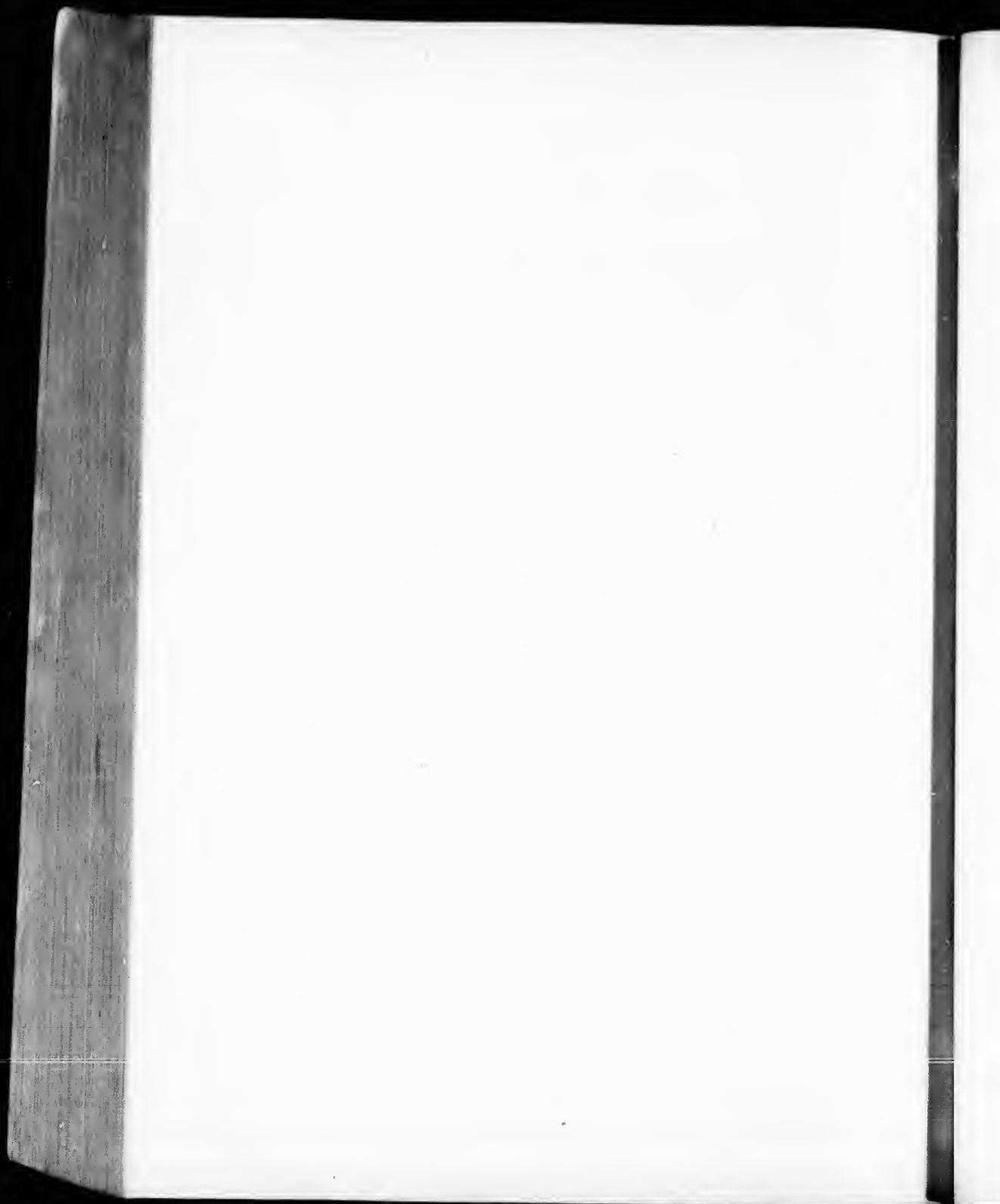
Q. They had not the characteristics of true fissure veins? A. No, they did not have them. They were fissure veins, probably, but they lacked all the characteristics Cotta gave; they lacked distribution of ore and structural arrangement. It was 20 years before they were settled to be fissure veins at all. All the law was based upon was the idea, which is undoubtedly characteristic of true fissure veins, that the vein would be a long, tolerably direct and tolerably uniform plane, like my piece of pasteboard there. That is the ideal vein of the law, no matter whether it has one fissure or two. A good many of them were beds tipped up, sedimentary veins, and so long as it had that shape the law could handle it, and that was the shape it was assumed to have; they did not know what irregularities it might have.

Q. But it was presumed to be a crack in the rock which could be followed as a crack and that was supposed to be the vein, that is to say, that was the boundaries of the vein? A. That was the presumption in the mind of the person who drafted the law of 1866 in the United States. And in 1867, if I may be permitted to say so, I had the honor to present to a Judge of the Supreme Court of the United States sitting in circuit with the other Judges in the Eureka case, a statement that that conception was not the practical conception of miners; and the Court then declared that the law must be applied to the miners' sense of a vein, and they gave us in that case as a true vein a body of sedimentary limestone.

Q. Yes, but, Doctor, in that case you put it on the ground, didn't you, that you had there a formation covering but one geological period, having on one side a boundary of shale, on the other side a boundary of quartz, and having within that boundary certain marks which miners could follow; then the argument was this: that the word "lode" was simply an alteration of the word "lead," and that what a miner could follow would be his lode, and inasmuch as the statute had said "veins, lode or ledge," then what the miner followed in that limestone to get to a body of ore must be a lode, and therefore a vein, and therefore a mineral vein. That was the line of argument, was it not? A. Yes, that was the line of argument.

Q. That zone was 800 feet broad in one place, was it not? A. It was 800 feet broad in this way: if you started from a point where it was exposed here and went over the top of the mountain and came down on the other side, it was 800 feet, and a great deal was made of that; but the horizontal distance was 250 feet.

Q. But you found a place, and mentioned it in your evidence, where the quartzite and shale came together? A. Yes.



Q. At least, there was mineralization all the way through, and it was only a short distance, a foot apart? A. I think a few inches.

Q. And therefore you concluded, as a geological fact, that the quartzite was underneath the limestone zone over the whole body? A. Yes.

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Q. And therefore you concluded that the mineral solutions came up along the quartzite, between that and the limestone and penetrated the limestone ore to the shale boundary on the other side? A. Certainly.

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Q. And having these two boundaries and a common source of mineralization and one geological period of time, you said you thought it ought to be called a vein, although it had only the characteristics of a vein in the sense in which I have just explained? A. I think your statement is very correct. I think I will put it to your own satisfaction in still briefer form. If in a zone as wide as that, 250 feet wide, there could have been found rock boundaries separating two planes or zones or channels with relatively barren rock between and no connection in ore, I should have unquestionably said that 250 feet was for a miner too big a jump, and that I would have made two veins out of that zone instead of one.

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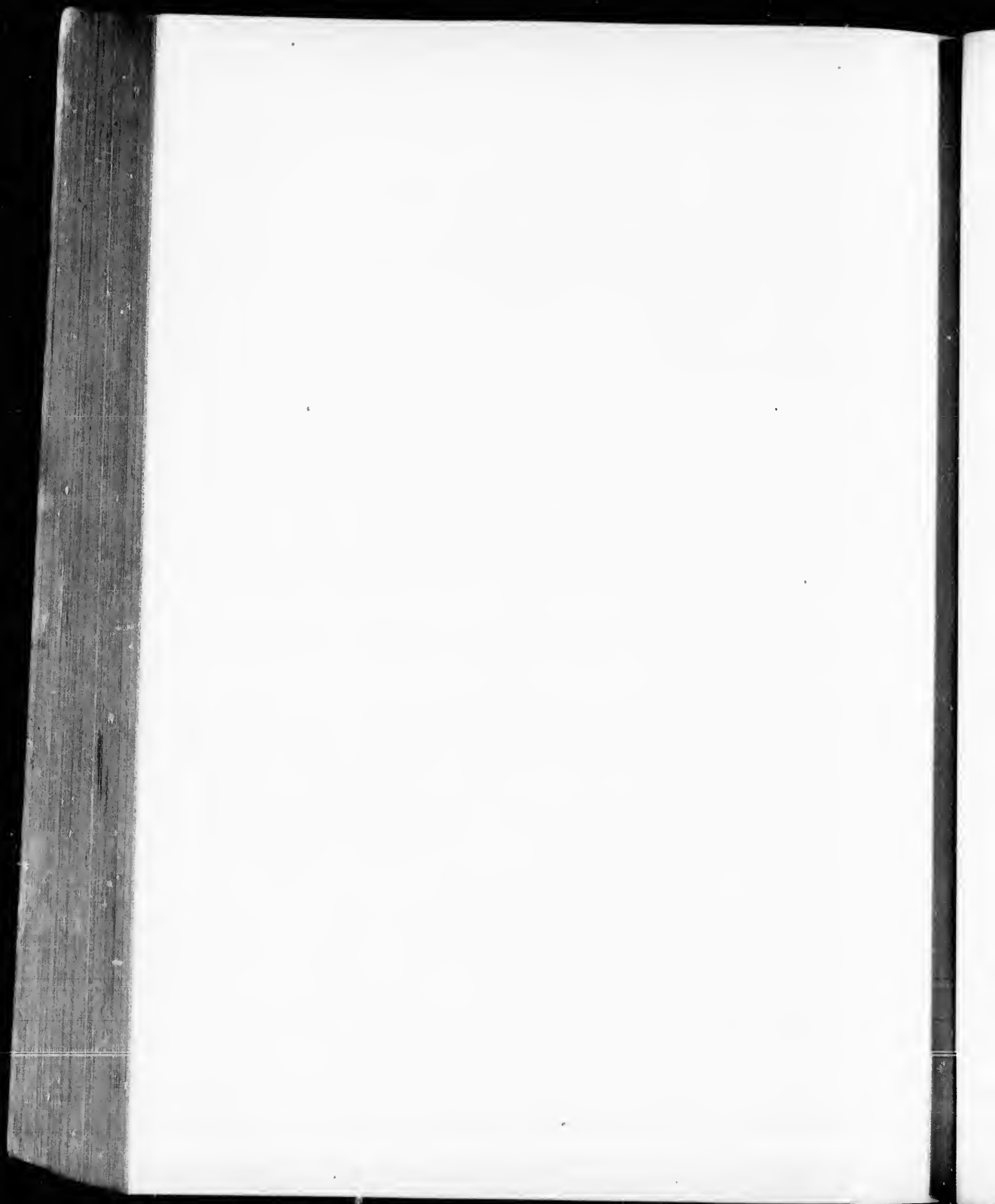
The Court: Running parallel to each other? A. Running parallel to each other. I would not have allowed, from a mining standpoint—a mining engineer's standpoint—whatever geologists might have said (it might have been quite true geology) that geologists have any right to run away with the subject; but that when a miner has defined boundaries, whether they are boundaries of clay zone or boundaries of assays, there is no difference, you may not be able to see them, it may take the crucible to shew them—but when he has them and has a tabular form, that is to say, has length and depth greater than thickness so as to give it the shape of a vein, which is the essential thing in a miner's classification, he will not feel it right, no matter what geologists tell him, to jump a large interval of barren country to get to another similar thing and then enclose them both in a zone. They might be both in the same geological shear-zone. There might be two separate groups of small shear planes in the same shear-zone; and there might be a wide geological shear-zone up on this hill; I don't know whether there is or not; I have not looked for it. There might be other shear zone groups constituting shear-zone veins within those limits; I do not know, I have not looked for them. But I do know that I have started from this one and I have seen its mineralization fading out away from its walls into the country rock, and therefore though I might not be able to fix the wall either by the eye or microscope, or see at any actual given point, I know about where it is, and I know the nearest plane which has proved a limit. To be sure, the mineralization has to go a little beyond that plane, because in any case the min-

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eralization spreads in both directions from the plane. Therefore it would be a vein extending from that top plane, as I have found, to the bottom plane, as I have found, and a little more according to the way it opened into the wall.

Q. Then you do not find here a definition, a line of demarcation corresponding to the quartzite in Eureka case? A. The case is entirely different from the Eureka case, and I beg to explain it. I cited the Eureka case because you asked me if the law was not based on fissure veins; I brought that up as a case in which the court decided and the law was expounded to me that fissure veins were not necessarily— 5

Q. But what I want to get on the record is certain relations to the Eureka vein. You did not find anything beyond the quartzite in the Eureka case? A. No, nothing beyond the quartzite. 10

Q. You do not find anything here which corresponds to the shale as the other boundary? A. No, the boundaries are both inside the same rock here. 15

Q. And they are all practically the same rock, the whole mass is in one kind of rock? A. The whole mass of rock apart from the dyke.

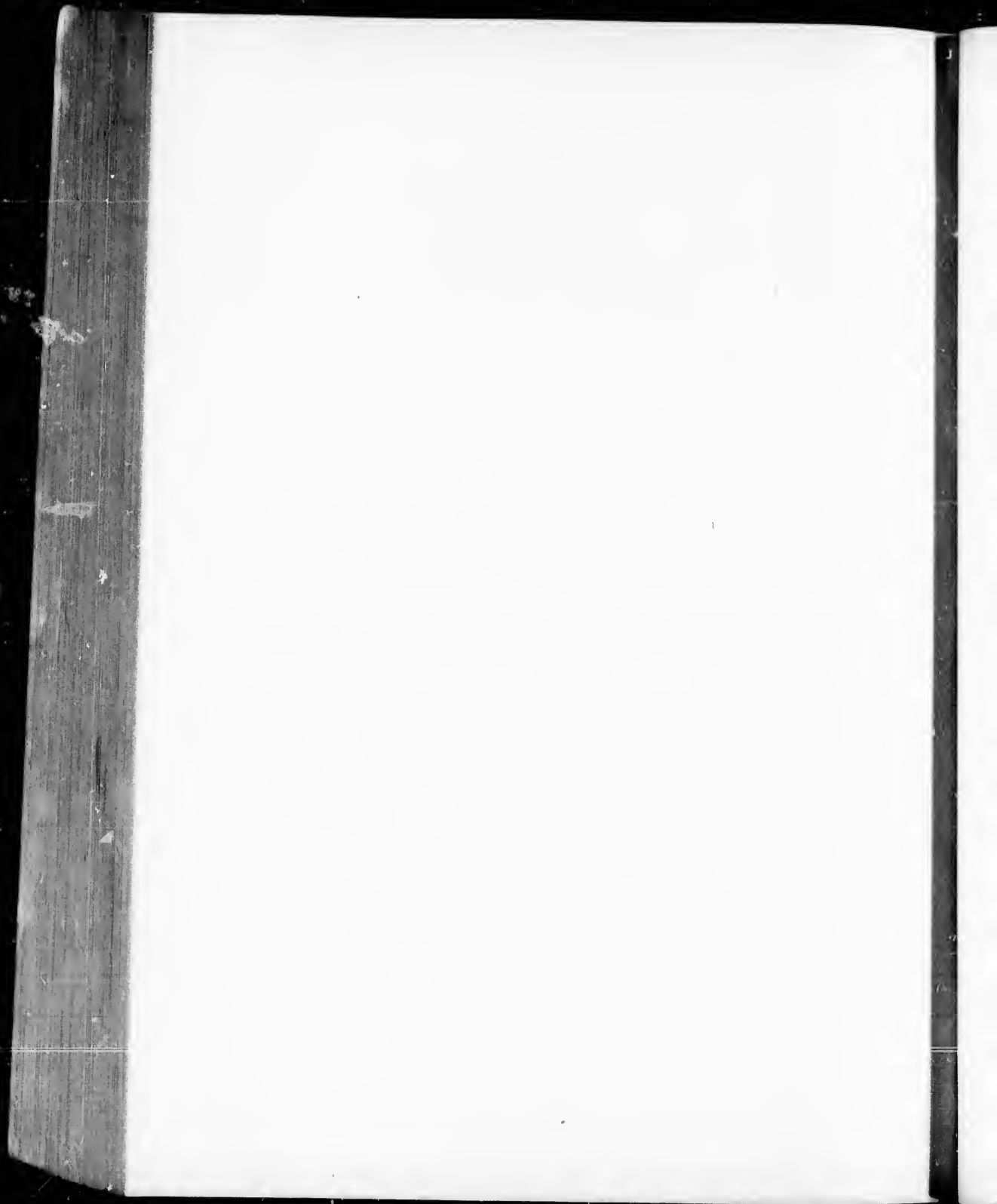
Q. And you have to make your line of boundary a place where the mineral ceases to be commercially valuable? A. That might be the ultimate boundary of the minable ore, but the boundary of the formations, the boundary of the contact—in any case I say it is always necessary—in this case I find it practicable, and therefore I take the plane as I find it. 20

Q. But you can not tell that by the eye, because this ore might look to be very valuable and assay very small? A. I can tell the plane by the eye but I cannot tell what the ore will assay just beyond it. 25

Q. But you would not stop at that plane if you got good assays beyond? A. I would stop at that place and try to ascertain what the value was; then I see this vein had also eaten a part of the way into the walls. 30

Q. Where do you get your ultimate plane? A. You do not have to have an ultimate plane to cover all the mineralization; but there is an ultimate plane to cover the concentrated mineralization. 35

Q. But is not that rather arbitrary? You must have something that will do for the boundary of this plane? A. Just the same as if it was the simplest fissure vein that could be described. If it had two walls and no more, and no walls inside, and there were walls of granite, and the gangue was altogether different and it had not come out of the granite and had not been altered from 40



country rock, but had come up the whole of it, even then there would be penetration beyond the wall into the granite.

Q. That would be all vein? A. I would not say it was all vein. I should say the miners' way of saying would be, "here's the wall, and as for the ore, she's gone behind the wall."

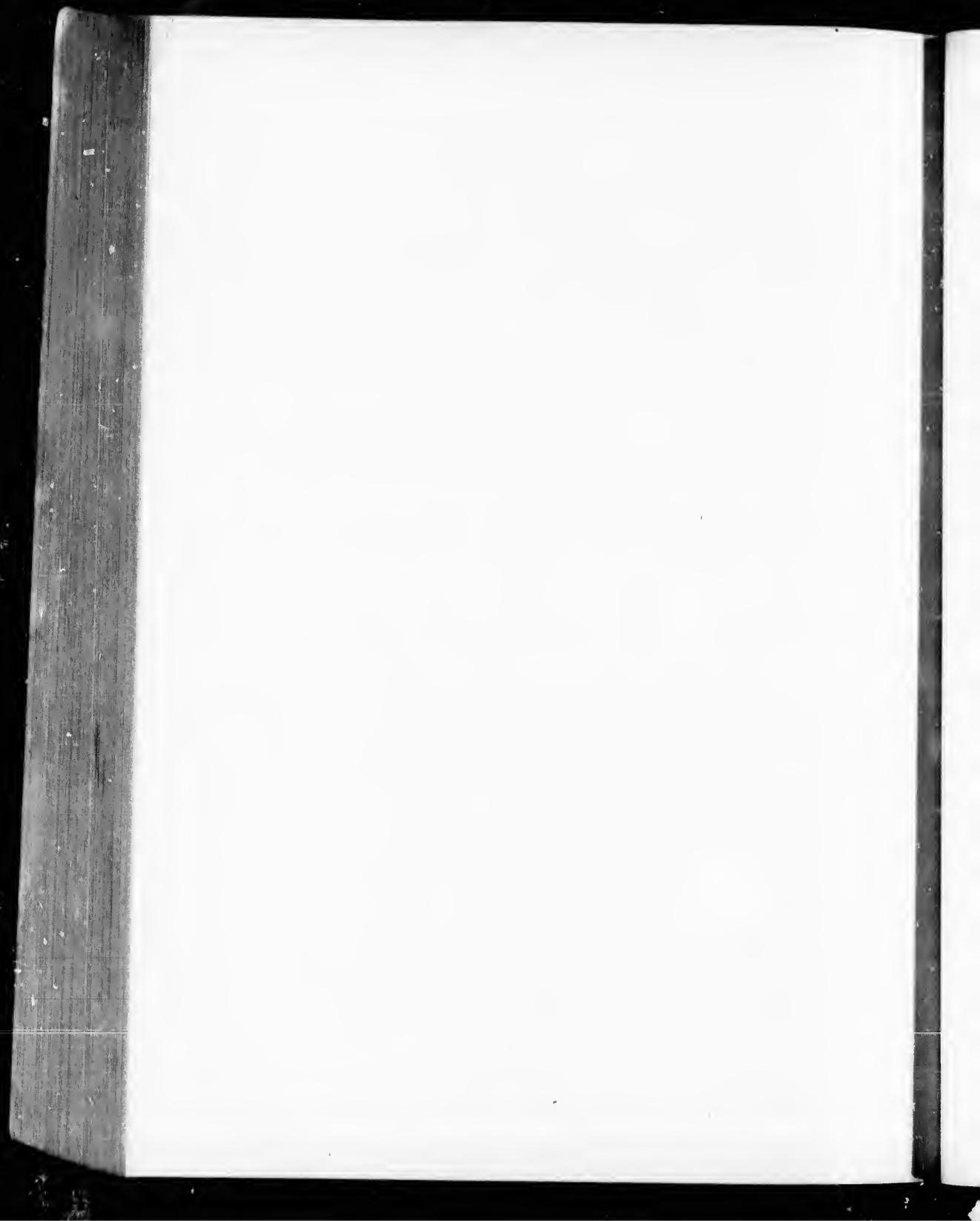
Q. The general idea, the favorable idea with writers now—Mr. Rickard and others—who have written on vein walls, is that it is a mistake about the apparent walls being the end of the vein; that the ore goes back to them, and if you cross-cut behind the wall you still may have your vein? A. That is very true, but I am not speaking of a case in which there are walls behind walls. In other words, that would be a case in which there was an outer plane enclosing the inner plane, and that would constitute a true wall plane if that were mineralized out. But there is a wall in this case, and there would be in the case you suggest, Mr. Rickard's case, a wall behind a wall; and beyond that there is metallic impregnation in the rock; very good; and we do not find any more walls. Then I should say that wall is an outside wall.

Q. The eating out of the vein? A. The eating out of the vein. The ore can eat from one fissure to another, and can bound the extent of mineralization. The only case of that kind I have cited is the sign that I have found, namely, that at the plane which I find which does not actually stop the mineralization of the rock, there is a sudden drop in the mineralization of the rock. So up to that plane it is more mineralized, and just beyond the plane it is very much less mineralized.

Q. Then you thought that Mr. King and Mr. Lindgren ought to have said that they had reached the ultimate wall, and not that they did not know whether they had reached the ultimate wall or not? A. I don't know what they ought to have said; they ought to have said what they thought.

Q. You do not agree with them, you would say that they had reached the ultimate wall? A. I think the ultimate wall, Mr. King said he thought he had reached the ultimate wall in the brown drift, the ultimate hanging wall in the brown cross-cut, and Mr. King subsequently said that he had found a wall in the Centre Star tunnel, yellow, below at a point—

Q. In the cross cut? A. In the Centre Star cross-cut; I think it was somewhere between 37 and 38 on that cross-cut, (referring to model): he found a plane there, and in going in that cross-cut south through the country he found no more, and he therefore, and that was the last foot wall plane, and the foot wall plane he found in the brown cross-cut, and the foot



wall drift he found in the yellow cross-cut, and when he was asked whether there was any reason why there would not be any more he said not that he knew of, and I agree with him still, because we do not understand the reasons of the limit.

Mr. Davis: No reason why there should be any more?

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The Court: No reason why there should or should not be any more than he knew of.

Q. Suppose you start to cross-cut in that No. 3 incline and go out beyond the plane and find another plane and more mineralized rock between the two, would you still be in the vein? A. It is a question as to how well it is mineralized.

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Q. You would put it altogether on the ground of mineralization, on the extent of mineralization? A. No, not altogether, because I should want to see whether that phenomena is repeated elsewhere; I don't think an exposure at one spot would settle it, but if it was the general phenomena that there was a wall underneath the lowest wall we have ever found, and that the ore run up to it, minerals ran up to it, there is no doubt about it; whether it is a vein as big as it is, you cannot help yourself if it is so many feet thicker if you find it here; I don't find it here; that is the whole story.

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Q. But the boundary is a plane, and commercial mineralization there? A. The boundary of the workable ore in a vein which I suppose would legally belong to the vein is of mineralization, the boundary of the vein itself is the last plane that gives the mineralization.

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Q. What was the proportion of mineralization in the Eureka case, it was less than one per cent. of the whole quantity? A. The Eureka case was not a question of mineralization, but of continuous ore.

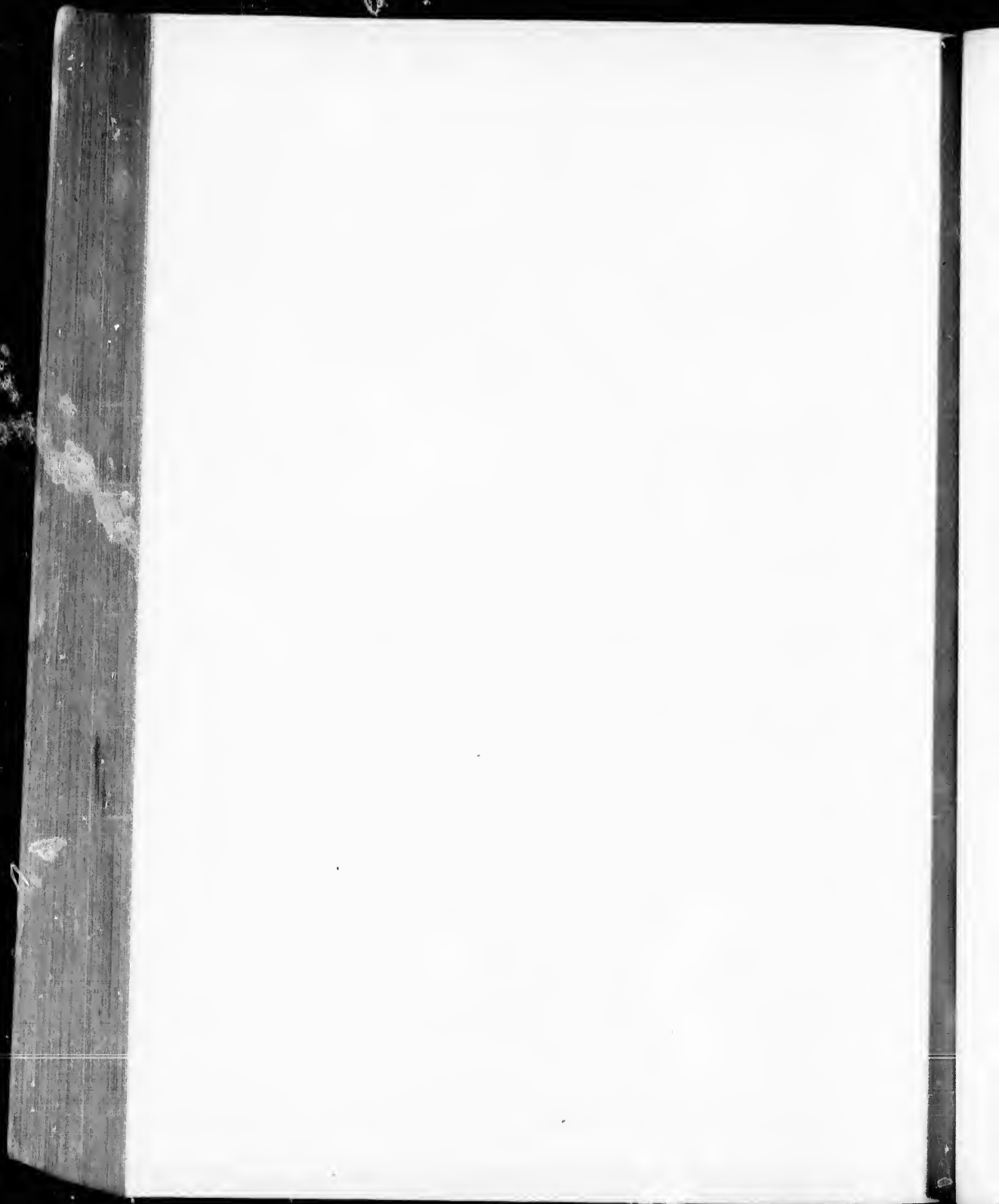
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Q. I know, but I think that evidence was given at that time, and I would like it, what the amount of mineralization was, the proportion of mineralization? A. I don't know.

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Q. It was stated in the Waterloo case to be less than one per cent? A. That figure was got at in this way, Mr. Bodwell, and is of no consequence. A large zone of limestone through which continuous bodies of silver and lead ore were running were finally decided by the court, because those bodies were irregular and had no zones or boundaries that could be classified as veins, but it carried everywhere in it limestone and it had one foot wall on the quartzite side, that the whole of that opening between the foot wall and the hanging was a

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vein. There was fifty millions taken out of it. It was claimed afterwards that by calculating all of the rock in the mountain that was left it was only one per cent. You can see what that evidence was worth.

Q. You were not a witness in the Waterloo case? A. No, sir. 5

Q. You don't know what the mineralization in that zone was proved to be? A. I do not know. I don't know what you mean by the question of mineralization; it was one one-hundredth part; I can tell you, it is a matter of information, although it cannot be questioned now in the Waterloo case, they proved the mineralization of the part that they called a zone was very much greater than the proportion of mineralization in the Eureka case. 10

Q. However, we can pass that case. A. One-tenth of one per cent. of mineralization, if it happens to be gold, would make a very good workable gold ore. 15

Q. Now, you cannot tell us either, Doctor, whether or not this Centre Star vein is part of a much wider shear-zone or not, whether it is or is not a part of a wider shear-zone. A. I cannot say for certain, but I think it is not and I have reasons for it. 20

Q. Do you find a true fissure vein in the Centre Star, in the sense in which you used that word in describing the Iron Mask vein? A. Just as true as the one that I find going down the No. 3. The vein of pyrrhotite in the No. 3 cuts only one fissure of the fissure zone, and therefore considered by itself it is a true fissure vein. You do not find true fissure vein in the Iron Mask in the sense it was filled in any other way than by replacement; I don't know about that. 25

Q. Do you think it was an open fissure? A. I can't tell; I think it may have been, because its position is so much more nearly vertical, and is likely to have left it open. Some fissure might have been formed for some time, and one that is flatter might have been close by the wall of the rock, and one that was open might be more likely to stay open, but that is all; I don't see the proof of it. 30 35

Q. Have you examined this vein over here in the No. 30 west drift? A. I never have been there except to walk by; I went up.

Q. Have you made any examination of the main Centre Star vein? A. I have not. 40

Q. Have you been up this? A. Only to walk through here, as I said the other day, and I hope you will allow me to add the reason is that I am on



the stand a good deal earlier than I expected to, owing to this ill-advised adjournment, and it has cut short my preparation.

Q. You have been up to No. 5 raise? A. No, sir; I had just time to finish—well, it is as shewn by the model.

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Q. Have you examined this cross-cut tunnel? What is this name on there—58 I think? A. Yes, from station 58.

Q. The cross-cut from station 58? A. Yes.

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Mr. Davis: You mean top of the Iron Mask winze?

Mr. Bodwell: No.

The Witness: It starts from just above the sump of No. 3 incline and goes east rather irregularly downward. It is irregular, broken over there.

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Q. In its course it ought to cut some part of the Centre Star vein? A. I should not see Centre Star vein in it.

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Q. You don't remember from your examination? A. Oh, yes, I do. That was really at the very entrance; station 59 is where the flat fault intersects a section, mass of ore coming down No. 3 shaft, and just under the flat fault the ore goes on. Now at that flat fault, we have it in a body right opposite 59 station, and that body you can trace except where the irregular excavations there have turned it out.

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Q. Do you find Centre Star vein continuing through the cross-cut there from station 38 to station 16? A. Thirty-eight to 16 is cross-cut; that goes from near the bottom of the drill hole.

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Mr. Davis: That is 68; 68 is the drill hole.

The Witness: Seventeen is the drill hole.

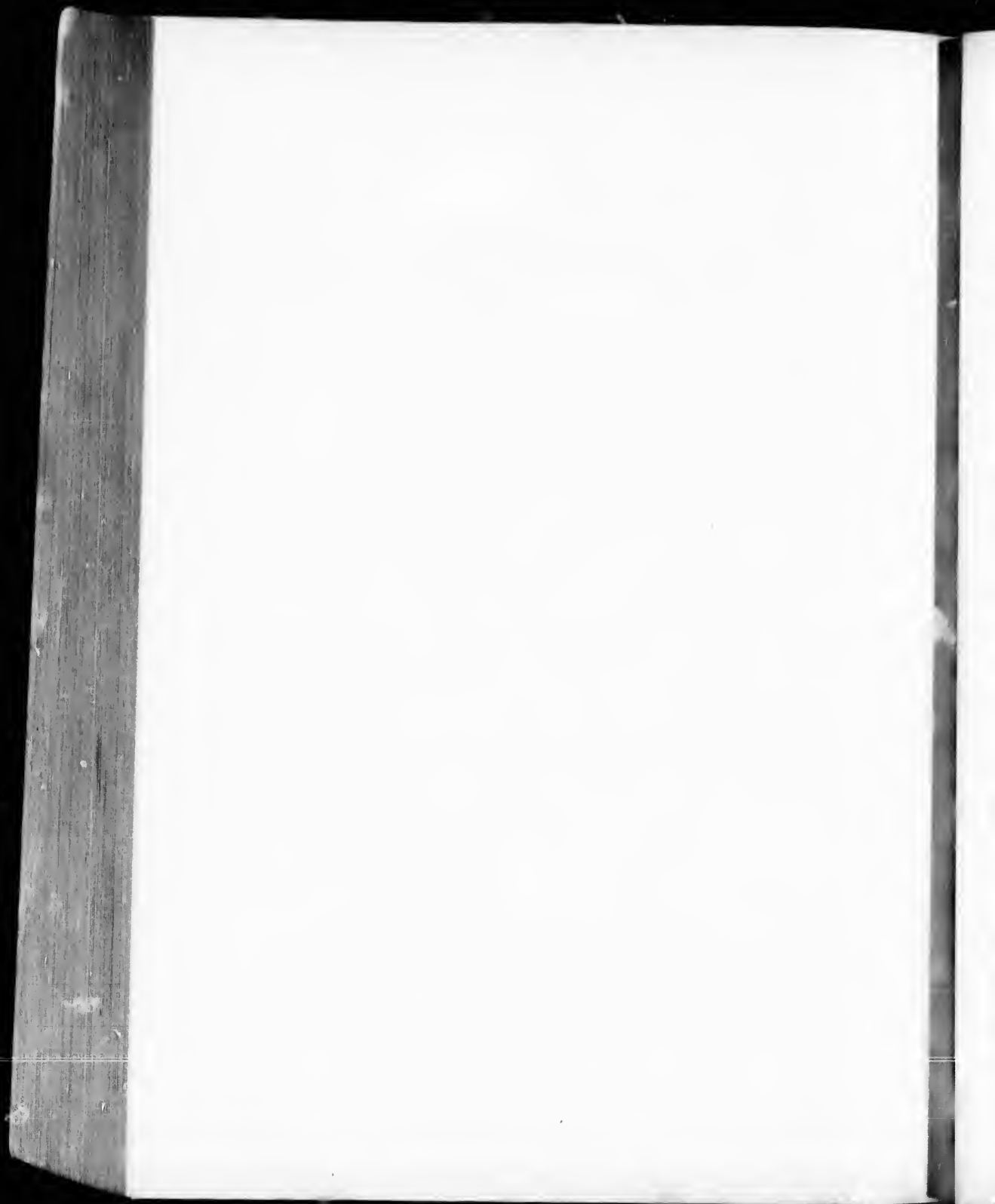
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Mr. Davis: No, 68 is the drill hole; 16 is about the top of the winze. A. That is it exactly, only I have got 17 marked. There is a new station of ours marked 17.

The Court: Sixty-eight to 38. A. Sixty-eight to 38.

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The Court: That drill hole is at 38? A. Yes, sir.



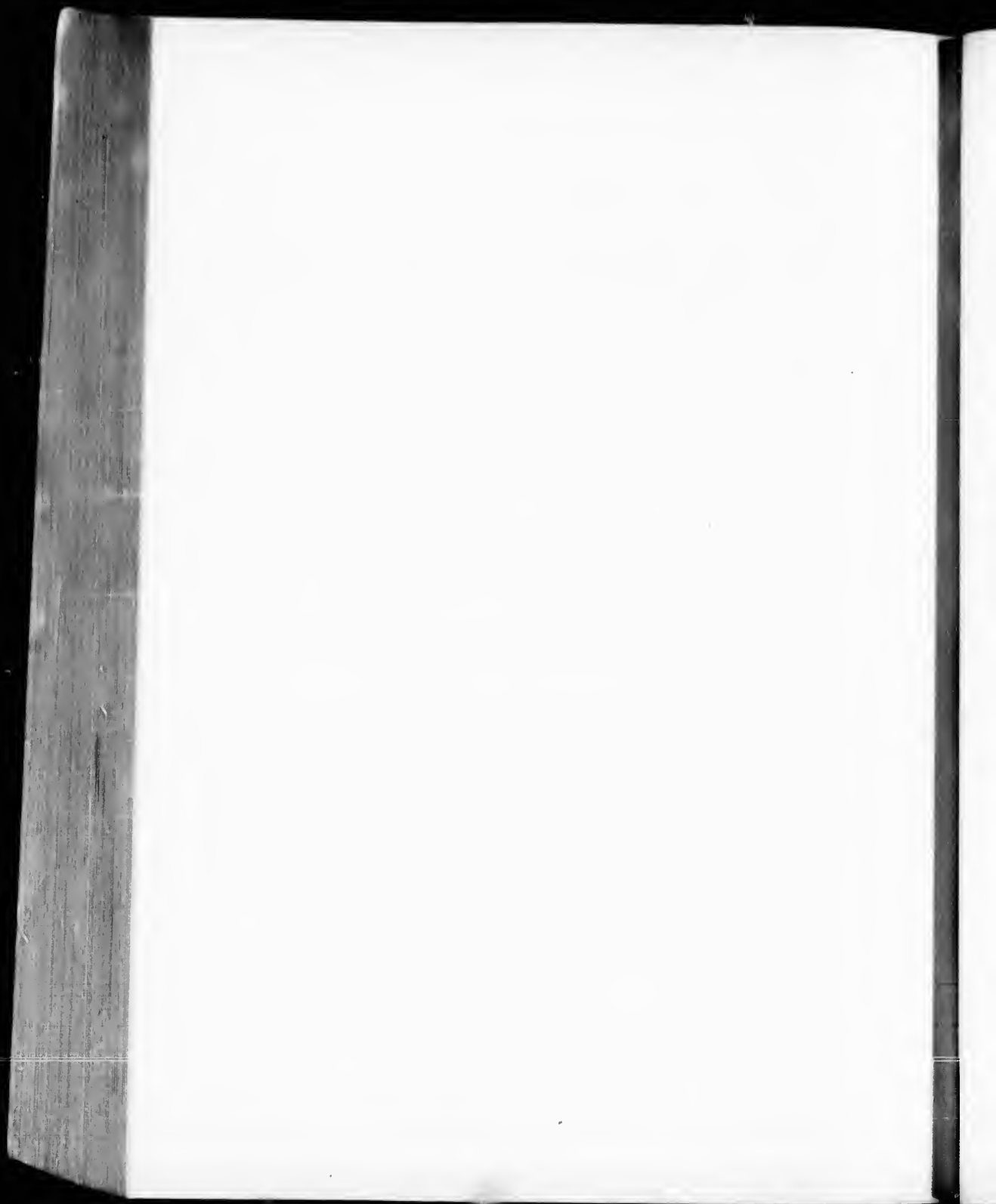
The Court: But that is at the bottom of the No. 3 shaft and also below the water-course, is that so? A. Yes.

Q. I am asking from station 38 to station 16, if that cross-cut, run by whom you like, is the main cross-cut tunnel to the top of the winze, if you can locate by that; it used to be called the door "M." A. That distance goes through the cross-cut, goes past the bore hole, and the wall comes down the middle of it about.

Q. Yes, that is right, the top of the lower Iron Mask winze. A. Yes, all the way from 38 to the top of the winze.

Q. Yes. A. I do find streaks of ore lying in proper position to be part of the Centre Star vein, but I do not find in that distance from the bore hole or any winze such a defined body of ore as I find in No. 3 all the way down to the green drift and down to the flat fault.

The Court: No. 3 shaft? A. No. 3 shaft all the way down to the flat fault. There is a little obscurity in there, and on that evidence alone we should not know what to say as regards the regularity of that vein, although I should feel sure that if it had effected some disturbance, that it came up because of the bottom material of the vein and ore, it is chalcopyrite and pyrrhotite ore scattered through there, but from that point down ore can be traced, and the only difficulty that I have at this point is to fix the limits to any given zone for the whole vein there, and the difficulty does not arise from the broken ground or obscure ground, mixed up ground just around and west of the bore hole. It arises from the ore at 38 and 39, which lies further back than the foot wall shown in the shaft. Now the foot wall spoken of by Mr. King, in that yellow cross-cut, just to the east of the point you name, would include in the zone of the vein this body of ore that is seen at 38 and 40, and that is so far as I know at present, the only important reason for supposing that that is a foot wall of the vein, but for that I would take a foot wall as quite sufficient to satisfy all facts observed that did not go so far below the lower floor, the floor of No. 3 shaft, but finding another plane there, and finding absolutely not merely so-called mineralization of this and that ore, and other of an indefinite degree, but absolutely solid pyrrhotite clear back to it, one feels as if that must be included in the vein; it is actually in contact with, and whether you would call it a body sticking out in the country rock or whether you call it a part of the vein and say that plane that is bounded below is the ultimate plane, makes very little difference practically and I have been willing to take on the whole of that plane as the ultimate foot wall in that sense, and taking that plane as the ultimate foot wall and carrying ore from that solid mass in scattered streaks to this broken country, I do find a connection in vein matter to the head of the winze.



The Court: The head of the Iron Musk winze? A. The head of the Iron Musk winze, and it involves just this connection, involves an amount of slight swell in the downward course of the vein which is shewn on section A-B, a section which goes through at right angles the very crosscut you are talking about.

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Q. Do you know what the strike of the ore is at the place called the door "M" station 38? A. I do not; I have not taken that.

Q. I understood you to say yesterday, Doctor, that this was not stratified rock, sedimentary stratification, and there was nothing in the vein itself by which you could distinguish one vein or one part of a vein from another so far as you observed, and in speaking of the probabilities of a certain body of ore, say above the mud-seam, being connected with a body of ore below the mud-seam, it was practically reduced to a question, based upon a mathematical calculation of the chances of that being different ore from the ore below it. Is that it? A. No chances of all possible occurrences when you are perfectly ignorant whether there were any. As I said, we had a million to one against any hypothesis that the parts coming together in that way and matching would not be parts of the same original body. But I also stated that in the case that a vein went down accompanied by a dyke or intersected by a dyke, and the vein and the dyke were both faulted and then came together so as to match, one being a slip to the vein and the other a vertical section,—that I said almost made very nearly inconceivable, because you would have to have another vein with just such a dyke.

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Q. I remember you said all that and it is all down in the notes, but what I want to get at is that there is nothing that catches the eye in the ore itself by which you can distinguish a part of one vein from a part of another vein. A. A part of one vein from a part of another?

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Q. Well, I put it that way. I would say a body of ore— A. (Interrupting.) I only wanted to get your meaning.

Q. Take any particular line, the line of the mud-seam as an illustration. There is a body of ore above and a body of ore below. What I want to get at is this: Is there anything which catches the eye which conveys a conclusive presumption—if you like to put it that way—that the body of ore below must belong to the body of ore above? A. I understand you. There is sometimes, in some instances; and in some instances there is not. There are several places in this mine where the presumption is overwhelming that it is the same; the thing matches seam by seam. There are other places where the presumption is still strong, but the mud-seam has parted, the two bodies being a greater thickness, for instance, at points 38 and 40 in the roof, there is this body of ore

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which is folded by the mud-seam, and it is two feet broader above the mud fault than it is below. Now, that shrinkage in its coming down, and narrowing above or when it reaches the fault, the part that you see below is the top of the same triangle, but it is not the top that you can put up to match, because there are two feet of the triangle gone in the mud-seam. Now, I regard that place, 5 though it does not match, as almost dead-sure proved that it did once match. There you have the top of the triangle, and the rest of the triangle above and you have a piece of the triangle gone by reason of the mud-seam, and that is the only reason it does not fit.

Q. You have the top of the triangle, and then a couple of legs of the triangle, and then the mud-seam cuts it off? A. Yes, but there is a mud-seam like that (illustrating on the blackboard). The place to which I refer to the mud-seam coming through is like that (illustrating). Now, that being put on there, it does not fit; it is not so wide, but the reason is that the mud-seam is too 10 thick; that is what you really have, and then you have that part shoved along 15 18 inches and you get it that way. (The witness accompanied these remarks by drawing diagrams on the blackboard.) I call that almost as good proof as the other, because it is so easily explained.

Q. It is always, however, a question of fitting up planes in the ore itself 20 to make the identity, is it not, Doctor? A. Yes, to prove the identity in that way.

Q. I think you mentioned yesterday evidences of a great deal of movement in this Red Mountain? A. I did not say that; on the contrary, I have 25 only one evidence of any considerable movement.

Q. You have noticed the terraces as you look up the mountain? A. From this side?

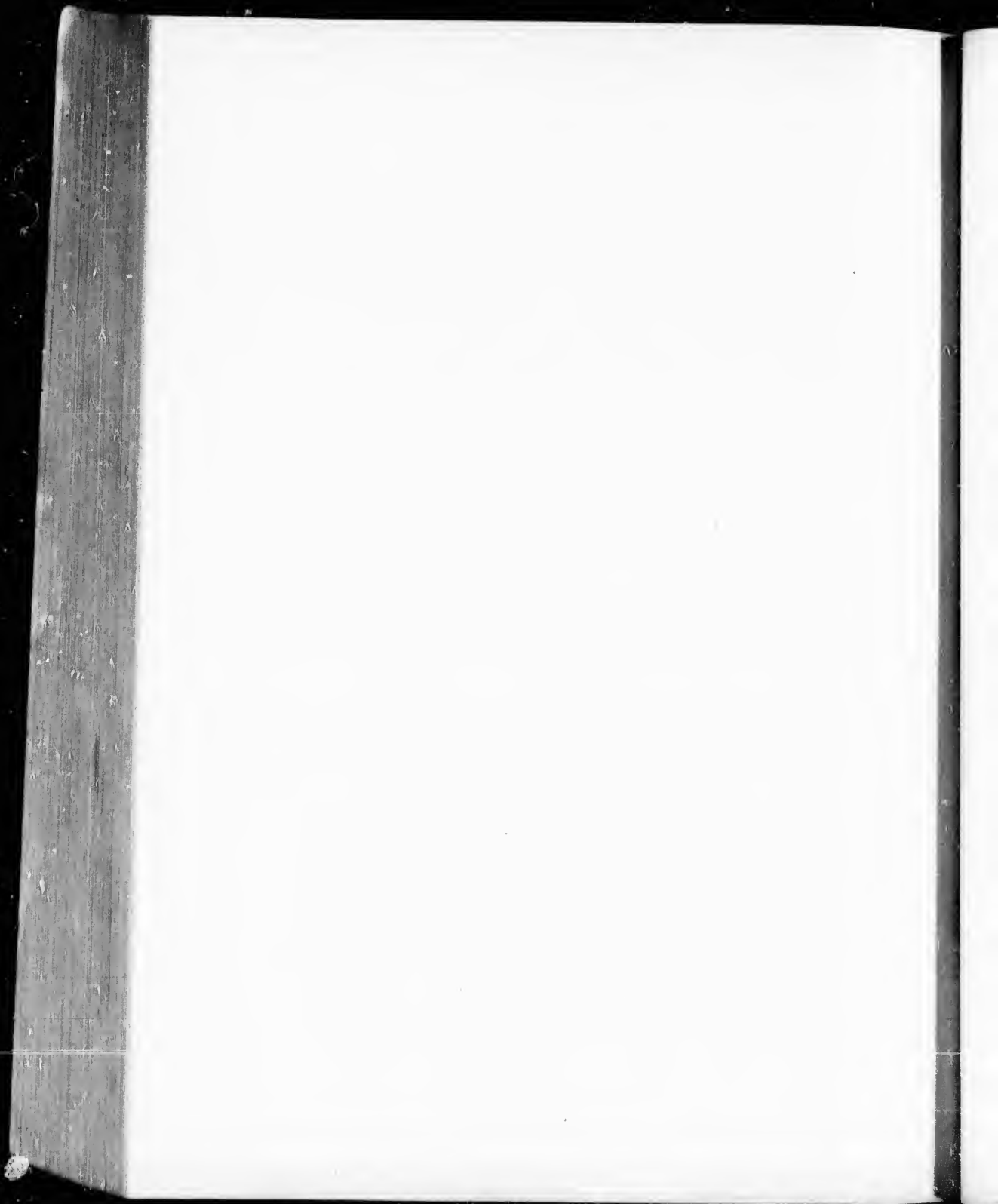
Q. Yes. A. I could not tell what was natural and what was artificial 30 from this side.

Q. You are not clear then whether that represents the flat fault? A. I can not tell anything about it. 35

Q. And you have noticed that you see the same thing in the Columbia and Kootenay mountain? A. Which mountain is that?

Q. The outside appearances, the visible outside step faulting in the terraces; haven't you noticed a difference in the mountains? A. Which mountains are you referring to? 40

Q. The Columbia and Kootenay, and Red Mountain. A. I don't know which the Columbia and Kootenay Mountain is.



Q. That is the one off this way (indicating the direction)? A. I have not noticed the difference.

Q. Would you be surprised to know that you find the flat fault all through Red Mountain and would not find it in Columbia and Kootenay Mountain? A. I should be very much surprised to know that a fault that only moved 18 inches could extend so far; but still, it would not be impossible. 5

Q. But if the flat fault is found all through Red Mountain, in all the mines in Red Mountain, practically, and if its plane is coincident with the planes of those faults, this apparent step faulting would attach no significance to that? A. I should say it was very interesting indeed. I do not know what it has to do with the mines except that it came along after the mines were formed; but the larger the area of the flat fault is the smaller the flat fault is likely to be. 10 15

Q. But it would be consistent with the movement of that flat fault? A. Yes.

Q. Either a reverse fault or a normal fault? A. Either way. 20

Q. A large amount of attrition mass in the flat fault would also be consistent with that? A. Yes, but the attrition mass is very small.

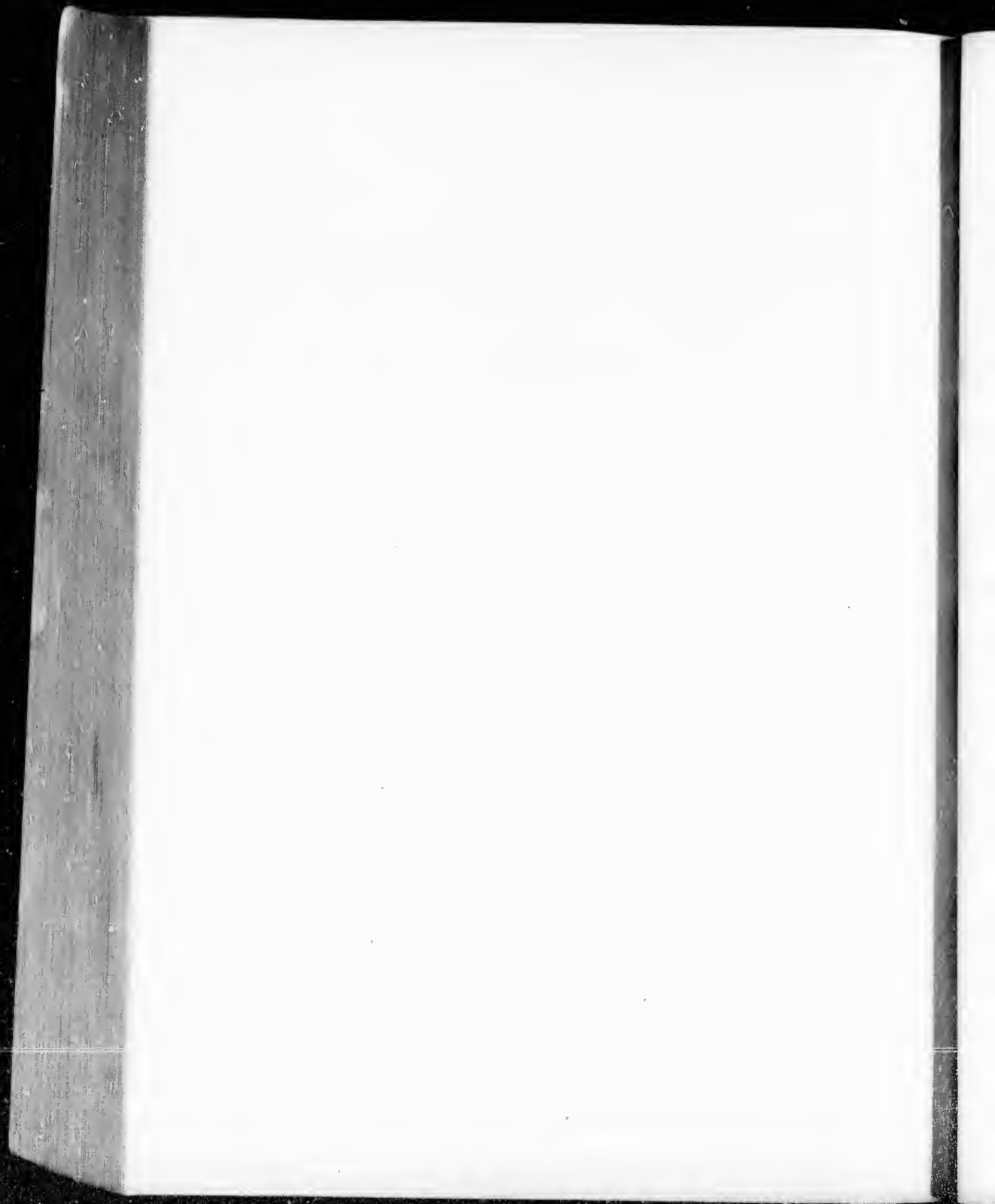
Q. Where it is two feet wide, that is pretty wide. A. Two feet of attrition mass is very small indeed. 25

Q. There are very extensive fault planes with very much less attrition mass than that? A. That depends entirely on the nature of the rock, as Mr. King has explained, that has rubbed together, but it is not a large amount; it is a very small fault fissure indeed. 30

Q. The Iron Mask vein is apparently composed of a fault fissure—that is, what you call the Iron Mask vein. A. Well, I am not certain that there has ever been any fault on it; I don't remember. 35

Q. Do you get any movement on the vertical fault? A. On the vertical fault, we have found the horizontal movement is about 30 feet.

Q. That would be equivalent to 80 feet of vertical. A. There is no equivalent about it; it might move horizontally 30 feet and have no vertical movement; you cannot deduce the vertical movement from the horizontal. I think the vertical fault is about 100 feet, but it is not because the horizontal fault is 30 feet, that I think the vertical fault is 100 feet, but from other causes altogether. 40



Mr. Davis: The big dyke. A. The big dyke, the vertical dyke in the big fault.

Q. I don't know that I am right, because I am not an engineer I will submit the proposition to you; if you find a normal fault, either going down on a certain line of inclination a certain distance, that is, if you find a horizontal fault, by that you can estimate the amount of vertical fault, having these two given things? A. Oh, not a bit. (Illustrating.) Here is a continuous plane, putting two books together to indicate a continuous plane. Now, you can have a vertical movement that way, and when you measure it across on the level, it will be 30 feet, say; there has been no vertical movement at all; you can have a vertical movement that way and when you measure it across it is still 30 feet; there has been 100 feet of vertical movement, and you cannot tell one case from the other, except by having more than one exposure, or some other mathematical data, surveyor's data, to work it out by.

Q. I was assuming a proposition which you do not admit, and with your premise, your conclusion is perfectly right. A. No, I do not admit anything.

Q. I was assuming that you had established the fact that it was a normal fault, and that you had established the inclination of its dip. A. You mean the inclination of the—

Q. Of the head of the fault? A. Of this dyke fault, we call it, very nearly vertical—we can call it vertical for all practical purposes, as I say of this vertical fault, this vein may be slipped, it don't need to come down; you can get in at any direction on a vertical fault. The dip of the flat fissure is not necessarily the dip of the faulting movement. You can slide down hill by the steepest grade on a fault, or you can slide obliquely along the same fault and never know which until you find it.

Q. We may say all of this is pretty well by the way. You do think that there has been a faulting of about 100 feet. A. I think there are indications of about 100 feet of faulting there, but I did not work it out in detail.

Mr. Davis: Vertical fault. A. A vertical fault comprised of 30 feet horizontally, and 100 feet vertically. If you want to know the exact amount of movement you must take the vertical 100 and the horizontal 30, and take a triangle and draw the hypotenuse.

Q. You did also find some evidence of movement on the fault, that is found at upraise No. 3 in the Centre Star north drift, didn't you? A. Yes, sir, a little; I found some stickenslides. I remember it very well (referring to



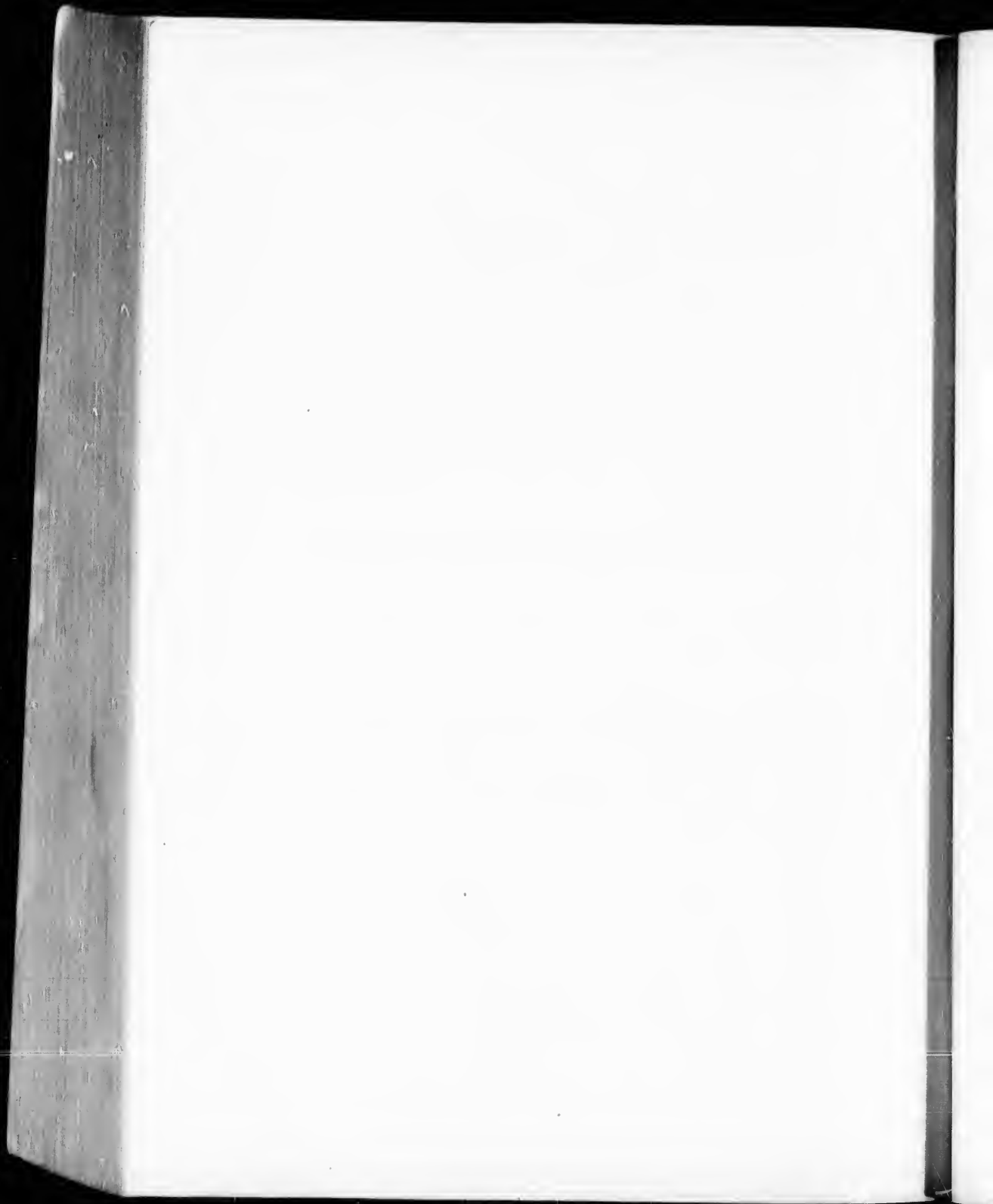
specimen marked Exhibit 141) I can identify the piece because I found it myself. I found the slickenslides, it is not necessary to introduce it, in the heart of that dyke. It is evidence of small movement, and there is faulting.

The Court: In the heart of which dyke, the large dyke? A. No, sir, the small dyke which is just spoken of is a dyke spoken of coming up No. 3— it is right on the back of this section of my model (pasteboard model). 5

Mr. Bodwell: I would like to have those put in evidence. A. All right, I will put them in. I will identify them from recollection. The original surface from which these are taken is about two inches by three, much larger, a very pretty piece; there is only one exactly like that that I found in the mine. There is a movement at this place—there is a throw of the Iron Mask vein horizontally six or eight feet, and there is over in the same dyke cutting through, near station 50, east of station 45 in the Iron Mask tunnel, faults at that point. The mud-seam or flat fault and throws that eight or ten feet in the opposite direction, as Mr. King explained, and his diagram is still there, the "V" is left; one span is thrown one way and the other is thrown the other way. That shews the intersection at the eastern part, the western part west of that dyke, has dropped and the east is up. The same seems to be indicated there, that is on the model, that is, the movement here seems to have been as I said 100 feet up. That has no relation to the other fault, but it will simplify the illustration for all of us if you simply consider that between those two dykes the whole country has sagged a little, this is up and that is up, and this is down and that is down; we don't know which has moved up and which has gone down, but that is relatively the result. 10 15 20 25

Q. Speaking yesterday of the Iron Mask vein in the Iron Mask upper drift, did I understand you to say that at this point, that is, at a point opposite station 41, say where the intersection is noticed, that the Iron Mask vein there ought to go out to the north on its proper course, the Centre Star vein goes to the north—south one goes to the north? A. I will tell exactly. I have got that here (referring to memoranda); it begins at the elbow west of 105, and at that point and for some distance beyond that point nearly to the winze, or quite to the winze, the Iron Mask fissure is exposed all along that drift, and this stope from that drift united and runs through the Centre Star obliquely, and it takes a good ways to do it, and 20 feet odd there it ought to come, and in my judgment it does go off into the country, and the Centre Star vein continues just as you here see it. 30 35

Q. How would you describe it? A. The Centre Star vein which has come in from the south at that point continues on its true course and dip to the east, and is now being followed by that drift to the east. 40



Q. What would you give as the course of the Centre Star vein at that point? Can you do that? A. I think pretty nearly. It has the same course; it has a course parallel to the Centre Star, it is very near the east and west, within a couple or two or three feet of east and west.

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Mr. Davis: One question I want to ask you.

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RE-DIRECT EXAMINATION.

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By Mr. Davis—

Q. There was some statements which you made to my learned friend which might be interpreted as meaning that the commercial values of the ore is the basis of the ultimate walls of the vein. You might just clear that up a little. I don't think that is what you meant. A. When you have definite walls, when you have definite planes which have been filled with ore, or which have been clearly shewn to be the boundaries of a vein elsewhere and you come to a place where there is a barren rock between them that does not stop the vein, if you have your mineral you can follow it on ore, if you don't have your ore, or if it gets very poor and you still have the adjoining planes you can follow them.

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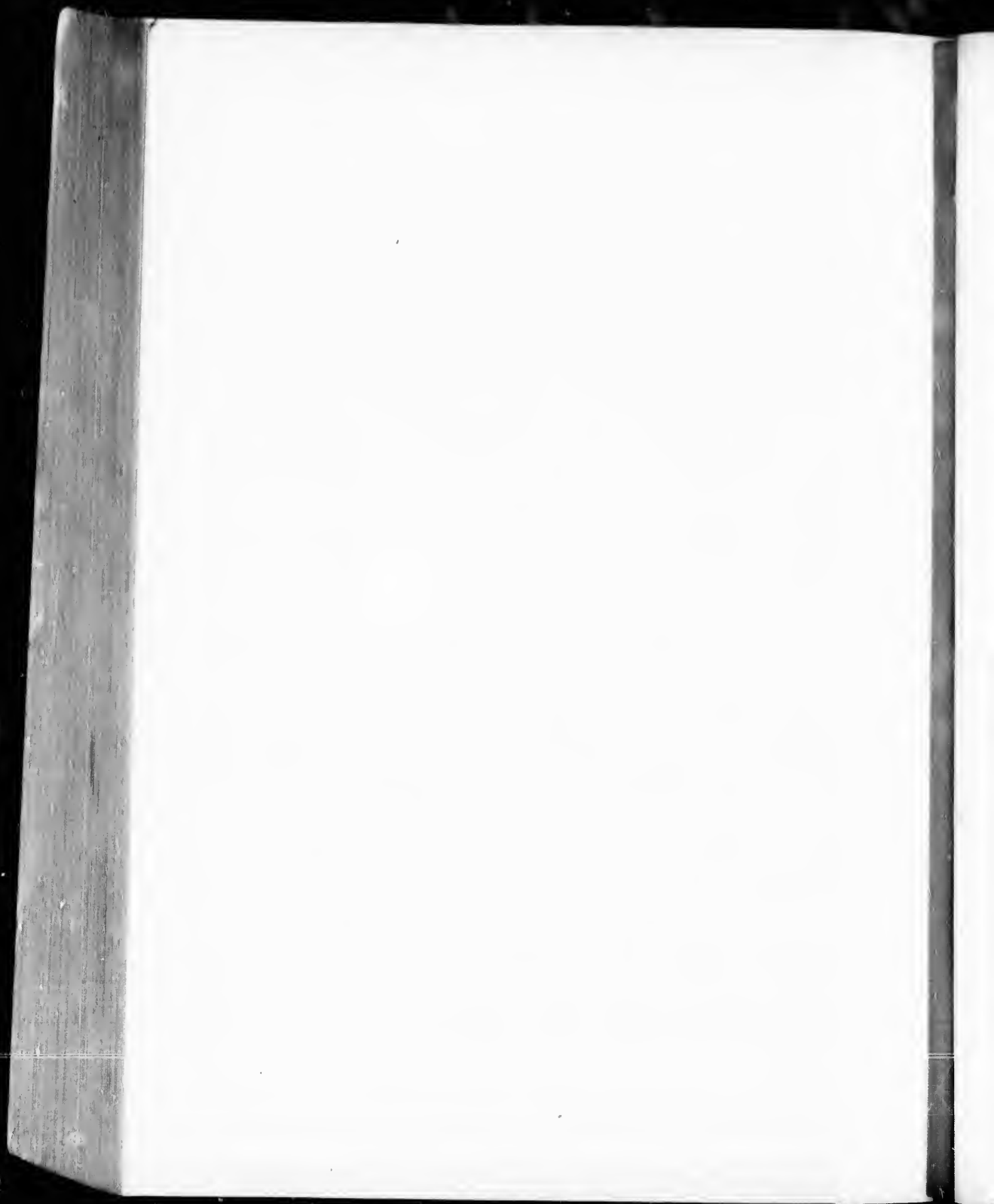
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Q. But you left the impression—perhaps I misunderstood you, that if once you got outside of ore that was commercially valuable, and I understood by that it must be of shipping value, it would vary at every point in the country, that when you got outside of that point, you got outside of your vein? A. No.

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Q. I knew you did not mean that. A. No, I was answering the question of the learned counsel on the other side. As I understood it it was, what you were going to say about mineralization that goes beyond the point you have



fixed as the wall, would you say there must be another wall? I say no, I have got a wall inside of it, I have a vein, and then I find mineralization going into the wall I should say, being a mining engineer and not a theoretical geologist, I would not discuss anything about its origin; I would say just as the miners all say that at this point the ore of my vein got out of it and went a little ways in the country wall and impregnated the country wall, and I would say there is the ore and there is the wall behind it. 5

The Court: I would like to ask you a question about what has been referred to here two or three times. Do you decide that is a mud-seam because it will sag and rise here and there, it would be irregular? A. In thickness it would be irregular, put it roughly, there is a vein here (illustrating on map). 10

The Court: Well, it is dislocated say this much, this arises from Mr. Bodwell's question, and it seems to me a very pertinent question, and hundredths and hundredths of feet—I am not drawing anything by scale—there is a vein here, and it is wholly dislocated. Now, as I understood Mr. King's explanation of that it was that the process might be different, and rock might be different and in one place hard, in another place soft and porous, and that the effect of the mud-seam would be different in the different places. Is that correct, or did I misunderstand you? A. I will tell you my view. I did not hear what Mr. King said. There is a certain amount of give and take in a solid rock. There is a certain amount of elasticity; now whether we have proved practically and determined mathematically the amount of give and take that the different rock shews here, we have to calculate the leeway that we might get to a rock of that kind of a simple fault, which appear to throw one part of the fault one way and another part another. I mean both the same way, but one part further distant than the other, say one part two feet and the other part six feet, if you like, because as you push that along the rock compresses one side more than it does on the other; it is a real elasticity in the rock. 15 20 25 30

The Court: It meets more obstruction? A. It meets more obstruction, but it is really the compressibility of the rock. On the other hand, where you find a rock in a case like that which your Lordship has supposed thrown in one direction at one fault, and in the other direction at the other fault—these are both in the same direction—a very remarkable case, but we do find cases where there is a reverse dip at one place and a normal dip at the other. In another case the fault seems to have been gone down and up in another. Those are what are really called swinging faults or rotary faults, because it happens that a plane has once crossed over a faulting plane and sets here, the faulting rock declines to go down like a toboggan and simply sticks on some point and swings there, so there are rotary faults, which may only be determined by careful surveys up and down all through the mines, and by and bye we get at them. 35 40



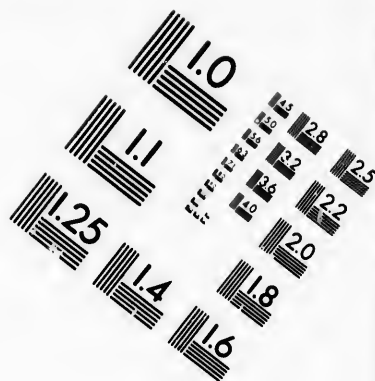
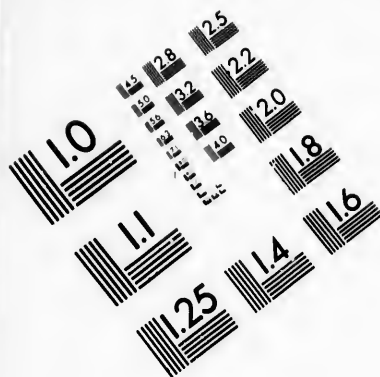
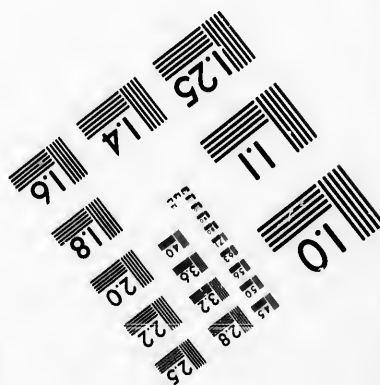
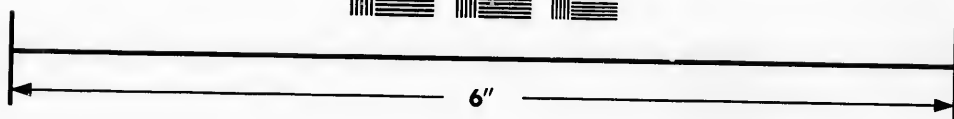
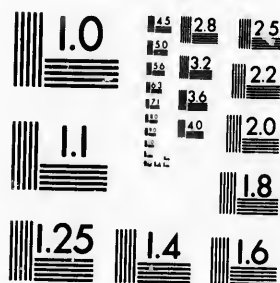


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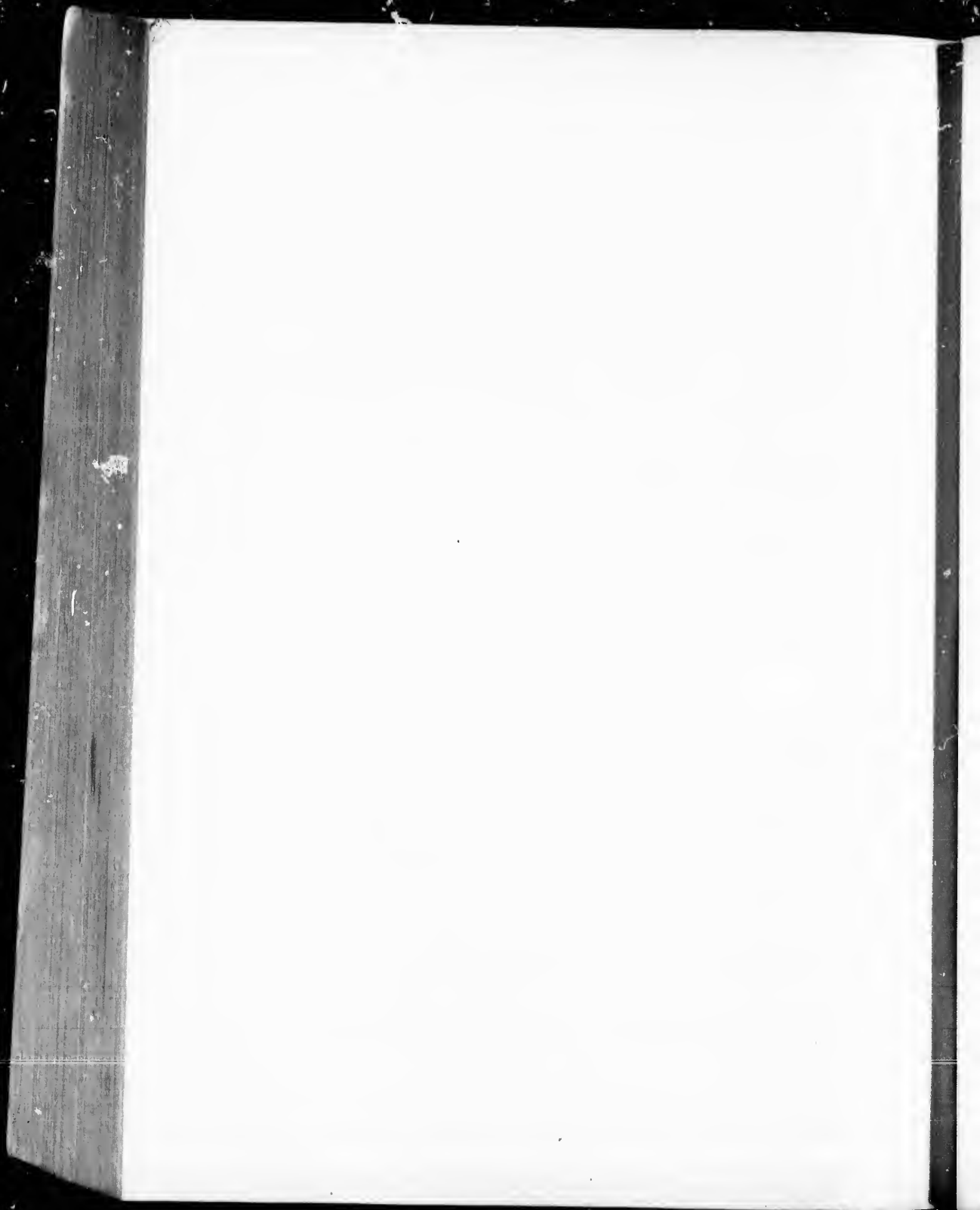
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I suspected that there was a very small rotary movement on the mudseam because I find at station 48 in the Centre Star tunnel No. 2 what looked like a normal fault, whereas either way in No. 3 incline at the bottom of the winze, it unquestionably was a reverse fault. I have been there several times to work it out, and I finally made up my mind that it might be a reverse fault like the others. 5
 In either case, it would not have any special significance, therefore I did not worry about it, but it was a curiosity. Then I found the fault away down in No. 1 south cross-cut and at raise No. 3, which is very nearly in the middle of the hole: I could not make out that there had been much movement at all, so I thought that there might be a pivot upon which there had been a slight swing 10
 instead of 3 or 4 or an 18 inch slip, as the case might be, in one direction. Those are complicated movements, and they have no great consequence, those dislocations are so small that it makes no difference what they are; but that is what looks like a rotary fault, and to a small extent a mere re-adjustment of the mass of the mountain.

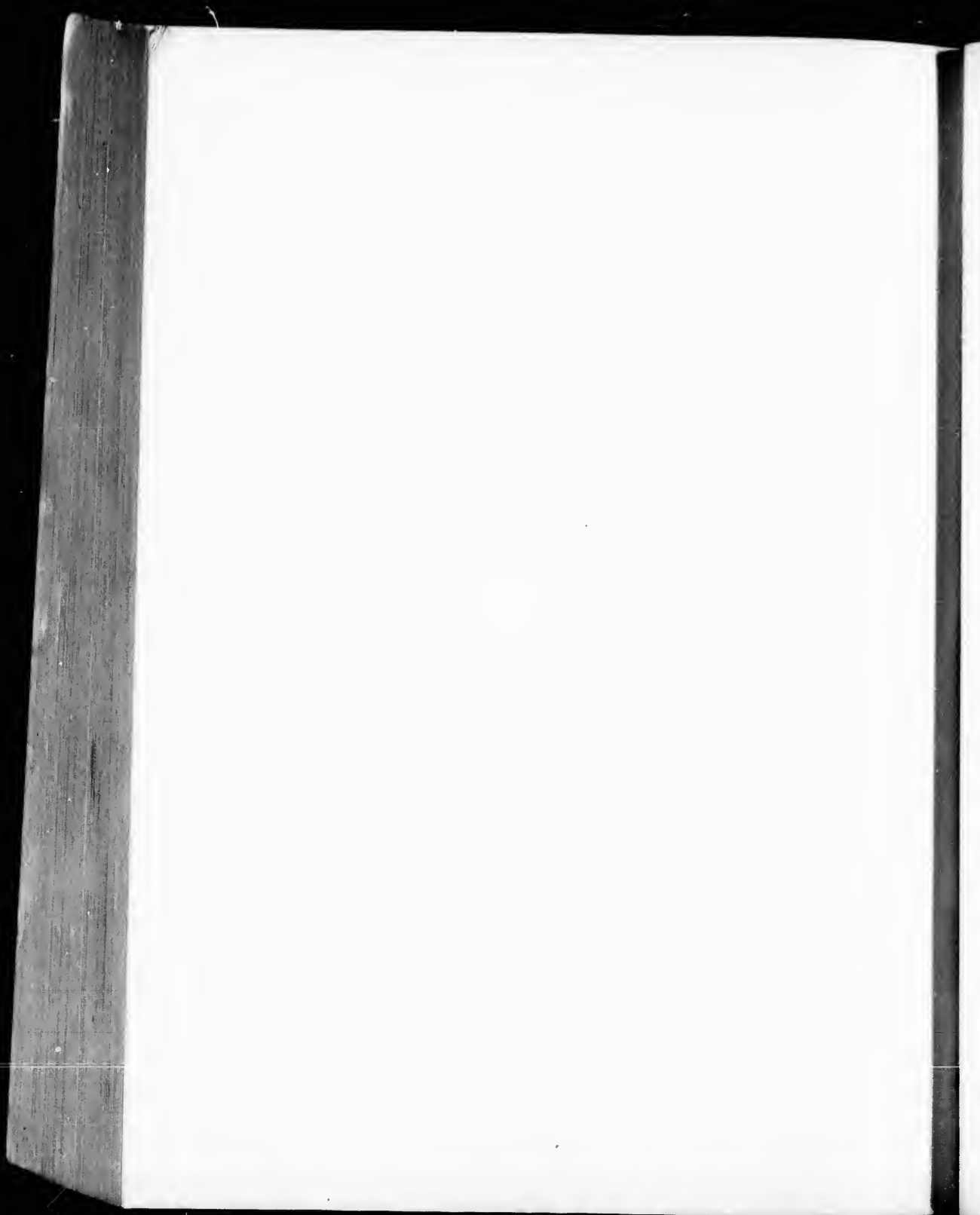
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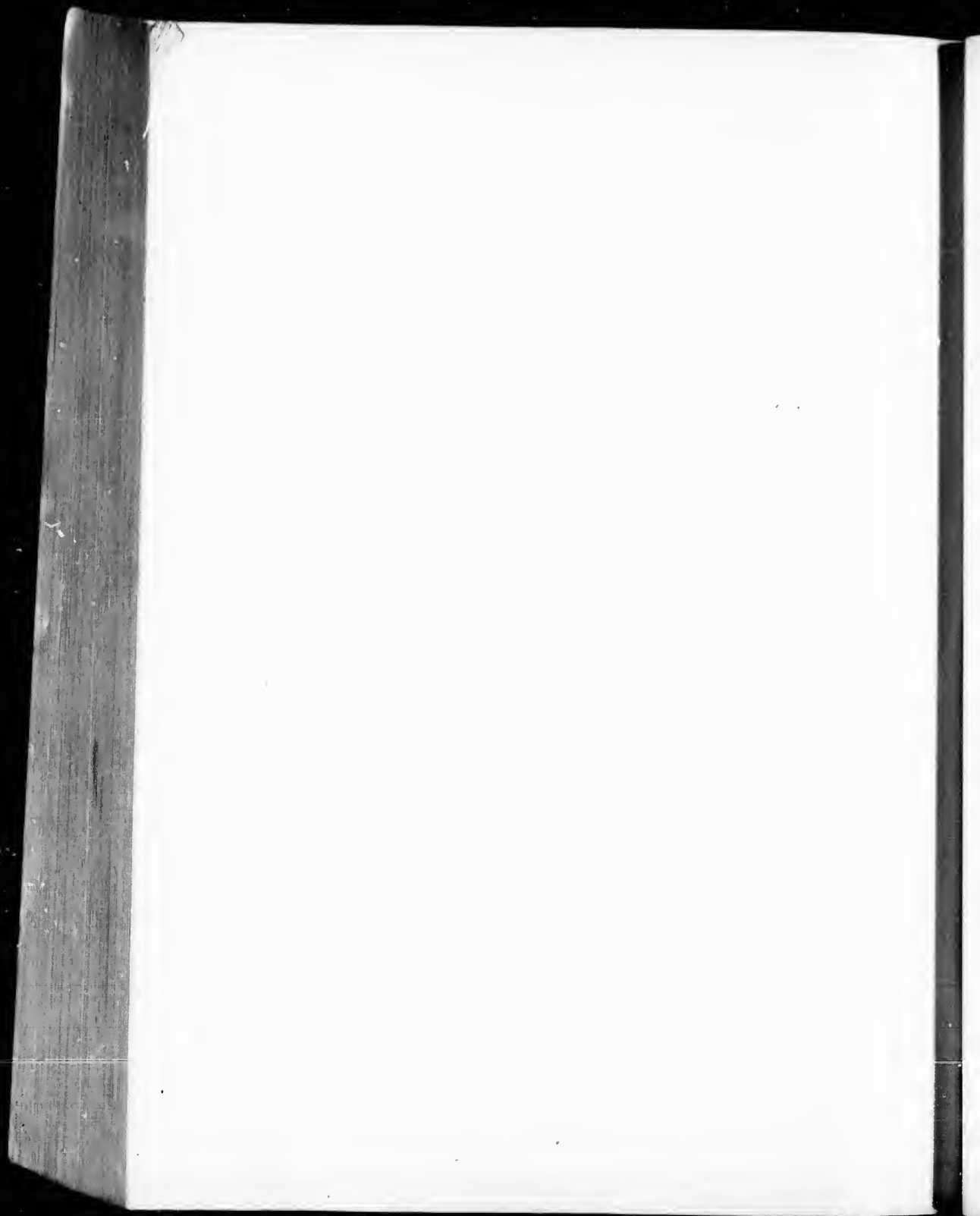
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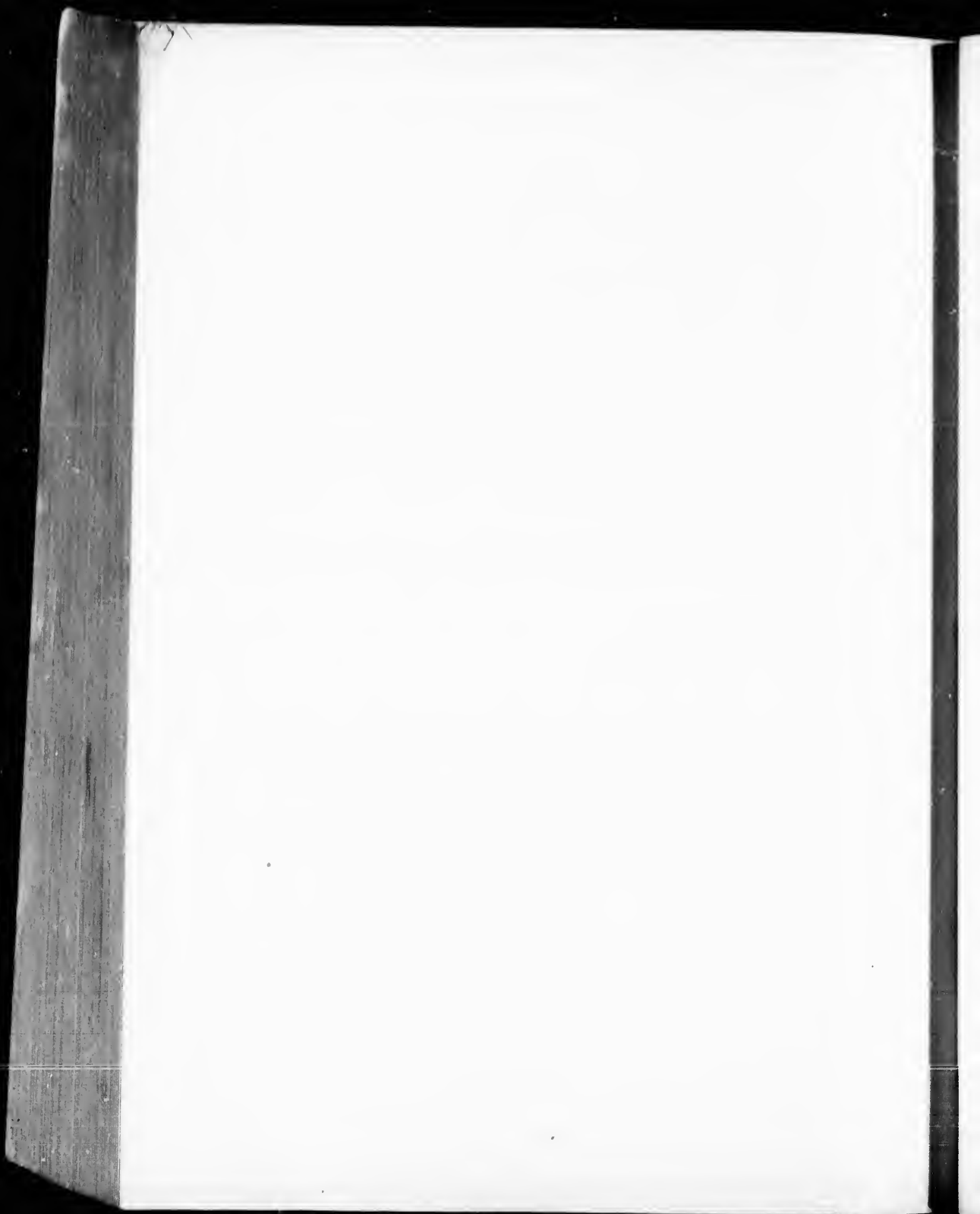
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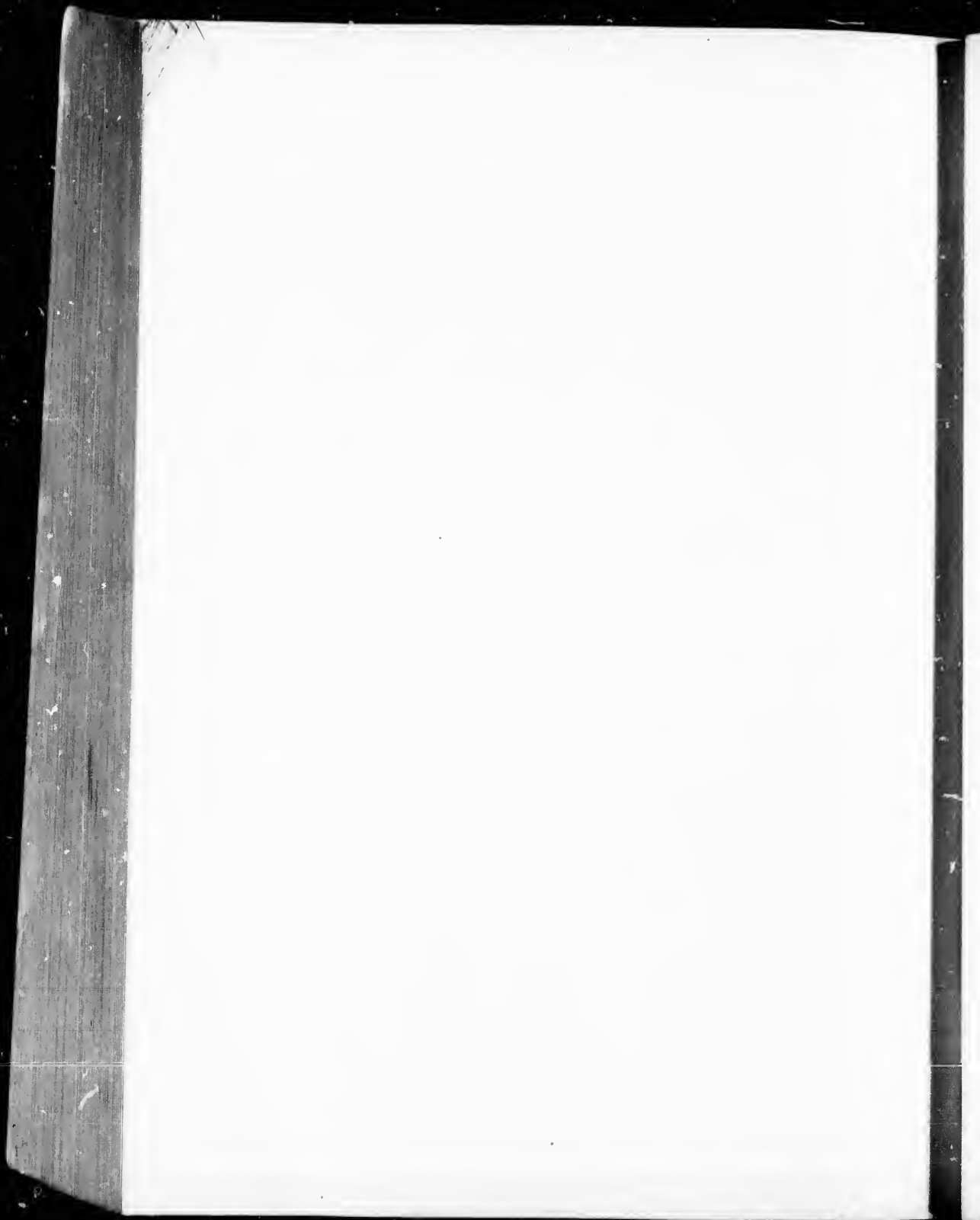
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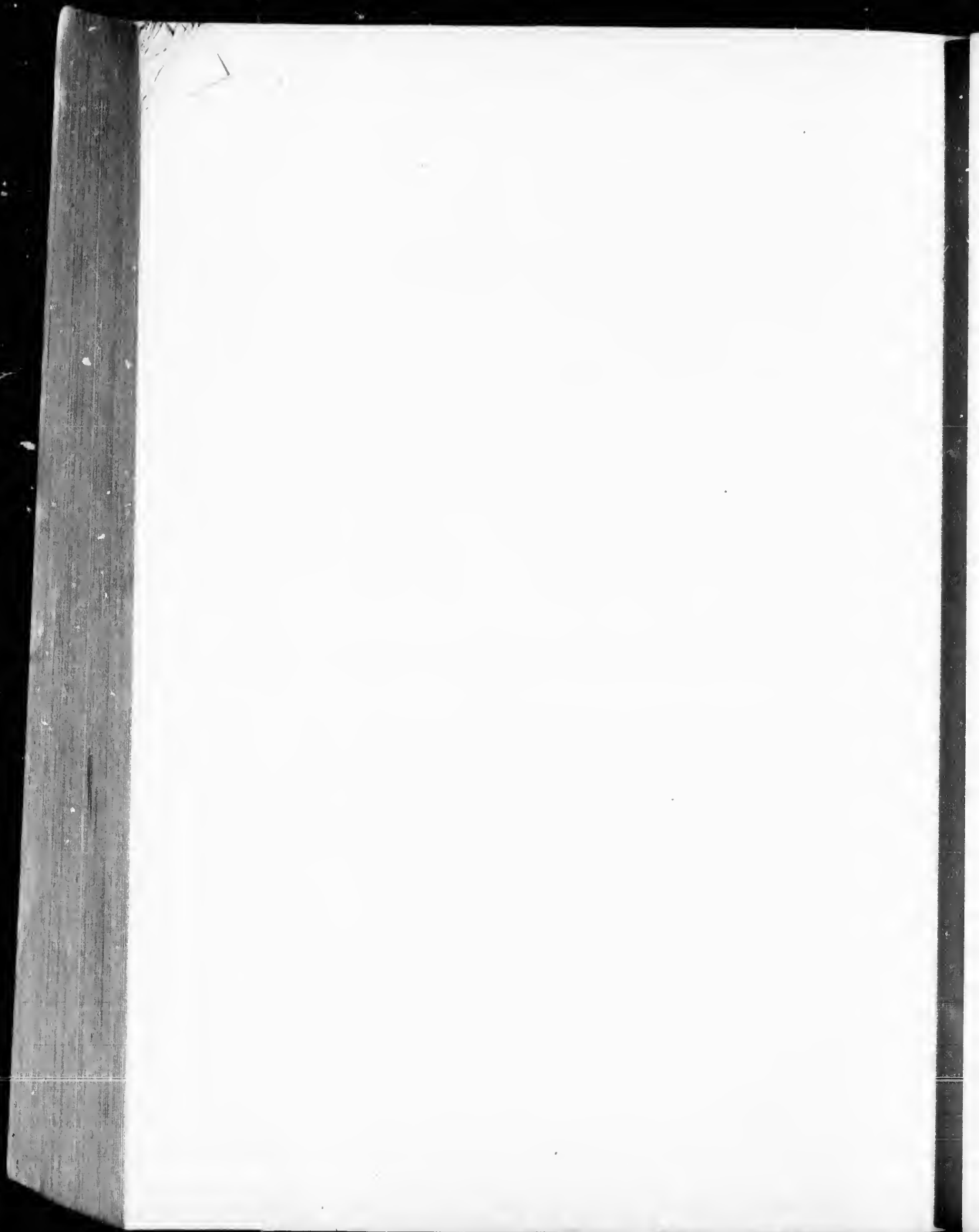
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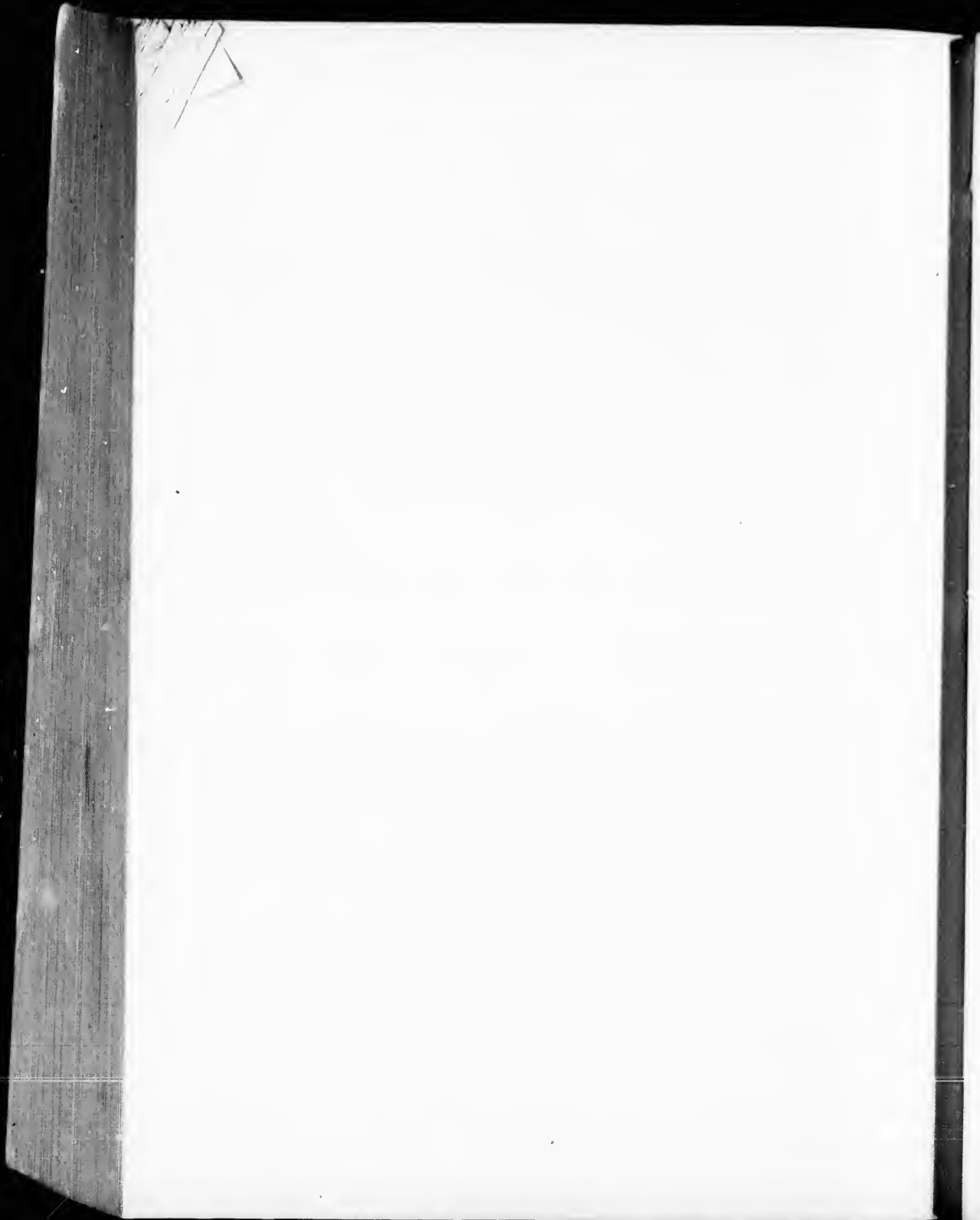


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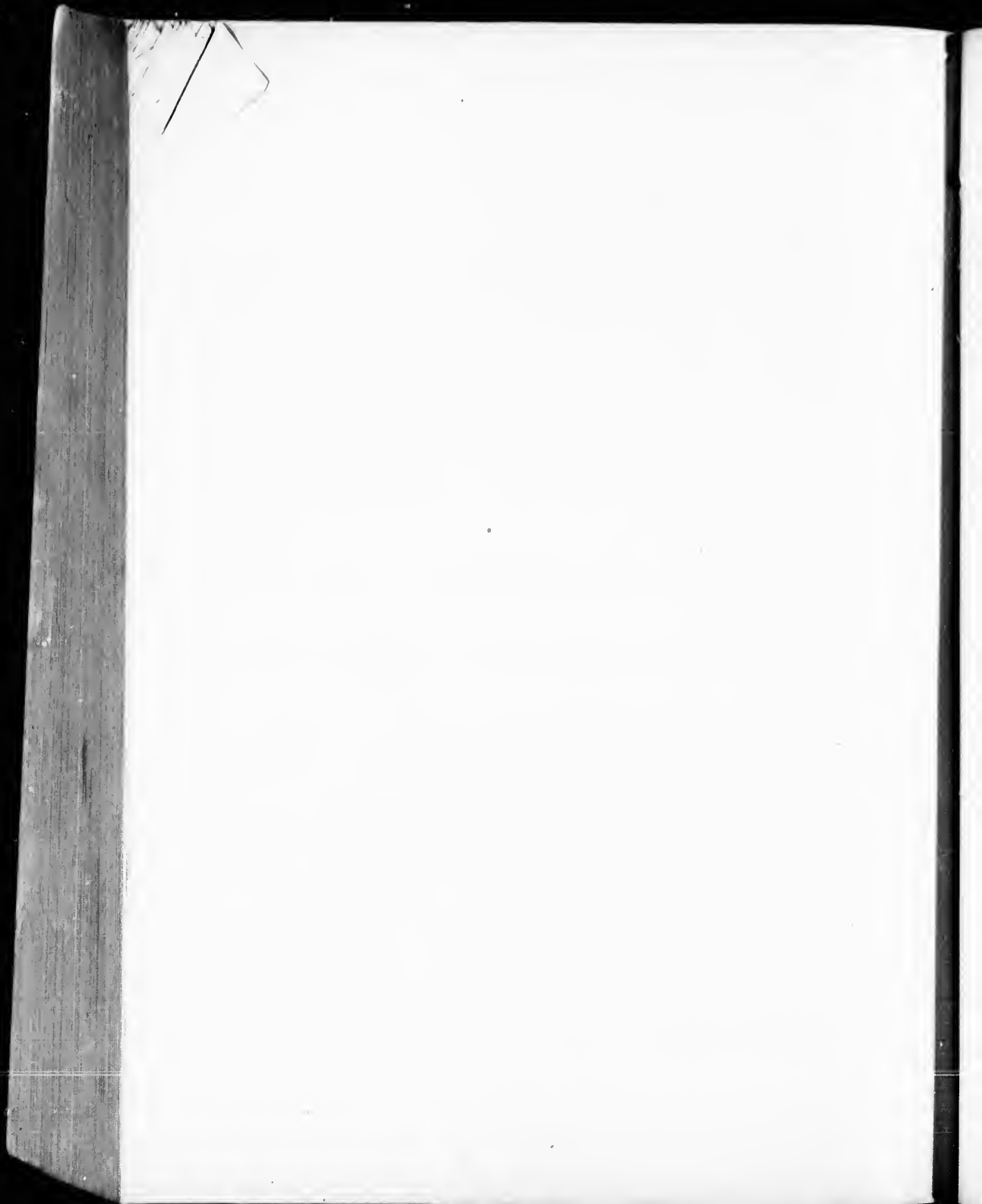
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