LIST OF ILLUSTRATIONS.

ERRATUM.

Plate 16, Fig. 25.—*For* Rhizophora *read* Spruce.

IX. *On the Action of Wood on a Photographic Plate in the Dark.*

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[PLATES 11–18.]

IT has been shown in former papers that if wood, even if old and dry, be placed on a photographic plate in the dark, it is able to act on it in such a way that when the plate is treated with an ordinary developing solution a clear picture of the structure of the wood is produced. Further experiments on this and allied subjects have been made, and interesting results obtained.

After experimenting with a large number of woods the conclusion is that, almost without exception, they have this property of acting on a photographic plate in the dark. The amount of action exerted, however, varies very considerably with different woods, some requiring a much longer time to produce a good picture than others. The ordinary limits of time and temperature are from $\frac{1}{2}$–18 hours' exposure and from ordinary temperature to about 55° C. The time of exposure may be extended to 30 or 48 hours, but a higher temperature cannot be used, since plates, as a rule, are damaged when heated above 55° C. This action occurs both when the wood is placed in contact with the plate and when it is supported above the plate.

Some of the most marked and interesting results are obtained by woods belonging to the group of conifers. To take first the common Scotch fir (*Pinus sylvestris*). A transverse section of a branch or stem about 3 inches in diameter is a convenient size to use, as it will stand on a quarter-size photographic plate. The specimen used should be turned quite flat on one side and then rubbed with fine sand-paper till quite smooth. It is also necessary that the section be dry, or else on warming, water will deposit on the photographic plate and the picture be spoilt. Plate 11, fig. 1, shows the picture produced by Scotch fir treated as above described. What is active in the wood is dark in the picture. The whole picture is perfectly clear and sharp, so much so that it will bear considerable enlargement. On carefully examining this picture, and comparing it with the original wood, it will be found that it is the light-coloured rings, the spring wood, which have acted on the plate, and that the dark rings, the autumn growth, are entirely without action. As previously pointed out, this picture is very sharply defined and is quite constant; all specimens of this and allied pines act in exactly the same way.

It has previously been shown that probably hydrogen peroxide is the active agent

in producing pictures on a photographic plate in the dark, consequently it seems probable that the resin in the wood is indirectly the cause of the picture. That it is not a case of radio-activity appears to be proved, for a glass or mica screen of one-thousandth of an inch in thickness entirely protects the plate from being acted on. This great difference between the action of the spring and autumn rings in the Scotch and other pines seems at first difficult to explain, but the following facts throw some light on the matter and may help to an explanation. It is difficult to imagine that in the soft porous white wood there should be sufficient resinous matter to make it active, and at the same time resin should be entirely absent from the dark rings, yet that is what the photographs indicate. It is, however, not difficult to show that resin is contained in the dark rings, for if the material forming these rings be carefully cut out so as to separate them entirely from the white wood, and then treated with hot alcohol, the filtered solution on evaporation leaves a residue of resinous matter, which acts strongly on a photographic plate. Again, if this dark wood, which is devoid of action on a plate in its normal state, is reduced to a state of fine powder by scraping or rasping it, it then becomes very active, readily acting on a photographic plate; thus it would seem that in the autumn wood the resin is confined in cells through the walls of which it cannot pass. Even a moderate amount of heat does not change the action of this white and dark wood of the Scotch fir, for if separate specimens of the rings be heated to 90° or even to 120° C. for some hours, and after cooling be placed on a photographic plate for 18 hours, the light wood still gives a good dark picture and the dark wood only a very faint one.

That the amount of moisture in the wood does not affect these results was proved by drying the wood at 55° and cooling it in a desiccator over sulphuric acid, when the action exerted on the plate was found not to be altered. When even a little inactive oil or wax was rubbed on to a piece of deal it did not affect its activity. Fig. 2 is a picture of a tangential section of deal; other members of the pine group—namely, *P. pinaster*, *P. strobus*, and pitch pine—have been experimented with. Fig. 3 gives a picture of radial transverse and tangential sections of this latter fir.

With the spruce firs (*Picæa*) the action on the plate is not of so definite a character as it is with the pines, for the dark rings are often active, the white wood, however, still remaining active, fig. 4.

The action of larch, which is also a member of the fir tribe, is very interesting, for it is the reverse of that of the Scotch fir, the dark rings being much more active than the spring wood. Fig. 5 is a picture of a transverse, and fig. 6 a tangential section of larch. The white wood in the larch is much harder than that in the Scotch fir, and, taken as a whole, the larch is a less active wood than the Scotch fir. In the cedar, which is so nearly allied to the larch, the dark rings appear to be the most active, but are so near together in the specimens examined that it is difficult to trace exactly their action. With the silver firs (*Abies*), the dark rings as in above cases are active. The *Cupressus* tribe all seem to give an active wood

and one in which the dark rings exercise more action on the plate than the light wood, fig. 7. The juniper gives a wood which is only very slightly active.

Passing on now to woods not belonging to the group of Conifers. The oak, fig. 8, is an active wood, also the beech, fig. 9, and the acacia (Robinia), fig. 10, and Spanish chestnut, fig. 11. Sycamore is also a very active wood.

The English woods which have been examined may be roughly arranged in three Groups, those which are very active, active, and slightly active.

Very active.	Active.		Slightly active.	
Oak.	Beech.	Maple.	Alder.	Laburnum.
Sycamore.	Box.	Robinia.	Ash.	Lime.
Scotch fir.	Cedar.	Rhododendron.	Currant.	Laurel.
	Cherry.	Silver birch.	Elm.	Pear.
	Cupressus.	Spanish chestnut.	Gorse.	Plane.
	Hornbeam.	Spruce.	Horse chestnut.	Tulip tree.
	Holly.	Walnut.	Ivy.	Yew.
	Larch.		Juniper.	

Elm is a wood which is remarkably inactive, as is shown by fig. 12. The wood of the tulip tree is of the same character. It is very slightly active except round the edge, where it is very active, fig. 13. Different specimens of the same wood naturally vary considerably in activity.

Foreign woods.—Many of these are very active, but as the annual rings are not generally well defined, the pictures which they give are of a somewhat different character from those already described. The following is a rough list of the woods which have been tried, arranged as before in three groups :—

Very active.		Active.			Slightly active.
African blackwood.	King wood.	Bass.	Hickory.	Partridge.	Sandal wood.
Bar wood.	Rose wood.	Bamboo.	Lignum vitæ.	Quebracho.	
Cocobolo.	Red saunders.	Cocos.	Mahogany.	Red gum.	
Kabucalli.	Snake wood.	Ebony.	Olive.	Teak.	
				Tulip wood.	

The following figures show some of the curious pictures which are produced by certain of these woods. Fig. 14 is produced by rose wood, fig. 15 by cocobolo, where the dark rings are inactive and the red ones are active. Fig. 16, lignum vitæ, transverse section, the outside yellowish ring is perfectly inactive and consequently not shown. Fig. 17 is bamboo, all the inner portion is perfectly inactive. In many of the foreign woods there is towards the outside a band of light-coloured wood which is inactive.

Knots in a wood are generally surrounded by resin, and it would therefore be naturally supposed that a very dense picture of a knot and its surroundings would

be formed, but this is not always the case. Fig. 18 shows a knot in yellow pine, and although the knot itself is dark its immediate surrounding, which is resin, is almost without action. In fact, resins evidently vary very considerably in their power of acting on a photographic plate, and their different degrees of volatility or general activity may be shown by placing the sensitive plate at a distance above the specimen of the wood and noting the result; for instance, a plate $\frac{3}{4}$ inch above a piece of deal will give a dark picture, whereas larch, pitch pine, or oak under similar conditions act only very slightly on the plate. Of course, the absolute amount of resin in each case is not known and varies considerably, but this variation in quantity does not seem to be the sole cause of the different effects produced. There is another way in which the resins from different sources may be tested. It is by placing the specimen of wood on a piece of Swedish filter paper, which is a perfectly inactive body, and heating it to a temperature of 90–100° C. for 2 hours, then when cold the paper is removed from the wood and is put up with a photographic plate. If larch, spruce, or red saunders wood has been used, then the paper on which it stood gives a distinct picture, and this is the case notwithstanding there being no visible sign of anything on the paper. Scotch fir, deal, beech, and oak will not act in this way, so that the larch at 90–100° is much more active when tested in this way than the Scotch fir.

It was evidently of interest, in place of a wood, to try the action of the ordinary commercial resin (*colophony*), and it was found to be very active, readily producing a dark picture. It can be used as a coarse powder, or by painting an alcoholic solution of it on one side of a piece of Bristol board and allowing this to dry and harden. Such a card will, if, for instance, different qualities of paper be laid upon it, give on the photographic plate very clear pictures, showing the structure and watermark of the papers. The resinous matter which is extracted by hot alcohol from different woods, as one would anticipate, varies much in properties. Deal and Scotch fir yield an oily residue which does not become hard, but is an active substance, whereas lignum vitæ and yellow pine give a resin which is also active and becomes hard. Larch, on the contrary, gives a hard resin which is not active or only very slightly so.

The following bodies, which range from resins to pure gums, are placed approximately in the order of their activity, ordinary resin being the most active on the list and the gums Senegal and Arabic being quite inactive:—

Strongly active.	Slightly active.	Not active.
Ordinary resin.	Dragon's blood.	Gum Senegal.
Burgundy pitch.	Asphaltum.	Gum Arabic.
Gum mastic.	Orange shellac.	
Gum damar.	Gum tragacanth.	
Venice turpentine.		
Gum copal.		

If a wood be wetted with ether, or even exposed to its vapour, it becomes more active, but the picture is less sharp. Merely heating a wood to 100° C. for 1 or 2 hours and then allowing it to cool does not alter its activity. If the heating be continued for, say, 8 hours, its activity is somewhat increased, but if continued for 100 hours the activity is considerably lessened.

To remove the whole of the resin from a wood so as to make it inactive is difficult. If it be digested with alcohol and ether, or with benzene, it retains its activity with great pertinacity, but if a shaving be plunged into boiling water for an hour it becomes perfectly inactive; also if it be treated with caustic alkali or gaseous hydrochloric acid or with chlorine it becomes inactive, but under less drastic treatment wood retains this power of acting on a photographic plate with great pertinacity. A piece of wood which had been exposed for many years on the roof of a London house was still active, so was an oak box more than 100 years old, and even decayed wood quite soft, taken from the stump of an old tree, and the central part of a piece of oak taken from a Dartmoor bog.

Generally the picture produced on the plate represents the structure of the wood with which it has been in contact and every part of the picture can be identified; but this is not always the case, for with certain woods a picture is always formed which is not visible to the eye even if the wood be examined with a magnifying glass. This is specially the case with bass wood. Fig. 19 is an ordinary photographic picture of a specimen of this wood and fig. 20 is the picture produced in the dark. Figs. 21 and 22 show the strong difference there is in the pictures of olive wood obtained by these different processes, and figs. 21A and 22A show the difference in cherry wood. With some specimens of the wood of *Abies pectinata* the same thing occurs. Bar wood also gives in the dark a picture in which apparently a large number of cracks are represented; these are not visible in the wood. That the picture produced in the dark is perfectly definite and constant is shown by the fact that if successive sections of the same branch be used the same picture is always produced. The botanist may be able to throw some light on this curious fact.

The true bark, the outside layer of a tree, appears to be in almost all cases quite devoid of activity, but the layer within it, often of a brownish colour, is very active, even more so than any other part of the wood. Fig. 23 is a transverse section of a small *Pinus pinaster*, showing that the outer layers, which were remarkably thick in this case, were more active than the wood itself. Fig. 24 represents two pieces of larch bark, and shows the great activity of the inner layer. With the oak and the beech the same thing holds good, the outside inactive and a thin layer between the bark and the wood very active. In the case of the *Rhizophora mucronata* wood the bark is about $\frac{1}{2}$ inch thick, but it acts in the same way as the other woods. In the cases where the resin canals come up within the bark they, of course, are very active. This is shown in fig. 25, where a series of dots are seen round the outside of the picture; these are the ends of the resin ducts, in a layer of bark, which is itself entirely inactive.

Ivy acts in a way different from most other woods, in having its outside layer active and the central part inactive; this is shown in fig. 26. This occurs in all cases where the central pith is largely developed. Fig. 27 is a section of a sunflower stem. The bamboo also gives a similar picture, its outer layer only being active.

In the case of different nuts it seems that the outside shell is very active, but not the kernel. Fig. 28 shows the picture produced by a section of a coco-nut.

There is another and very interesting action which occurs with wood, it is the action which light has upon it The activity—that is, the power which wood has of acting on a photographic plate in the dark—is always increased by increasing the amount of light falling upon it. For instance, if two similar pieces of Scotch fir be taken, and one remain in ordinary light and the other is exposed to sunlight for 10 minutes, and then both be put up with photographic plates, the pictures they give will be of very different density. Or a still more conclusive experiment is to take one piece of wood and cover half of it with black paper or tinfoil, and expose to a bright light, then two pictures will be obtained from the same piece of wood which vary much in density. Fig. 29 is a picture of a piece of deal which was treated in this way.

Similar results were obtained with other woods; for instance, elm is one of the least active of woods, but after even a short exposure to sunlight it becomes very active, fig. 30. Fig. 31 shows the picture of ivy under ordinary conditions and after exposure to sunlight. Again, fig. 32 is a picture of a piece of teak, half of which has been exposed to sunlight. Even specimens of bark may, in this way, be stimulated into activity. Fig. 33 shows the pictures, on the same plate, of larch and oak bark in their ordinary condition and after a short exposure to sunlight. Even pith, which under ordinary conditions is practically inactive, becomes very active after exposure to sunlight.

It is important to note that this action of light on wood is not a general or all over action; it does not obliterate at once the picture which would naturally be formed, but the first action is simply to intensify this picture, and with stronger light the action increases and the picture becomes more and more indistinct. It is not necessary that the exposed wood should be in contact with the plate to obtain the increased effect, but if it be at some distance above it the action still takes place. This increased action of light, like the normal action of the wood, is entirely unable to pass through glass or mica.

This increase of activity produced by light does not immediately pass away. If the increase has been considerable the wood may retain some of its added energy for nearly a month, but in all cases the wood gradually returns to its former condition.

A piece of deal, after exposure to the sun for 9 hours and then kept in the dark for a month, had returned to its original state of activity. Two other pieces of deal were also exposed for 9 hours to sunlight, and then one was at once put

up with a plate, and the other, after being kept in the dark for 24 hours. This latter one gave a considerably lighter picture than the former one. It is not necessary to have direct sunlight to produce these effects. Two similar pieces of wood, one left in the middle of a room and the other placed at the window, when there was no sunshine, for about a couple of hours, gave a marked difference in their action on a photographic plate.

Artificial light acts on wood in the same way as sunlight does. A wood exposed to an arc light for one hour gives a good dark picture, also if 8 feet of magnesium ribbon be burnt at a distance of 3 inches from a wood it will cause a very considerable increase in its activity.*

It was interesting to ascertain whether a wood which had never been exposed to direct light would be capable of acting on a photographic plate, and to test this thick blocks of larch, oak, and deal were taken and sawn up in perfect darkness and a section from the central part of each put up with a plate without allowing it to come into the light. Each gave a good picture Another piece of wood cut from the centre of a block and not exposed to light was kept for two months in the dark, but it still gave a picture of the same density as the former ones.

The action of light on the Spanish chestnut is remarkable, for it appears readily to stimulate the central portion of the section, but does not stimulate the outer portion. This is seen in fig. 34 ; the ring shows the outside of the specimen.

Resin is acted on by light in the same way as wood is. A simple way of proving this is to take, for instance, a 15-per-cent. alcoholic solution of ordinary resin and paint it on a piece of inactive Bristol board, and allow the resin surface to become perfectly dry and hard, then on exposure to sunlight it becomes very active. This is well shown in fig. 35, where a Japanese screen was placed on a resin card and exposed to sunshine for 3 hours. So great is the difference between the activity of the exposed and the unexposed resin that a sharp picture was obtained. Fig. 36 shows the effect produced on a gum guaiacum card, half of which was exposed to sunlight for 6 hours and the other half covered by a screen.

Ordinary cork is also acted on in the same way. An old card which had been varnished with picture copal and become only slightly active had its activity restored by exposure to sun light.

In a former communication it has been shown that printer's ink is able to produce a picture on a photographic plate ; its activity is much increased by sunlight, and even old printing, which is now only slightly active, becomes much more so after exposure to sunlight. Leather and pure indiarubber, also fur and feathers have their activity increased by exposure in the same way, and it was interesting to find that paper which had been sized with resin on being exposed to sunlight had its activity much increased, whereas paper which had been sized with gelatine was not affected.

* The light from the electric discharge of a Ruhmkorff coil, with aluminium poles, also increases the activity of wood, but not to any great extent. Glass entirely prevents this action. July, 1904.

Not only are resins acted on by light, as already described, but so is turpentine and its allies. Two samples of turpentine placed close together in similar glass vessels, one being covered with a glass plate and the other with a metal one, were exposed to bright light for some hours; then, in the dark, each vessel was covered with a photographic plate, which was left on for 21 hours. The turpentine which had been under the glass plate gave by far the darkest picture.

With bodies such as metals, slate, porcelain, flour, sugar, in which there is no resinous or allied body, this action of light does not occur; and with pith, if it were perfectly pure, it would probably, after exposure to light, be absent. Having then proved that bright light had so strong an effect on woods and certain other bodies, the next step was to ascertain which rays were the most active in producing this effect. With this object strips of different coloured glasses were laid on sections of different woods and then exposed to sunlight.

The following figures show well the actions which took place. Fig. 37 is the picture of a piece of deal on which a strip of white glass and a strip of red glass were placed. The rest of the wood was left uncovered. Fig. 38 shows the action of a blue and a green glass and no glass on the wood, and fig. 39 shows how completely the effect of the sunlight is cut off by either a strip of black paper or tinfoil, although not more effectually than it is by a red glass. In the above case the exposure to sunlight was for 5 hours. Many different woods were tried, but the effects produced in all cases were of precisely the same character.

In place of using coloured glasses experiments were made with light which had been filtered through different coloured solutions. With this object wood specimens were placed in double-cased bell-jars which had either potassium bichromate, copper ammonium sulphate, or pure water in the double casing. Similar pieces of deal were placed in each bell-jar and exposed for 4 hours to sunlight. The deal specimen in the red light gave only a faint picture, the one in the blue a dark picture, and the one with the water alone a picture a little darker than the one in the blue light. Other woods acted in the same way, so did cards painted with resin, with guaiacum, and with copal varnish. The varnish obviously must not be very active or the action of the light is masked. White oil paint is also rendered very active by the blue rays, and the same applies to the resin-sized paper.

Another series of similar experiments were made by interposing in the light from an electric arc different coloured glasses and allowing the coloured light to fall on wood and also on other bodies; it was found that when a beam from the lamp which has passed through a red glass was allowed for $1\frac{1}{2}$ hours to fall on a wood section, it produced no effect, but when a blue glass was interposed and the beam fell on the wood section for only 1 hour a dark picture was produced. Other bodies, such as cork and resin paper, are affected by the coloured beams in the same way. A wood section which had been stimulated by sunlight on being kept in red light loses

its activity as it would do if kept in the dark. A spectrum formed with the arc lamp and thrown for $4\frac{1}{2}$ hours on a wood section produced no visible effect.

It has already been stated that this action of wood, even when stimulated by light, does not pass through glass, but it does through porous bodies and through gelatine; it can also be shown that it will pass through a certain thickness of wood. A piece of deal 1·4 millims. thick had a red glass and a green glass laid upon it and was exposed at a window for 3 days, then it was turned over and the photographic plate placed on the side which had not been exposed to the light; the picture it gave showed that underneath where the glasses had been there was very little action, but elsewhere there was much action. Both turpentine and pure terebene are acted on by blue light so as to increase greatly their action on a photographic plate. Some experiments with these liquids were made by suspending some Ford blotting paper in a bottle with the liquid covering the bottom of it till they had taken up some quantity of the vapour; in one set of experiments the bottle with the paper in it was placed in the bell jar with the coloured liquid, and in the other experiments the paper saturated with the vapour was taken out of the bottle and placed in the bell jar; in both cases the blue light produced a more active substance than the red light did. This is shown by fig. 40.

I desire to record my thanks to the managers of the Royal Institution for allowing me to carry out the foregoing work in the Davy-Faraday Laboratory. My best thanks are also due to my assistant, Mr. O. F. Bloch, who has been of much help to me and has made all the illustrations for this paper.

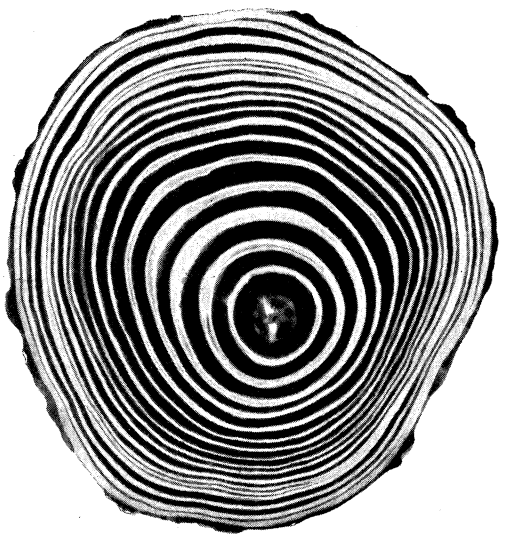


Fig. 1.—Scotch fir.

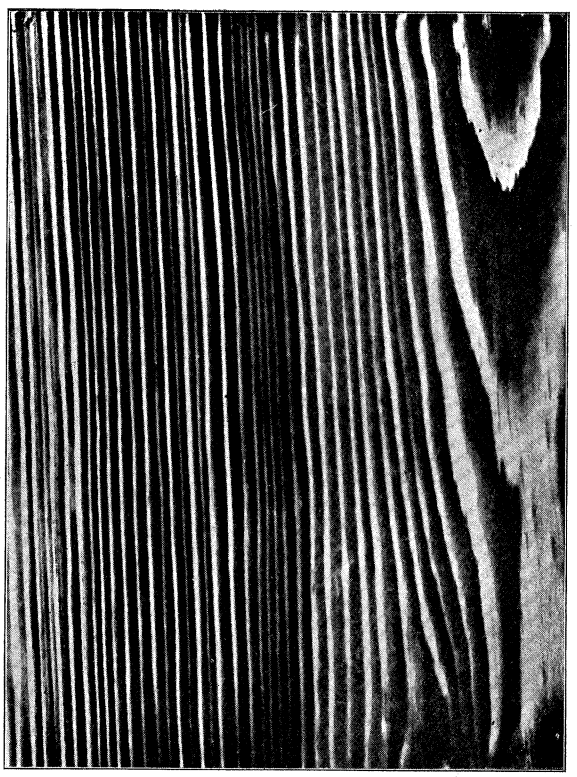


Fig. 2.—Deal.

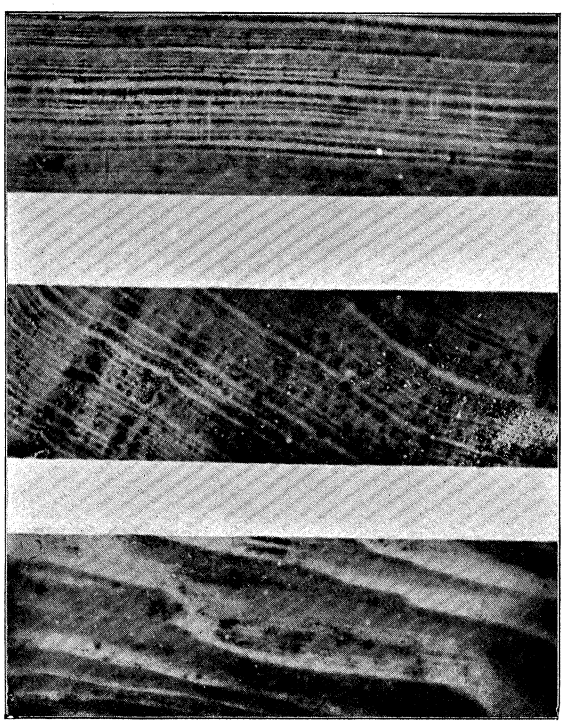


Fig. 3.—Pitch pine.

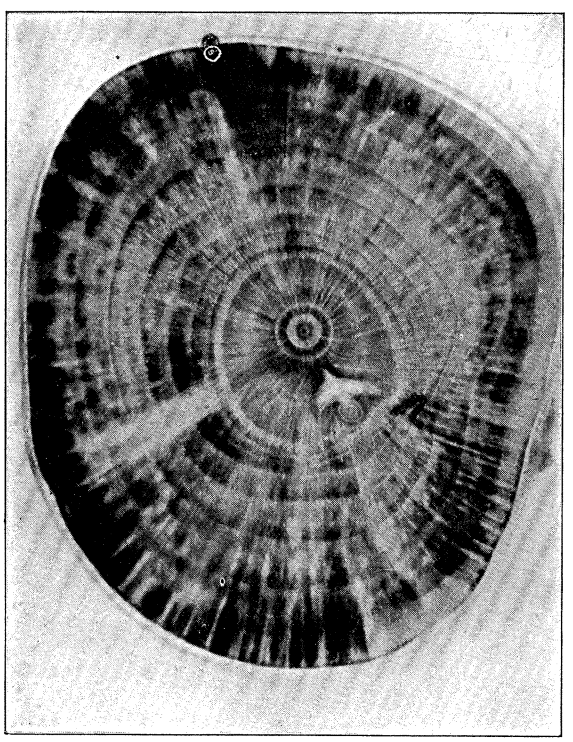


Fig. 4.—Spruce.

Fig. 5.—Larch.

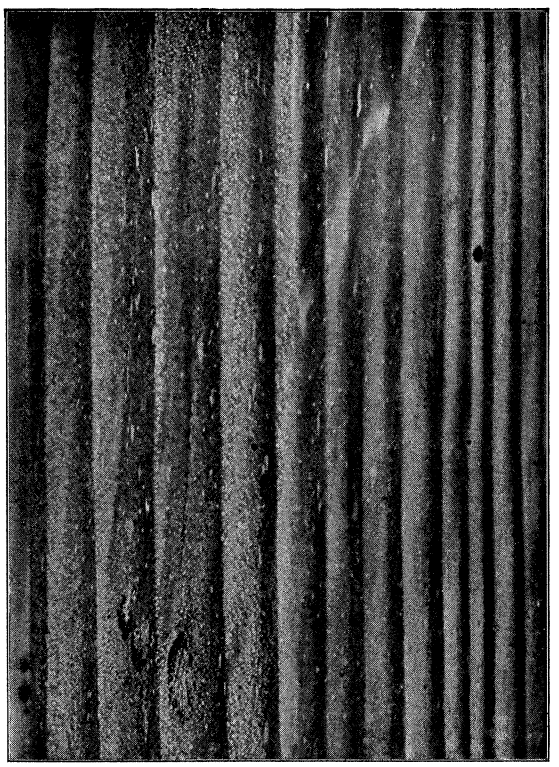


Fig. 6.—Larch.

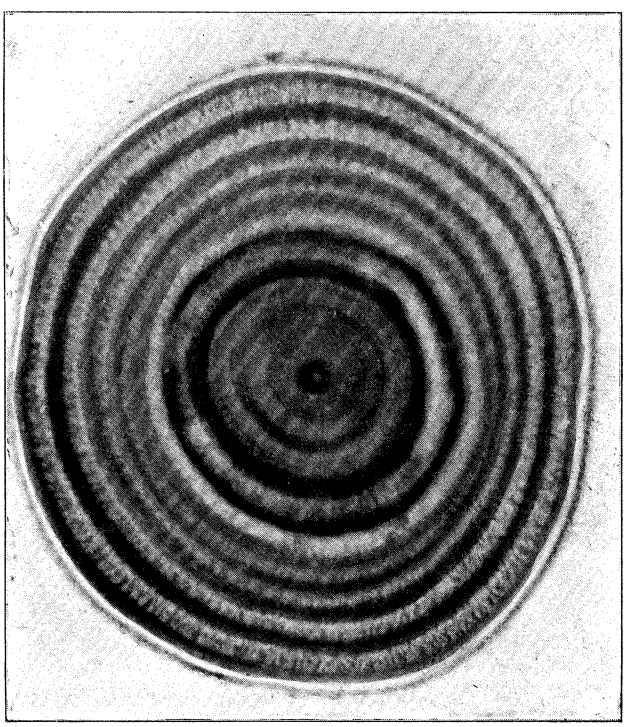


Fig. 7.—Cypress.

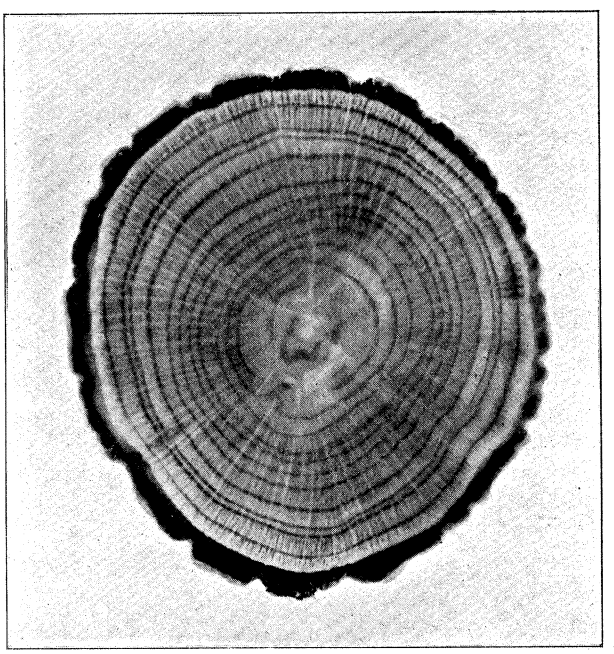


Fig. 8.—Oak.
(Three-quarters size.)

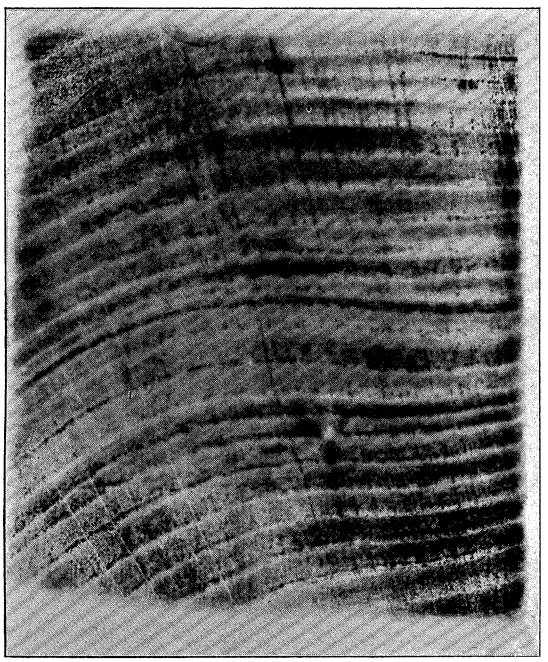


Fig. 9.—Beech.

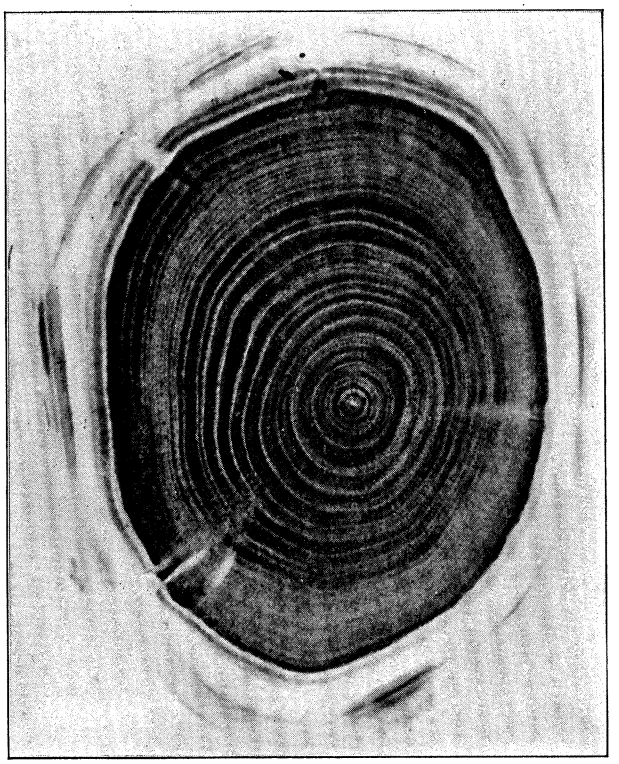


Fig. 10.—Robinia.
(Three-quarters size.)

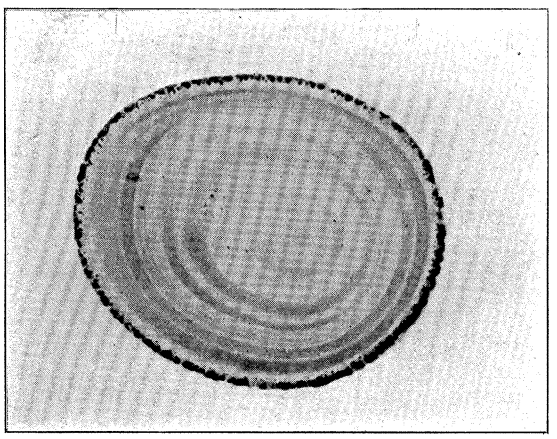


Fig. 13.—Tulip tree.

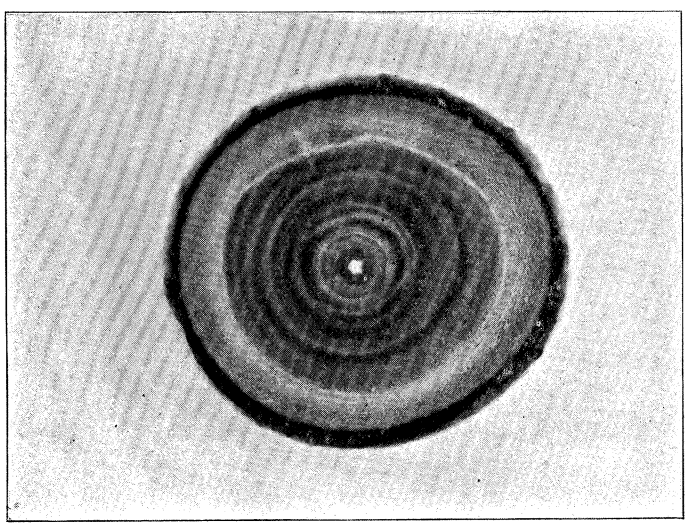


Fig. 11.—Spanish chestnut.

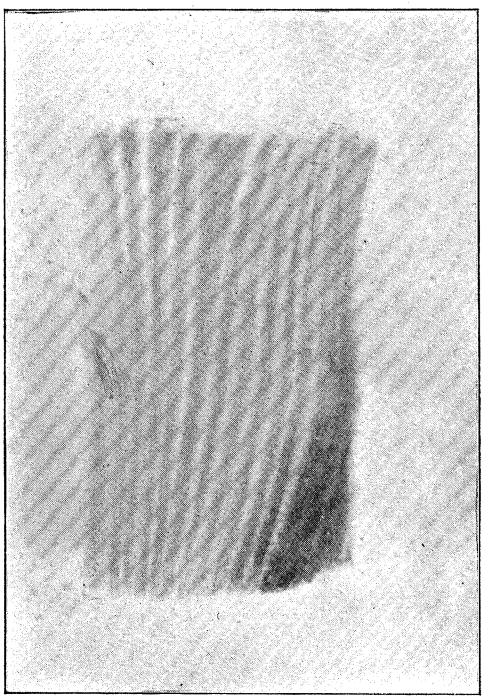


Fig. 12.—Elm.

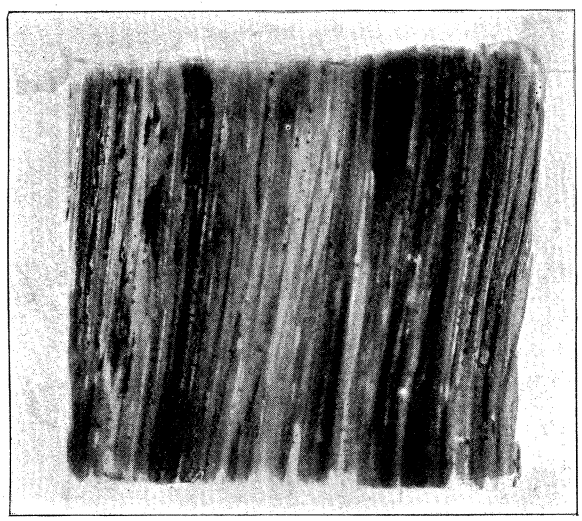


Fig. 14.—Rosewood.

Fig. 15.—Cocobolo.

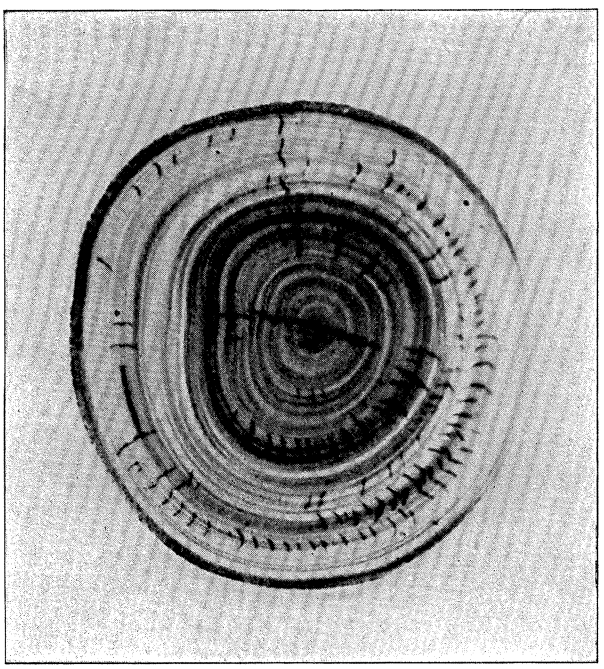


Fig. 16.—Lignum vitæ.

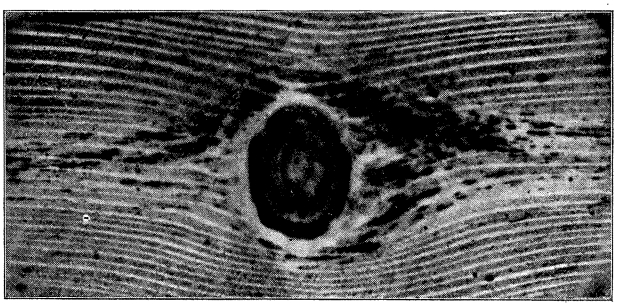


Fig. 18.—Yellow pine.

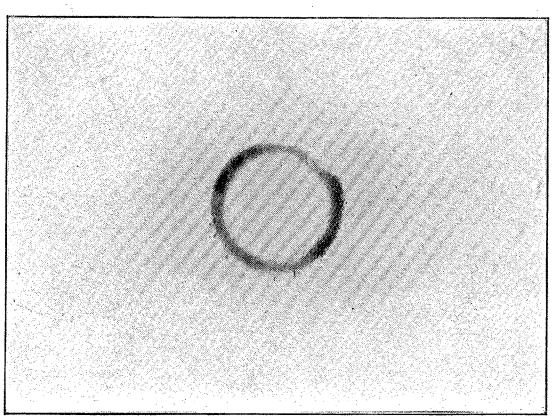


Fig. 17.—Bamboo.

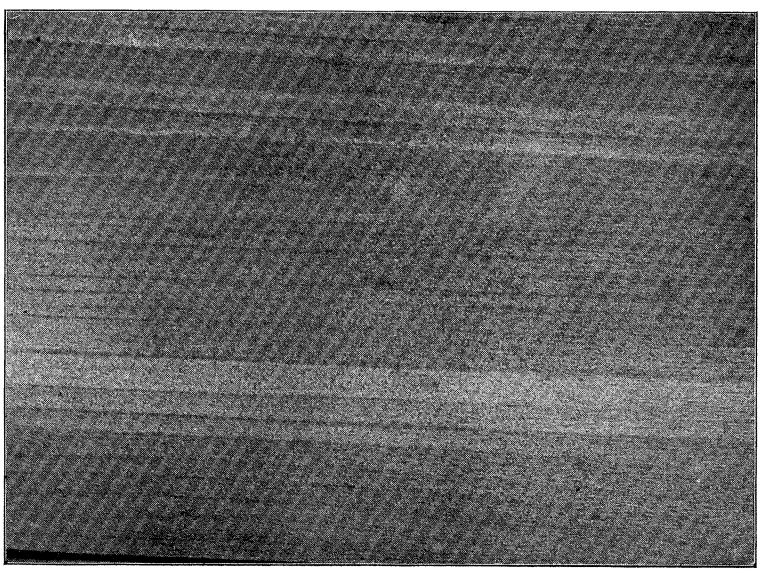


Fig. 19.—Basswood.

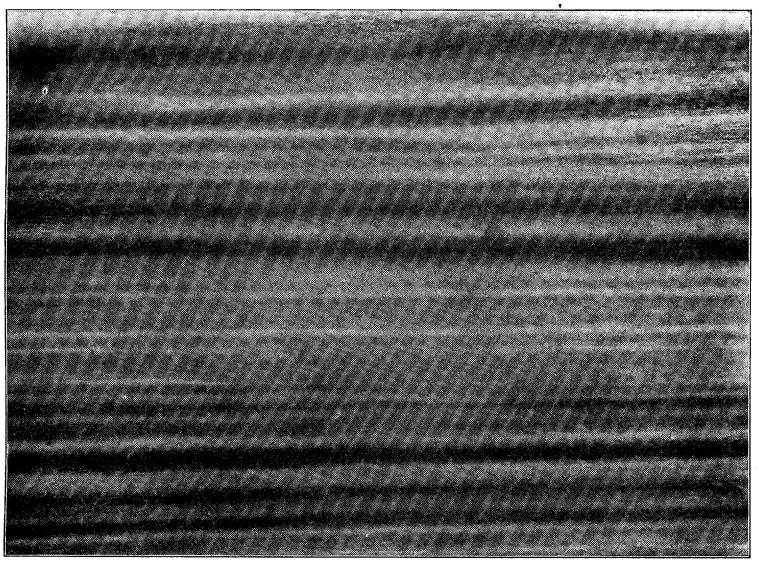


Fig. 20.—Basswood.

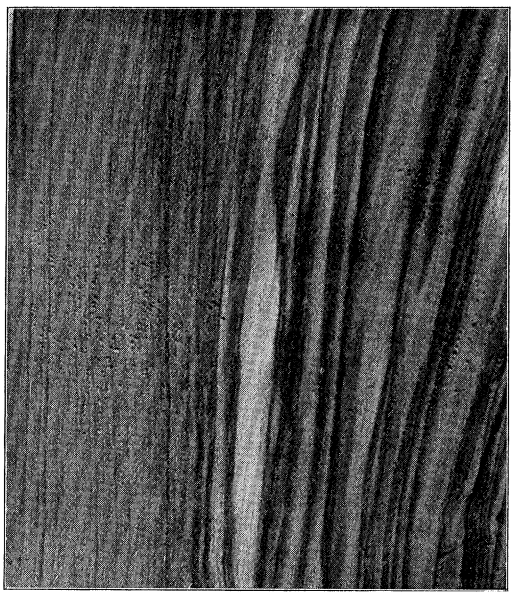


Fig. 21.—Olive.

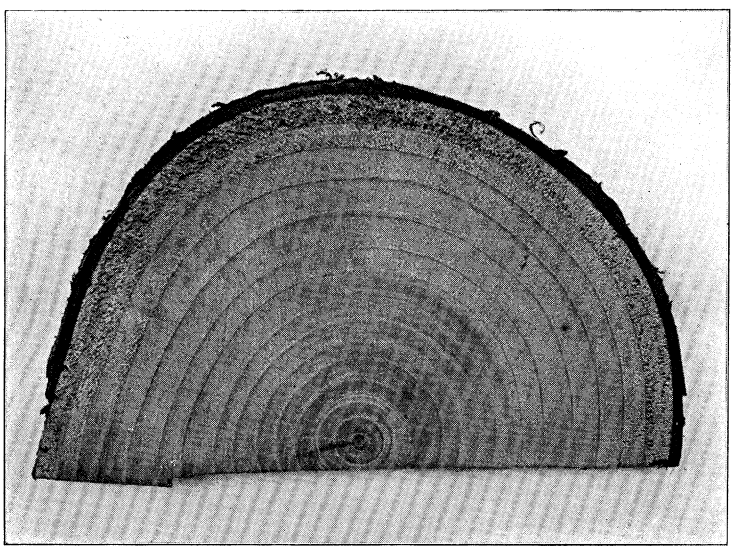


Fig. 21A.—Cherry.
(Three-quarters full size.)

Fig. 22.—Olive.

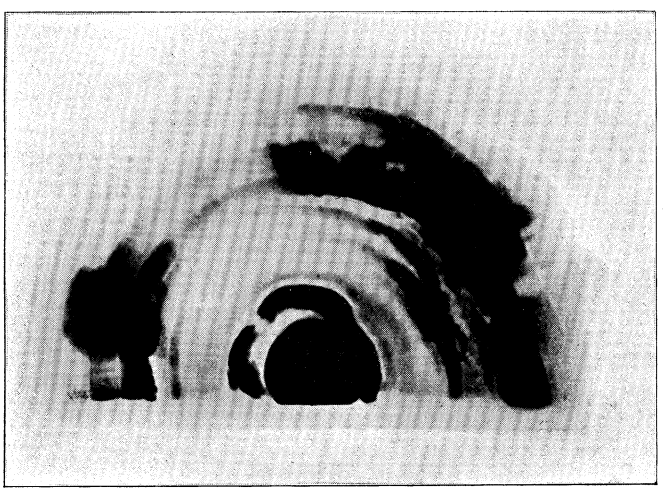


Fig. 22A.—Cherry.
(Three-quarters full size.)

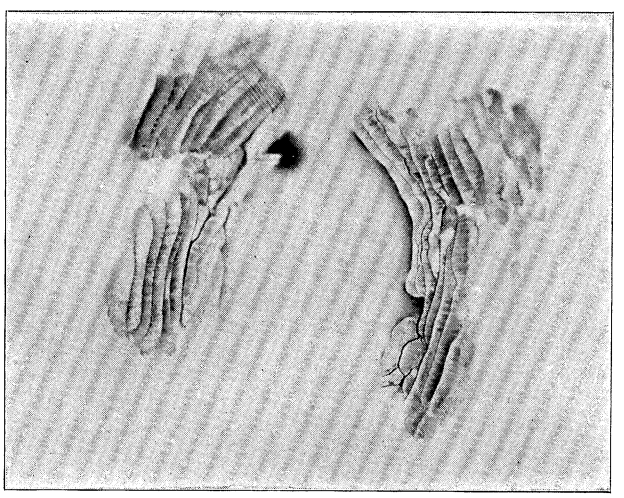


Fig. 23.—*Pinus pinaster*,

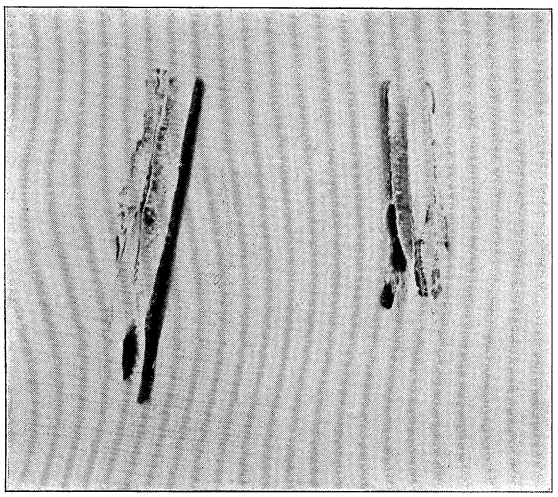


Fig. 24.—Larch bark.

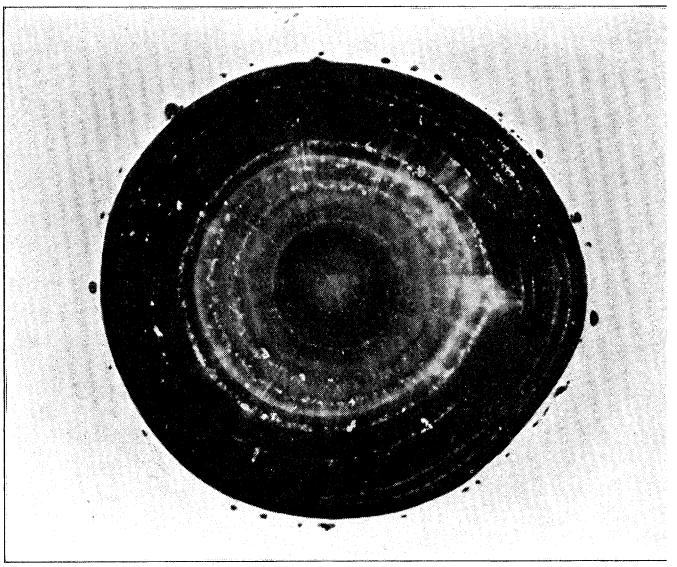


Fig. 25.—Rhizophora.

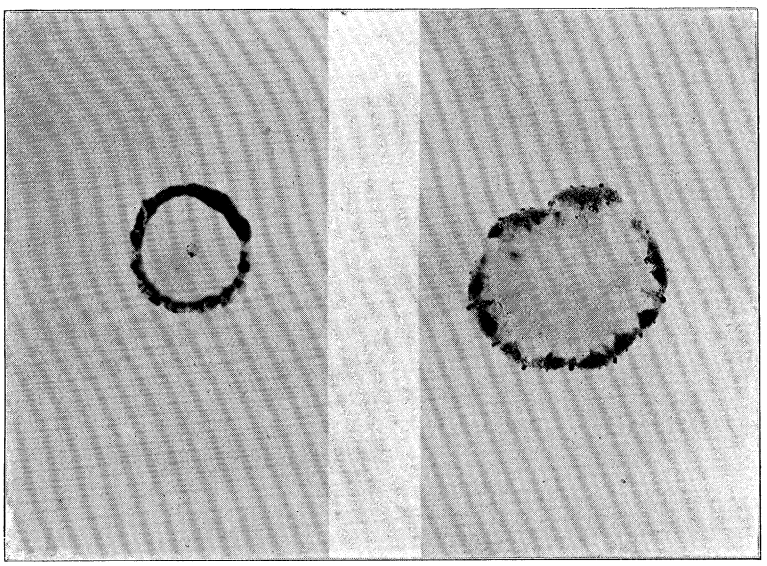


Fig. 26.—Ivy.

Fig. 27.—Sunflower.

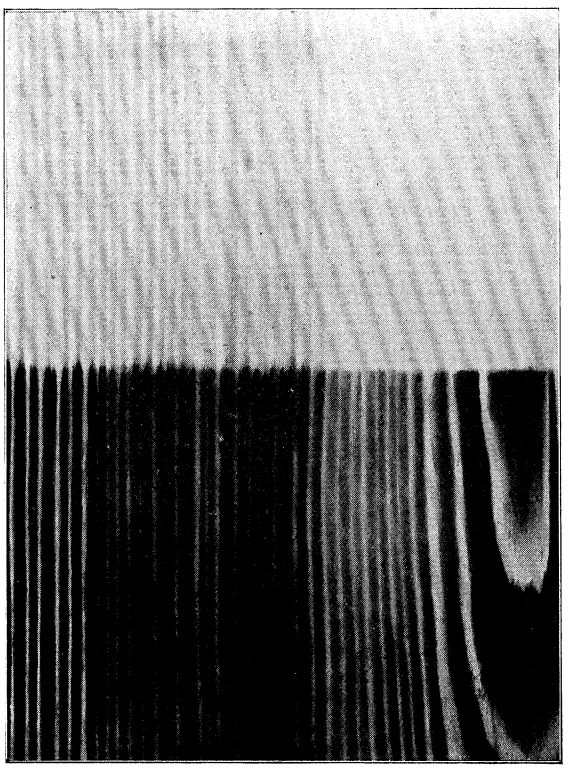


Fig. 29.—Deal.

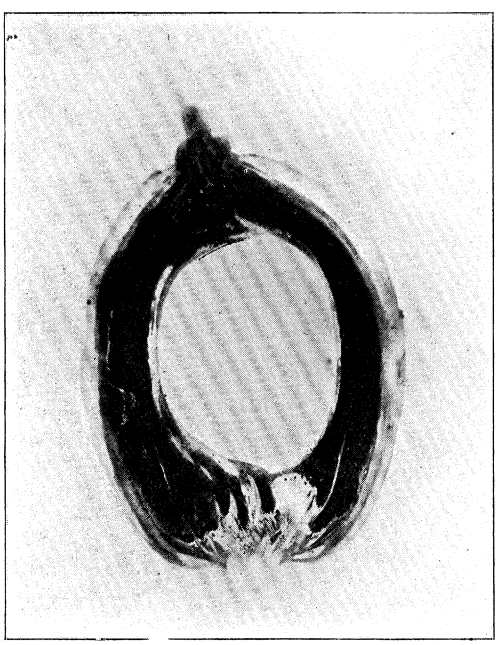


Fig. 28.—Coco-nut.

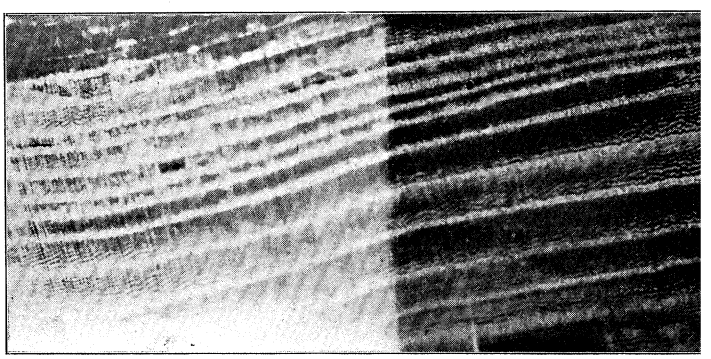


Fig. 30.—Elm.

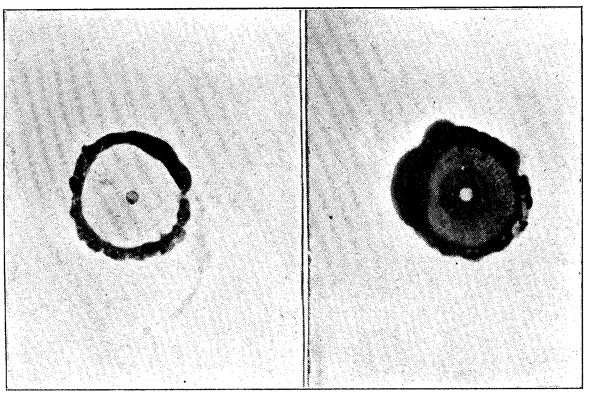
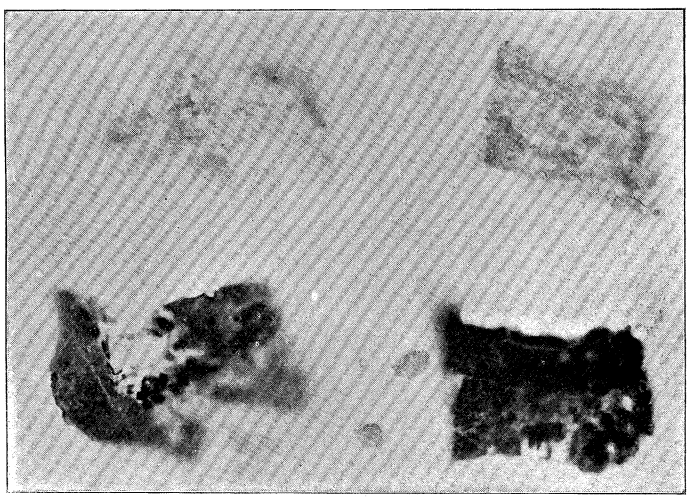


Fig. 31.—Ivy.



Larch. Oak.

Fig. 33.

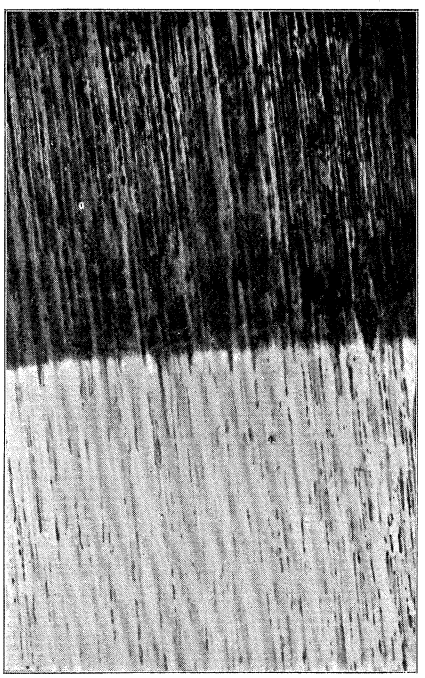


Fig 32.—Teak.

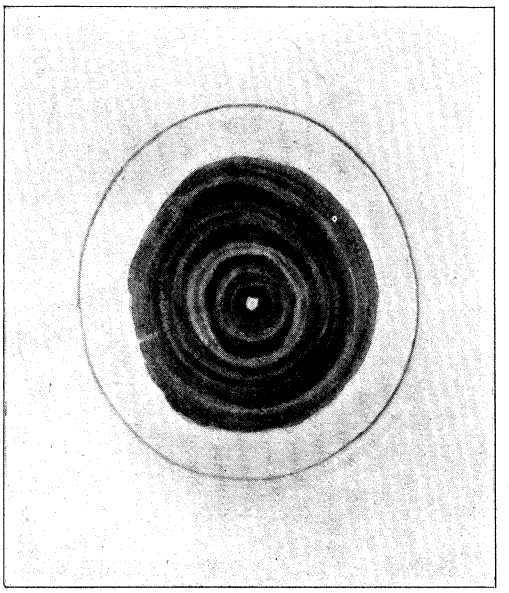


Fig. 34.—Spanish chestnut.

Fig. 35.—Japanese screen.

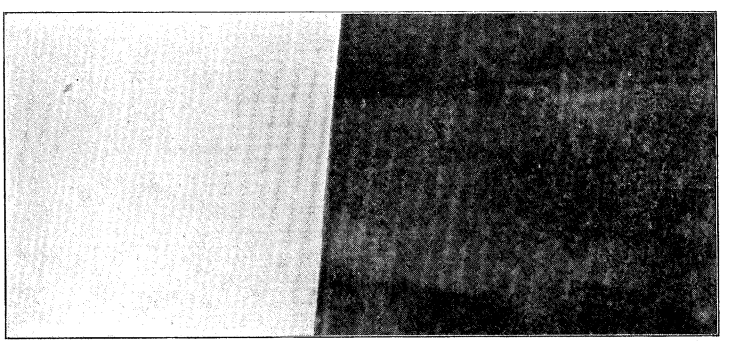
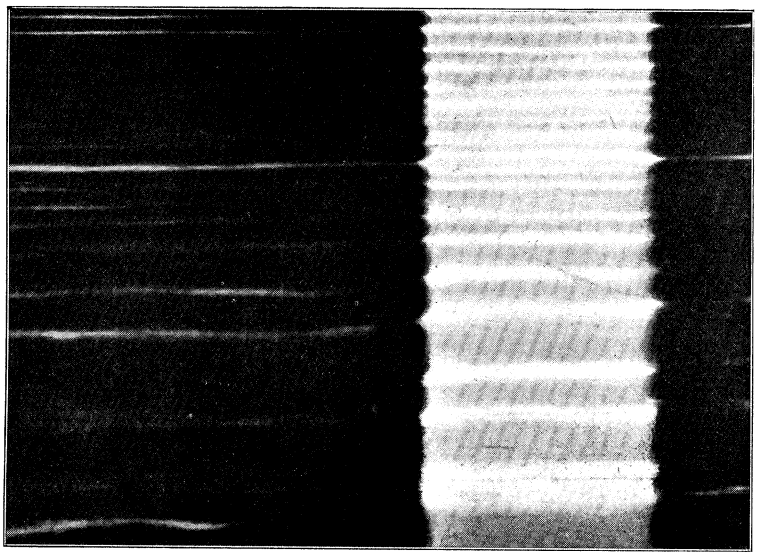
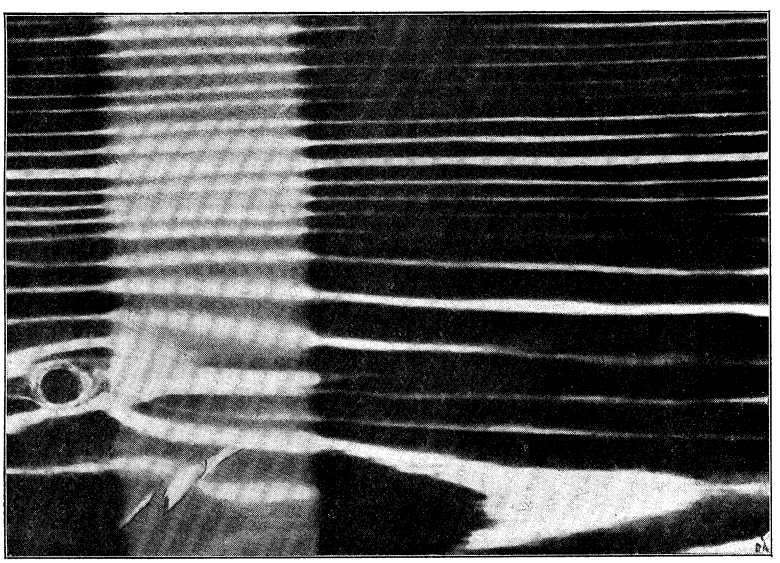


Fig. 36.—Gum guaiacum.



White. Red.

Fig. 37.—Deal.



Green. Blue.

Fig. 38.—Deal.

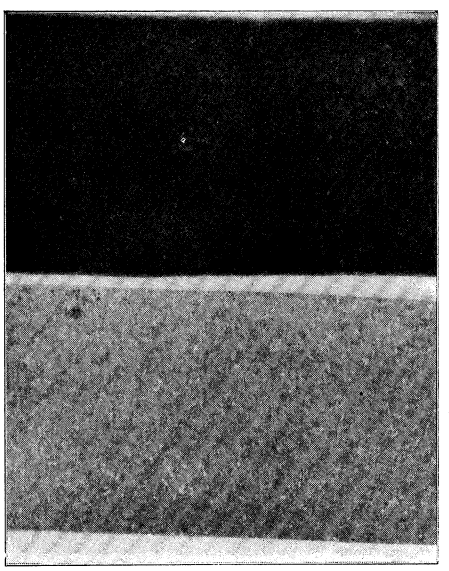
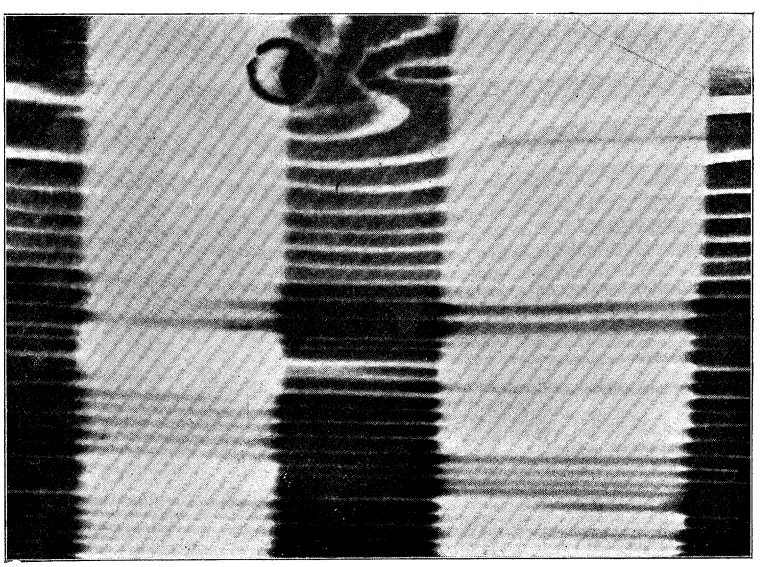


Fig. 40.



Black paper. Tin foil.

Fig. 39.—Deal.

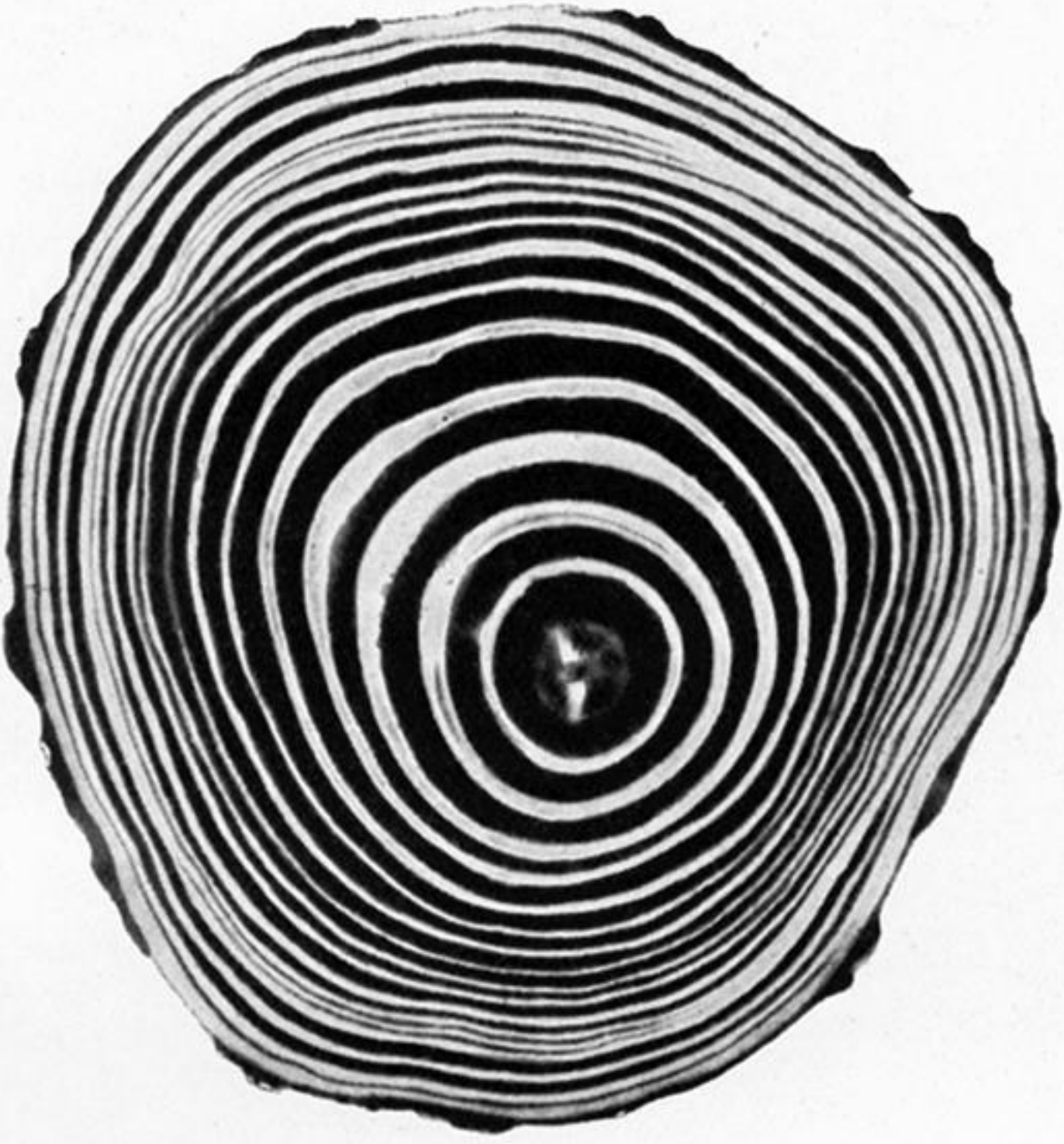


Fig. 1.—Scotch fir.

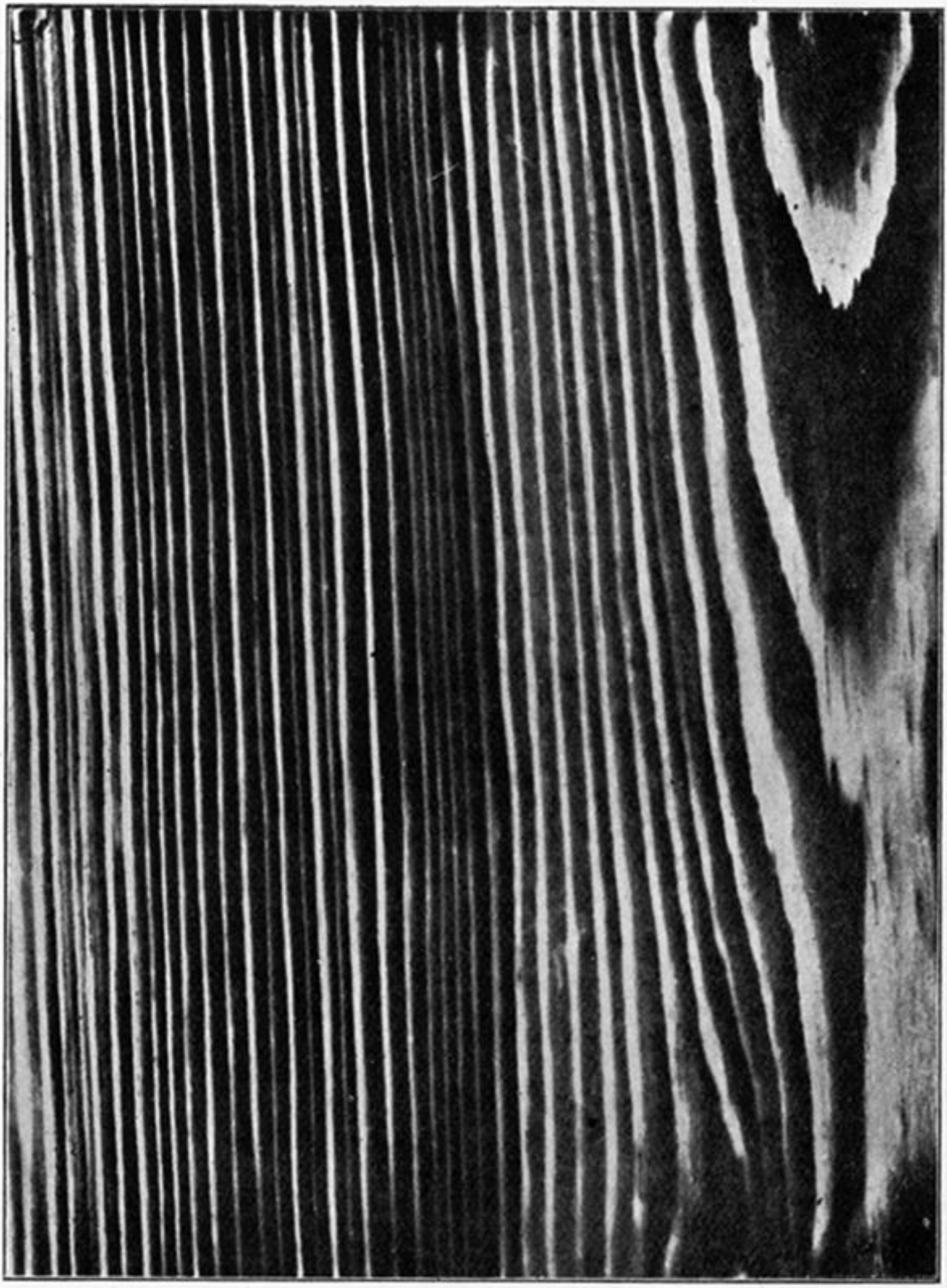


Fig. 2.—Deal.

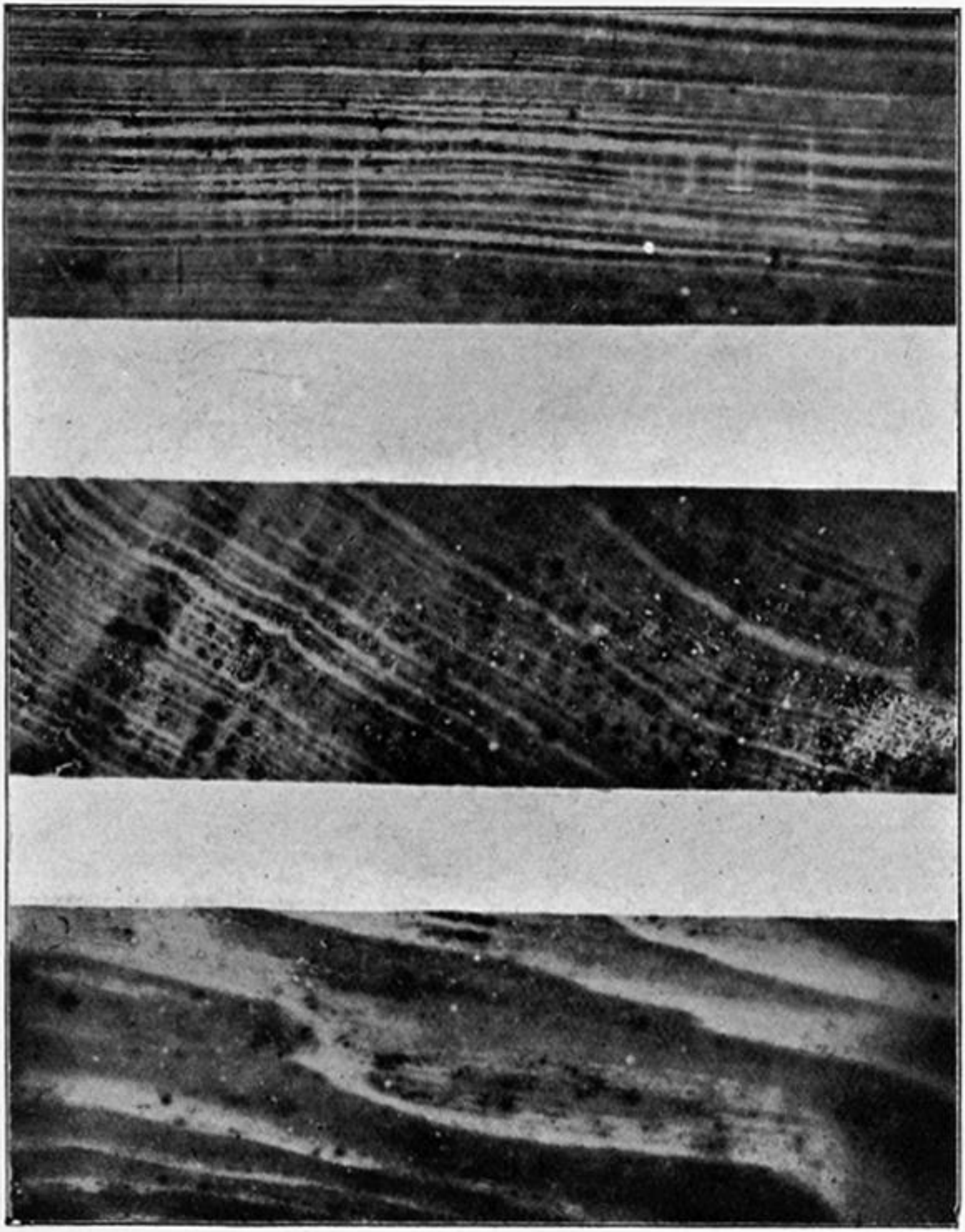


Fig. 3.—Pitch pine.

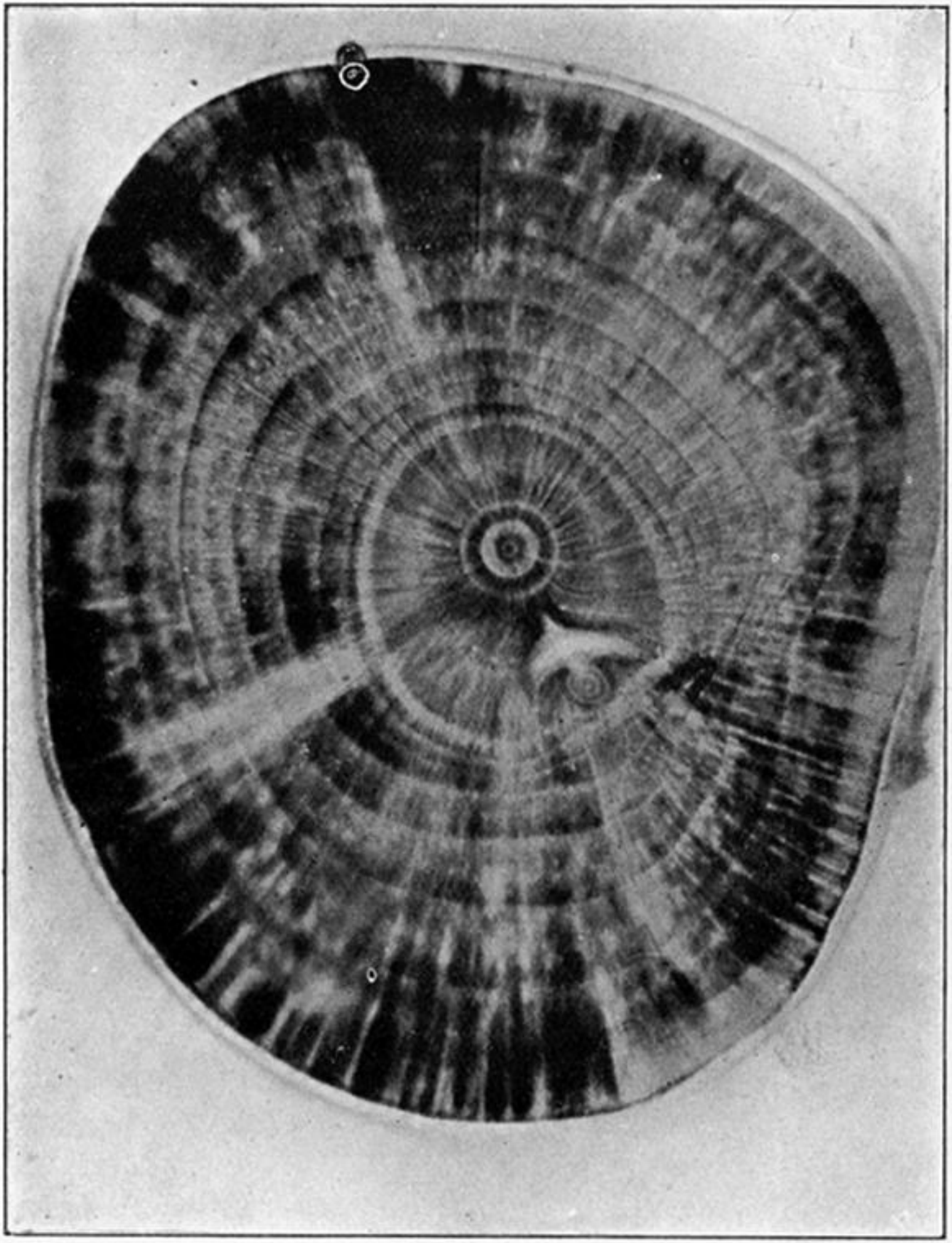


Fig. 4.—Spruce.

Fig. 5.—Larch.

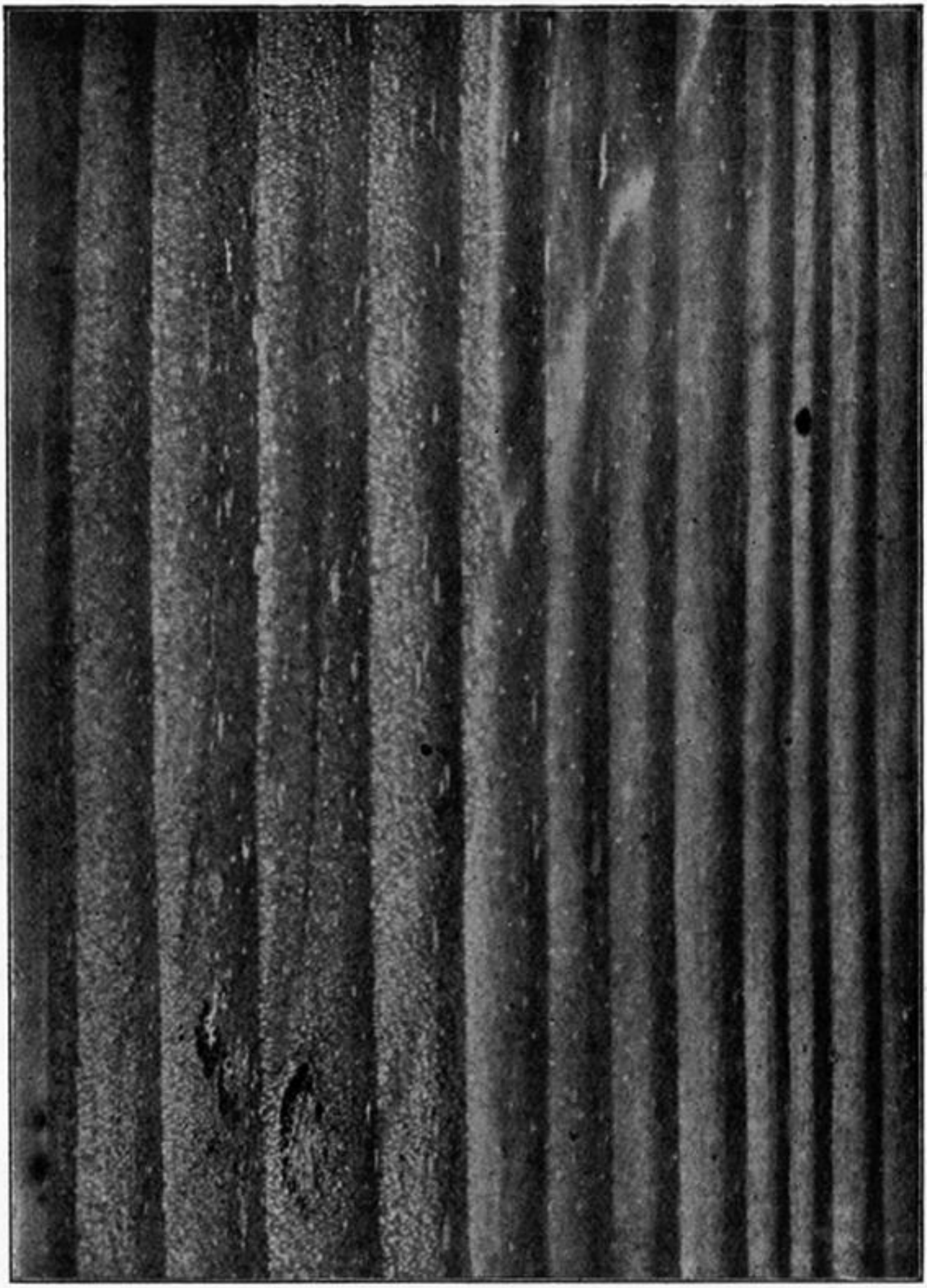


Fig. 6.—Larch.

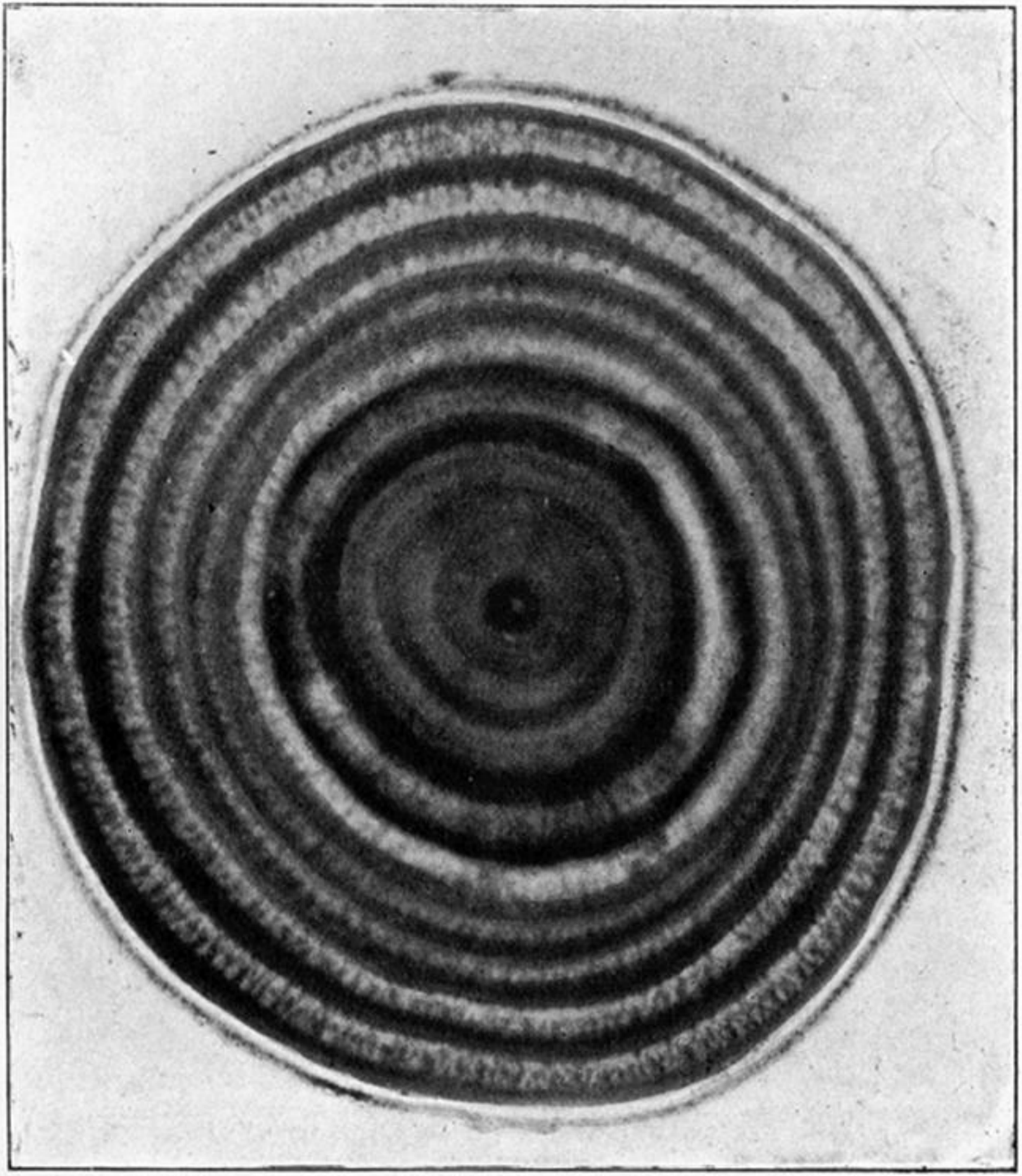


Fig. 7.—Cypress.

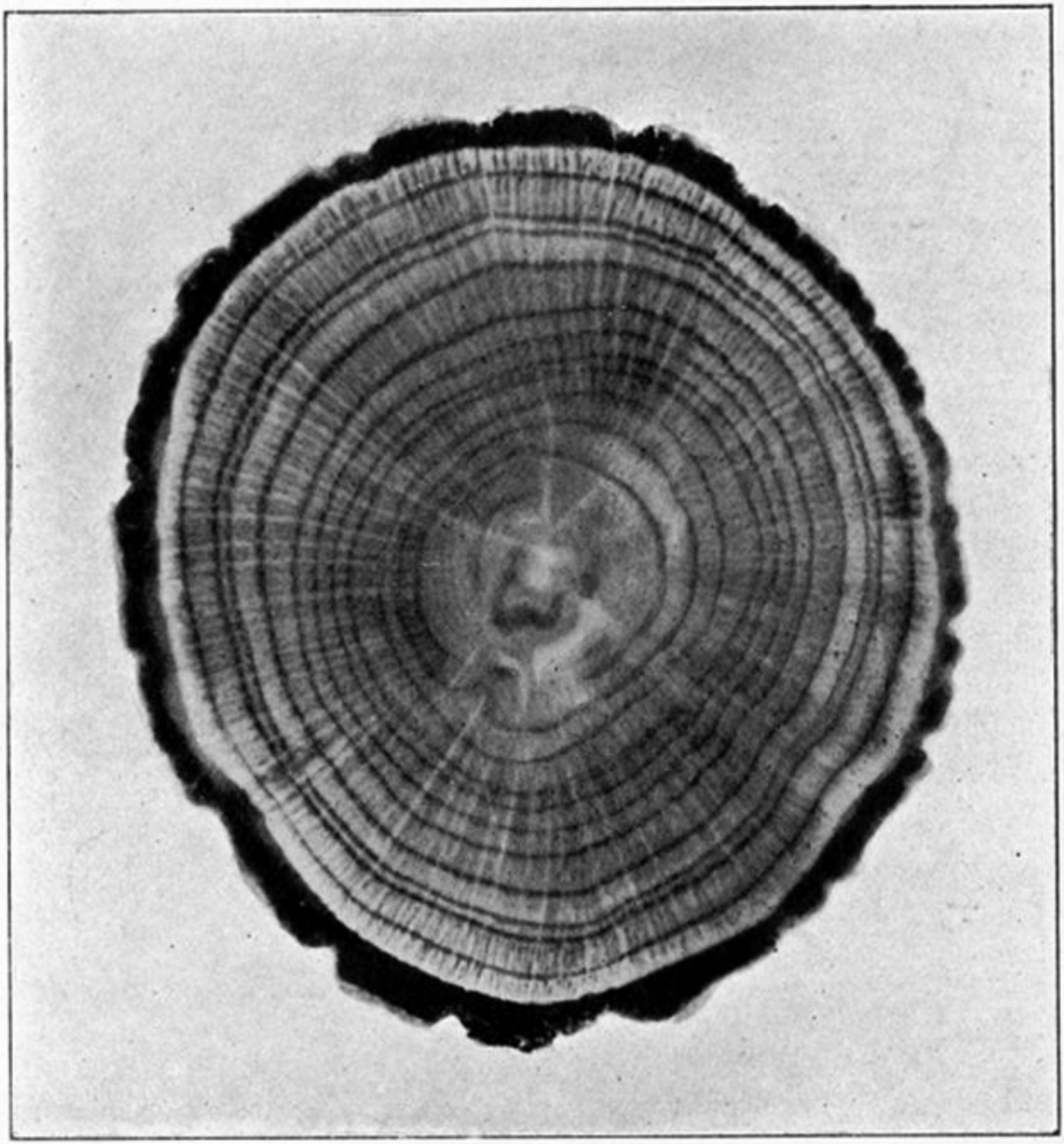


Fig. 8.—Oak.
(Three-quarters size.)

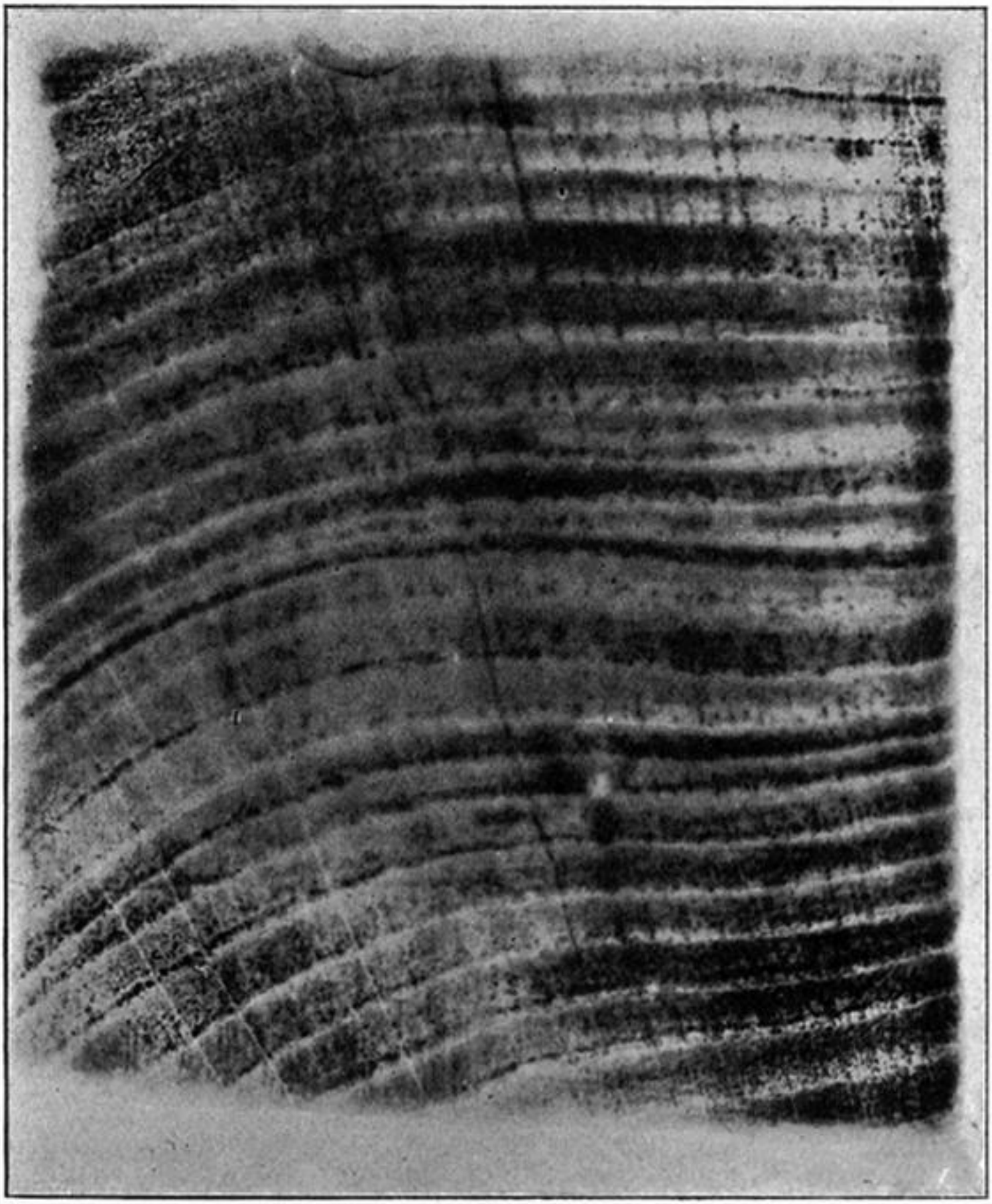


Fig. 9.—Beech.

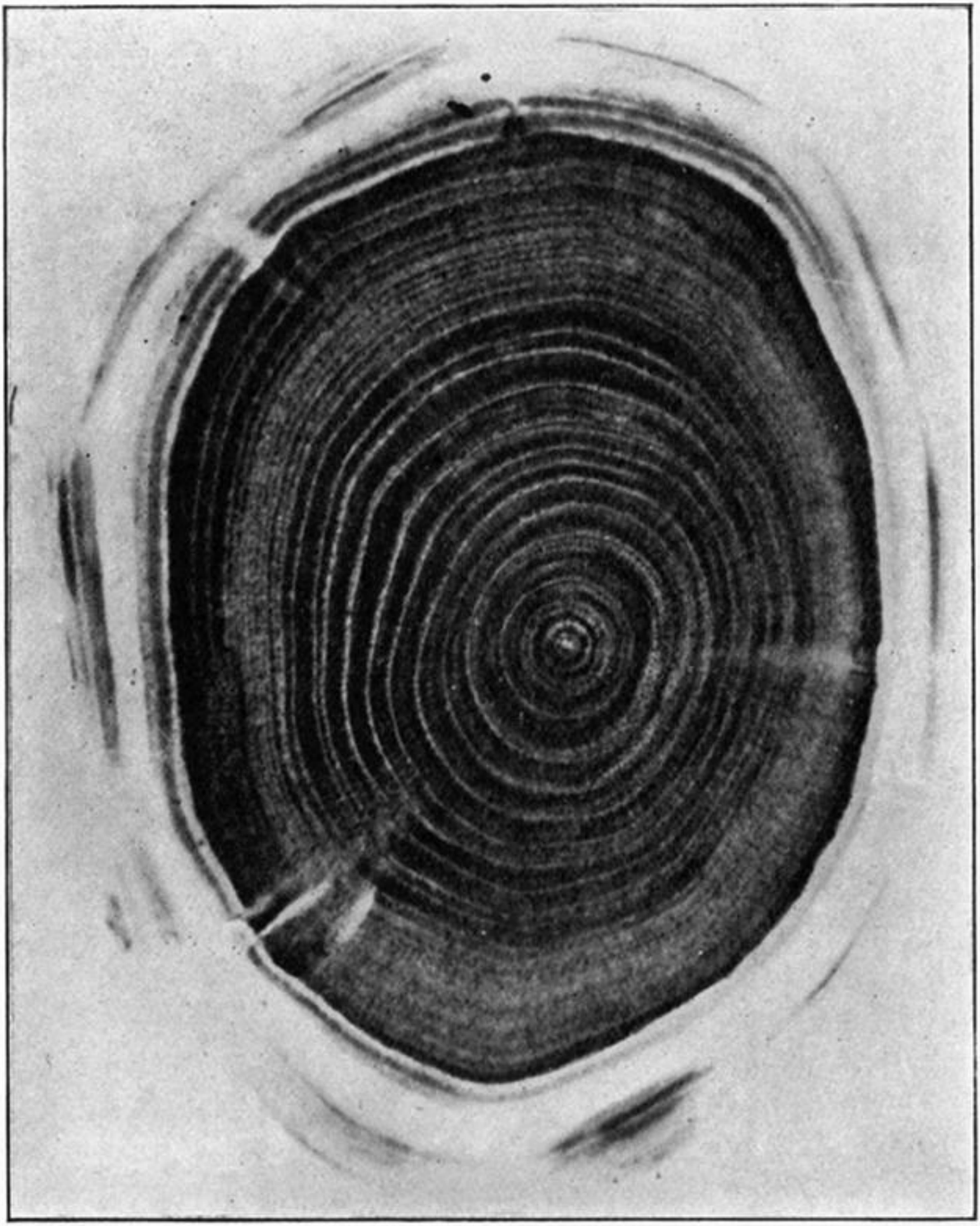


Fig. 10.—Robinia.
(Three-quarters size.)

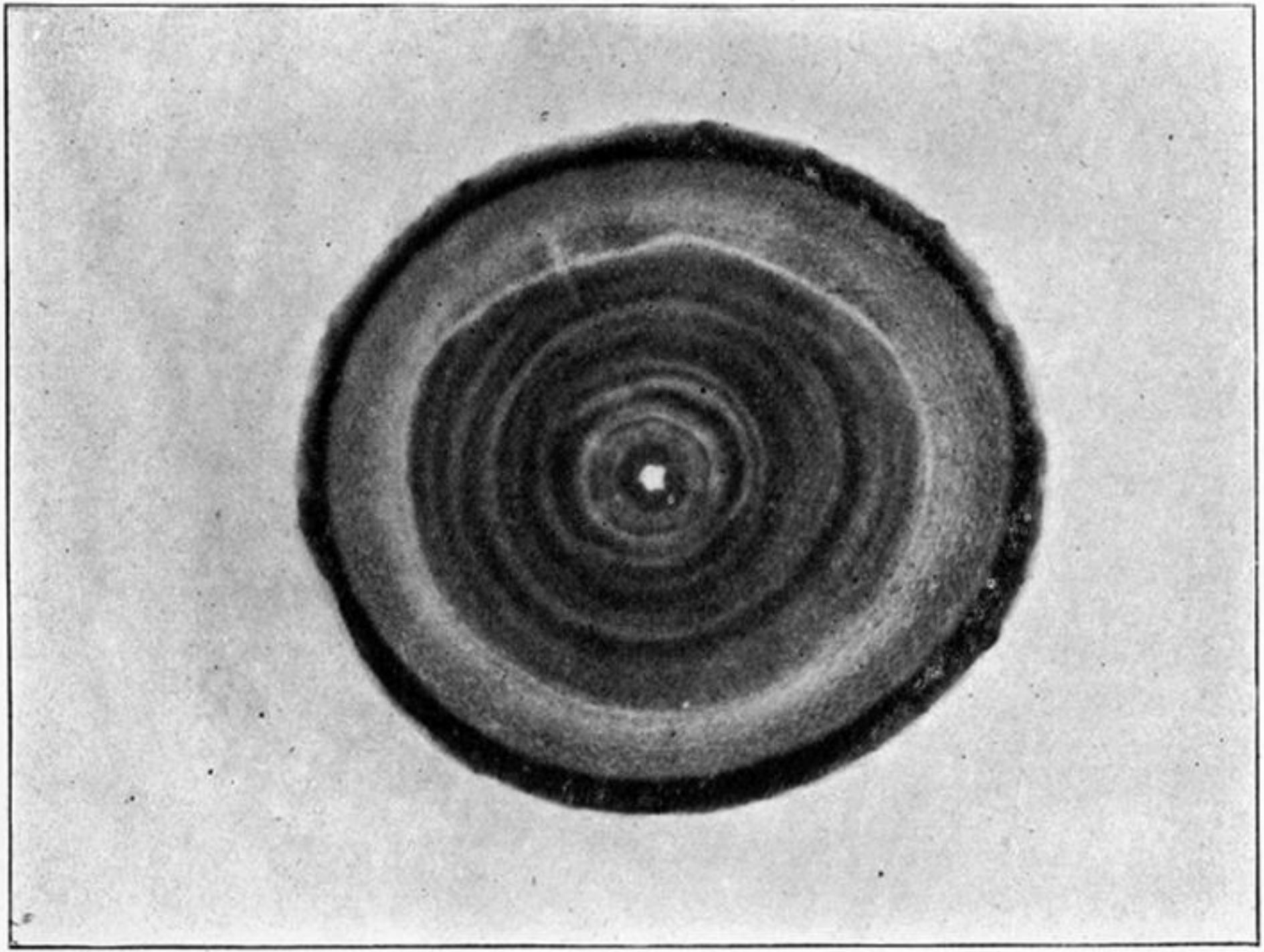


Fig. 11.—Spanish chestnut.

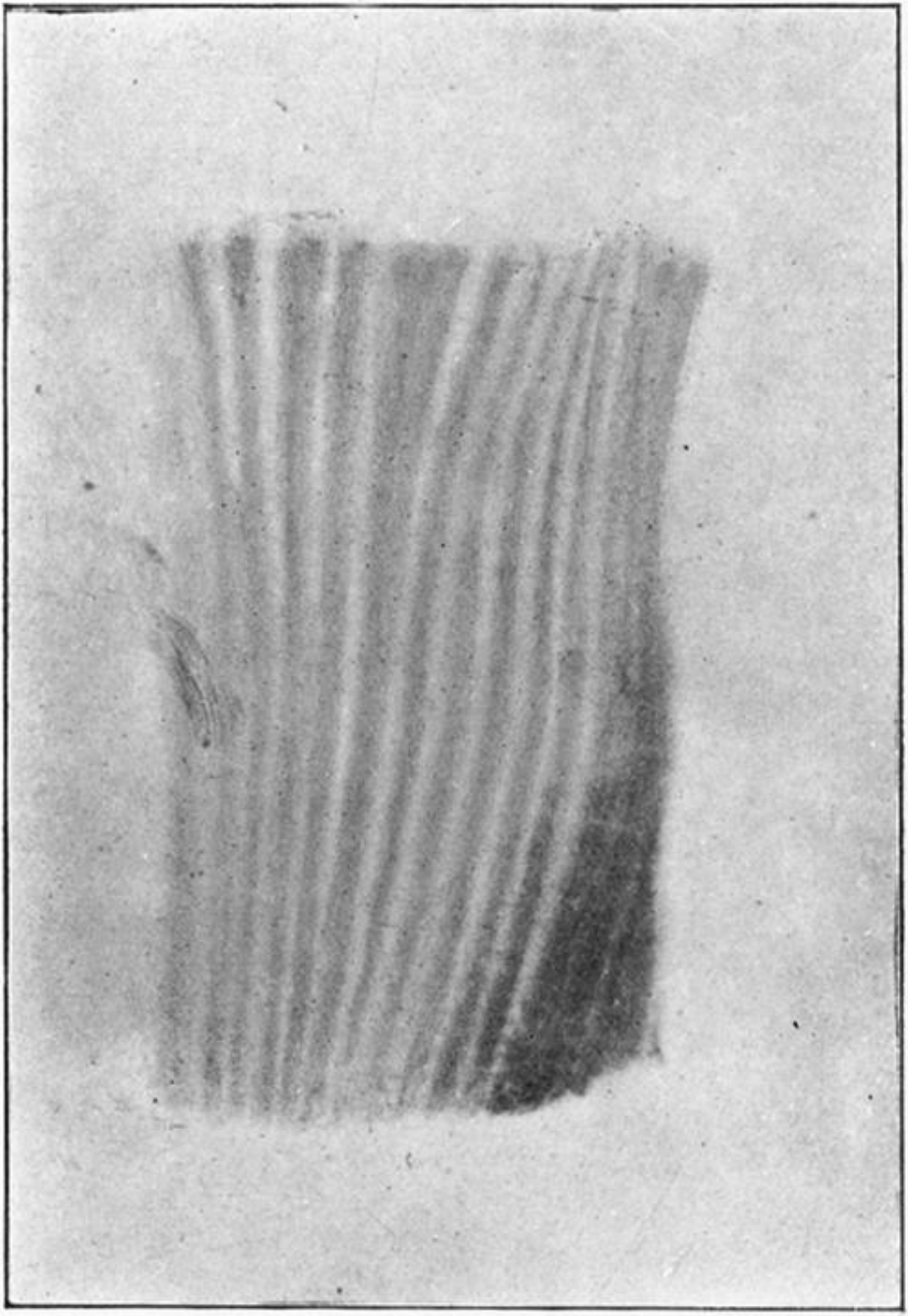


Fig. 12.—Elm.

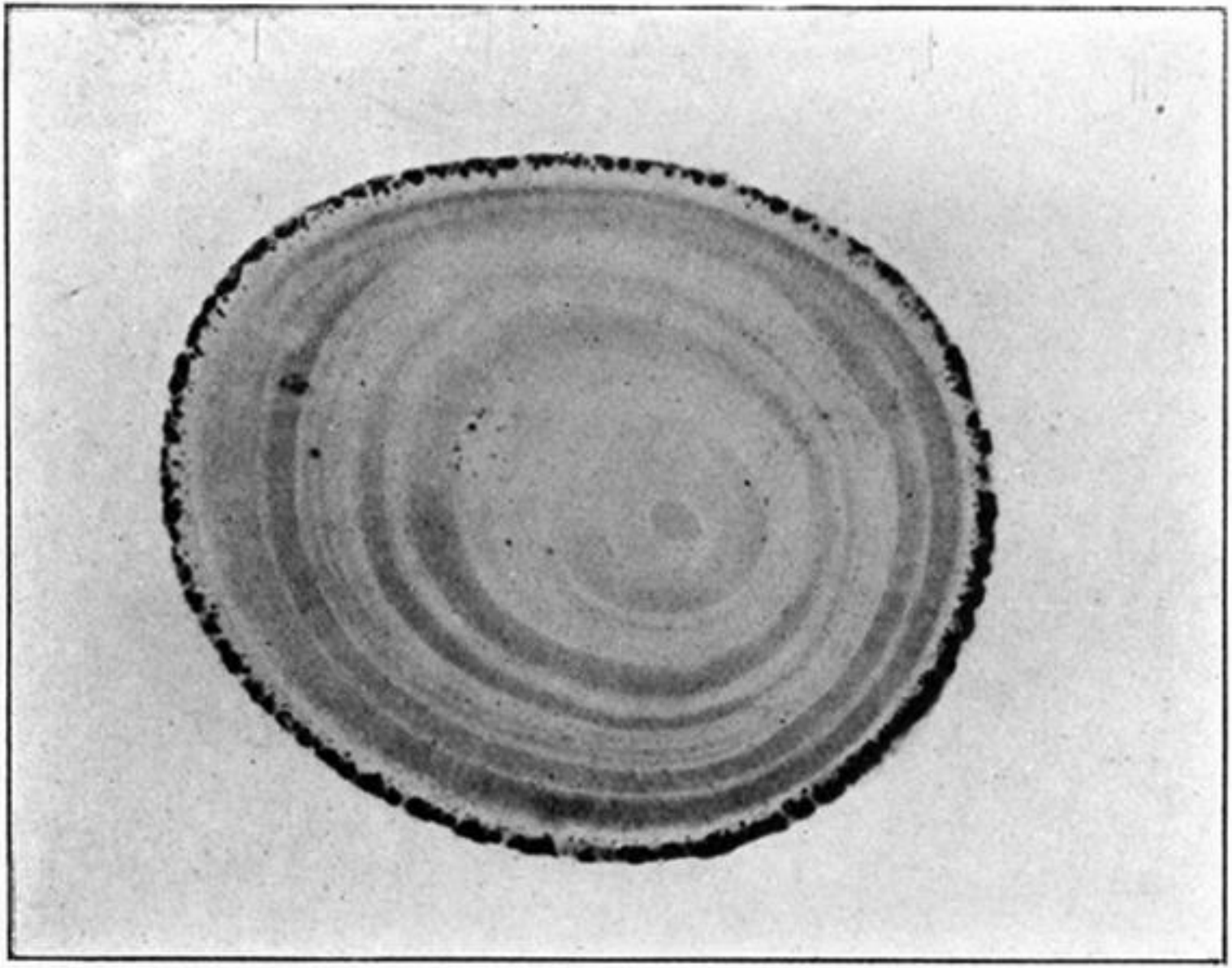


Fig. 13.—Tulip tree.

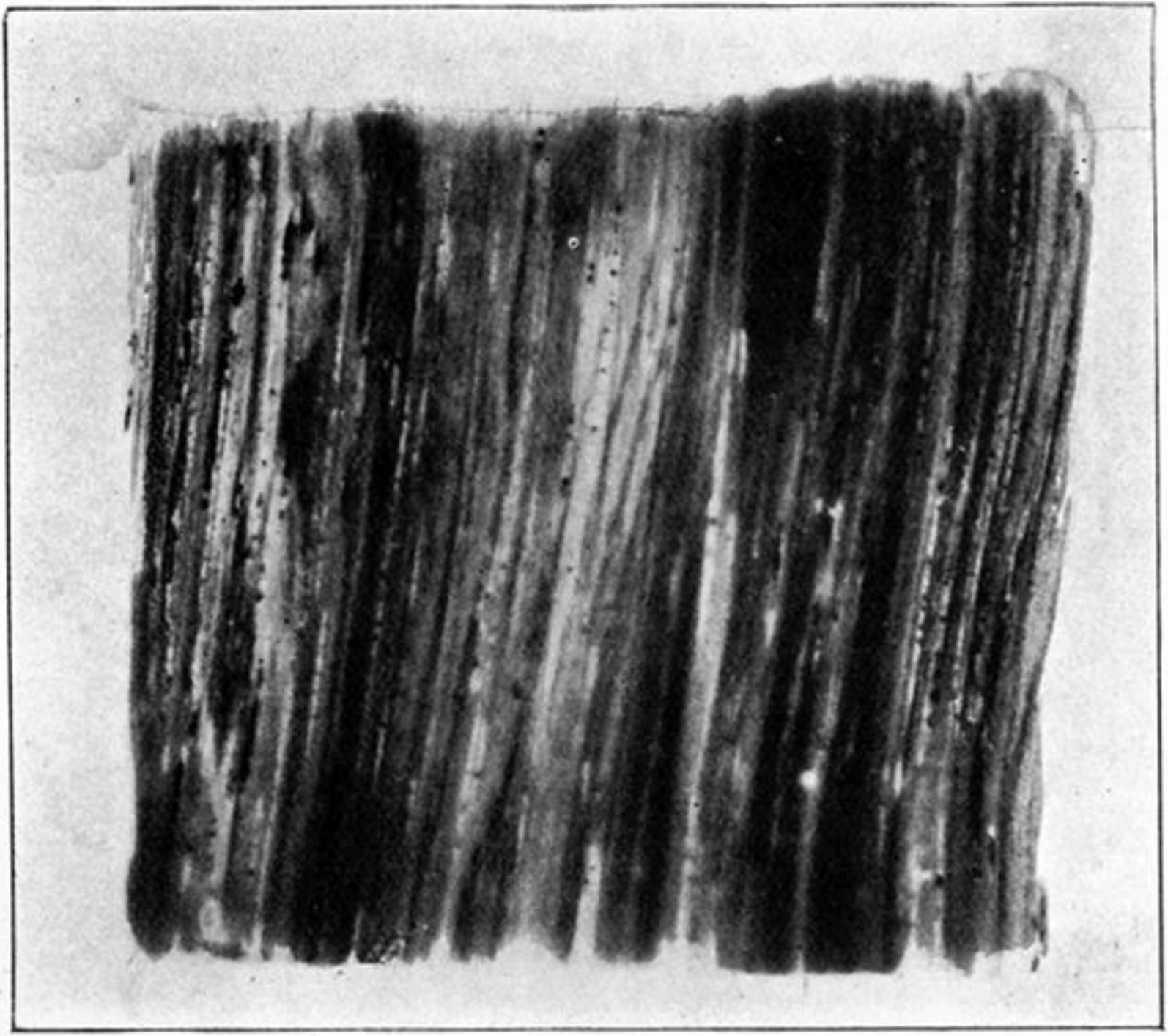


Fig. 14.—Rosewood.

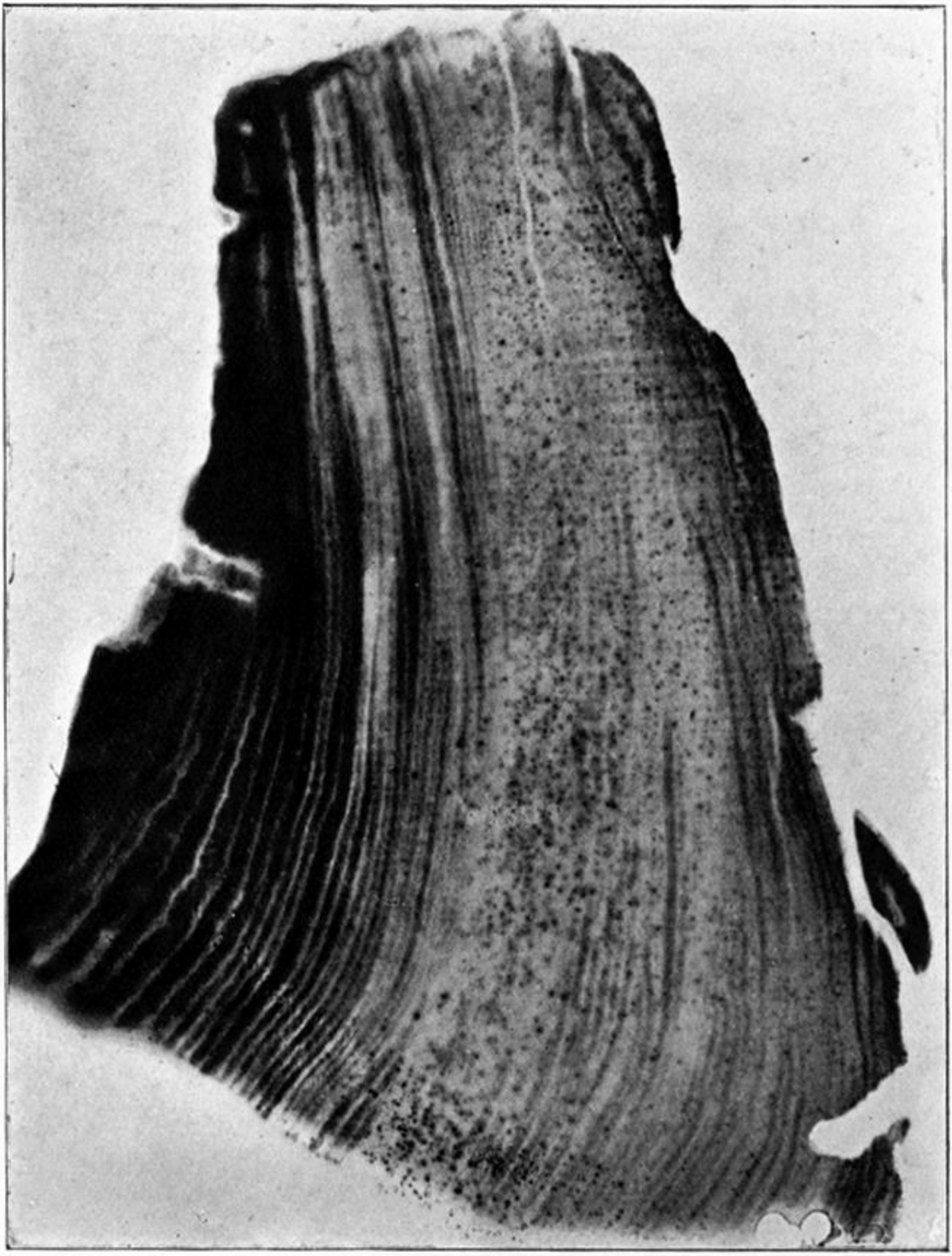


Fig. 15.—Cocobolo.

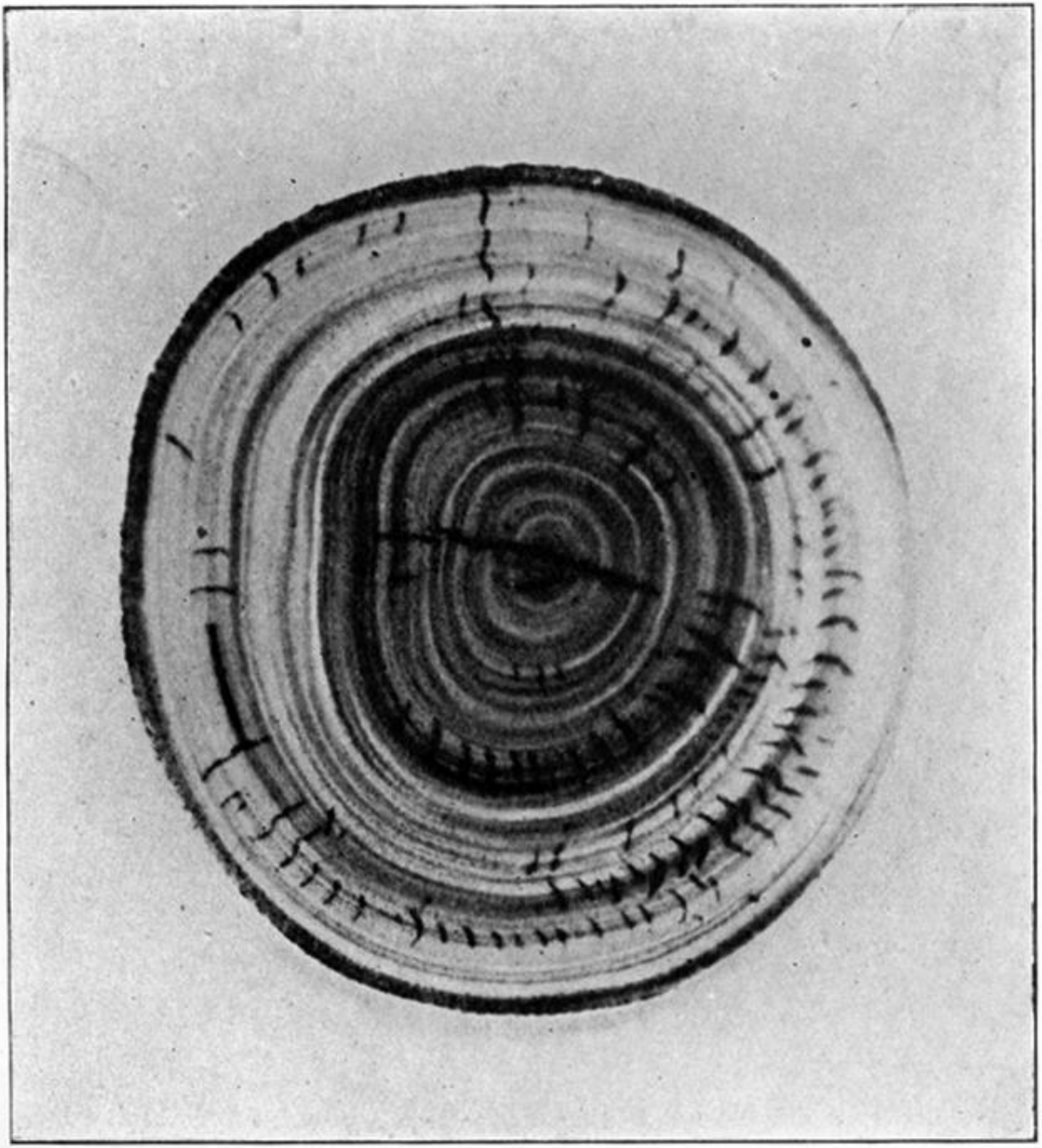


Fig. 16.—Lignum vitæ.

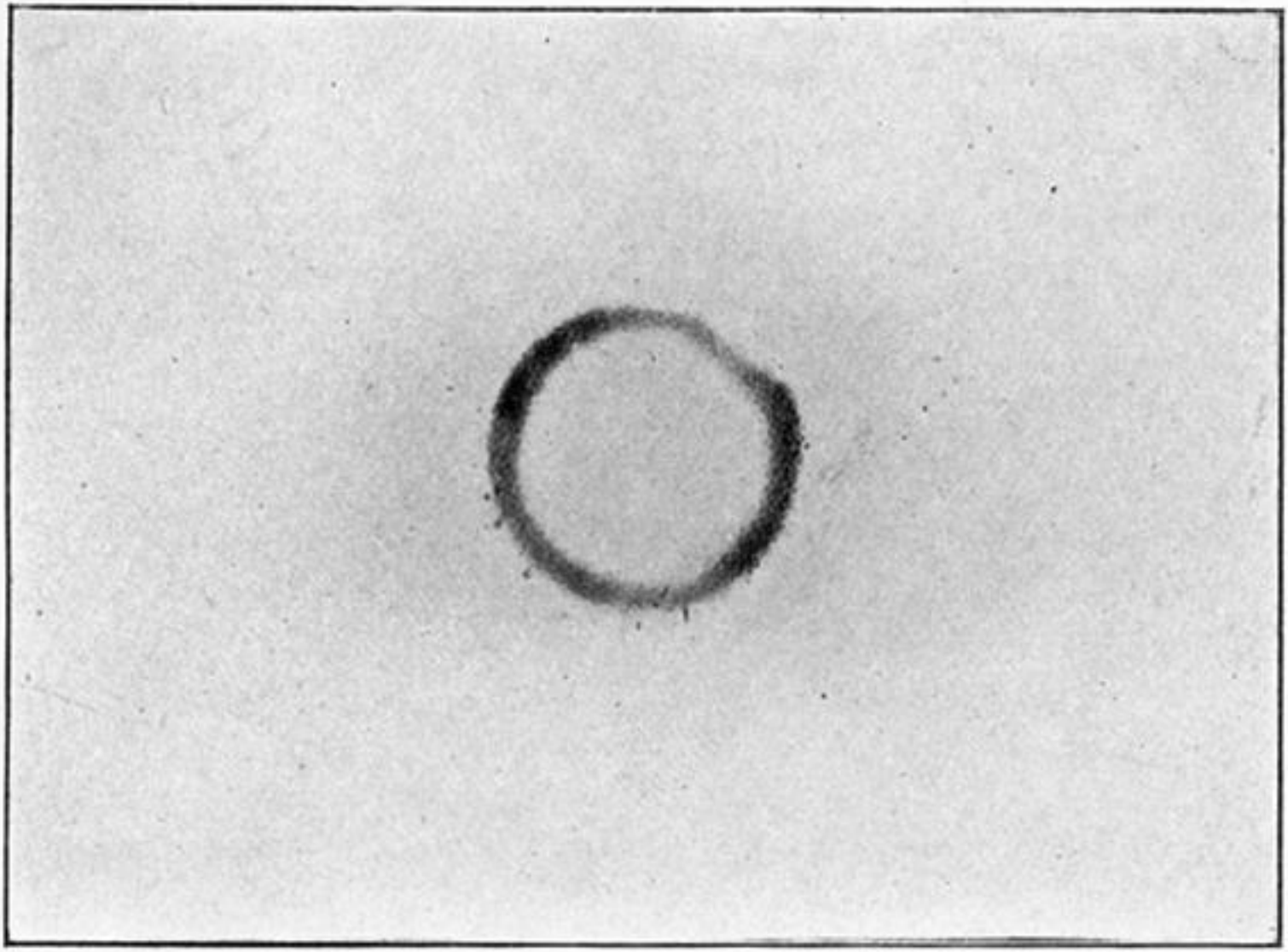


Fig. 17.—Bamboo.

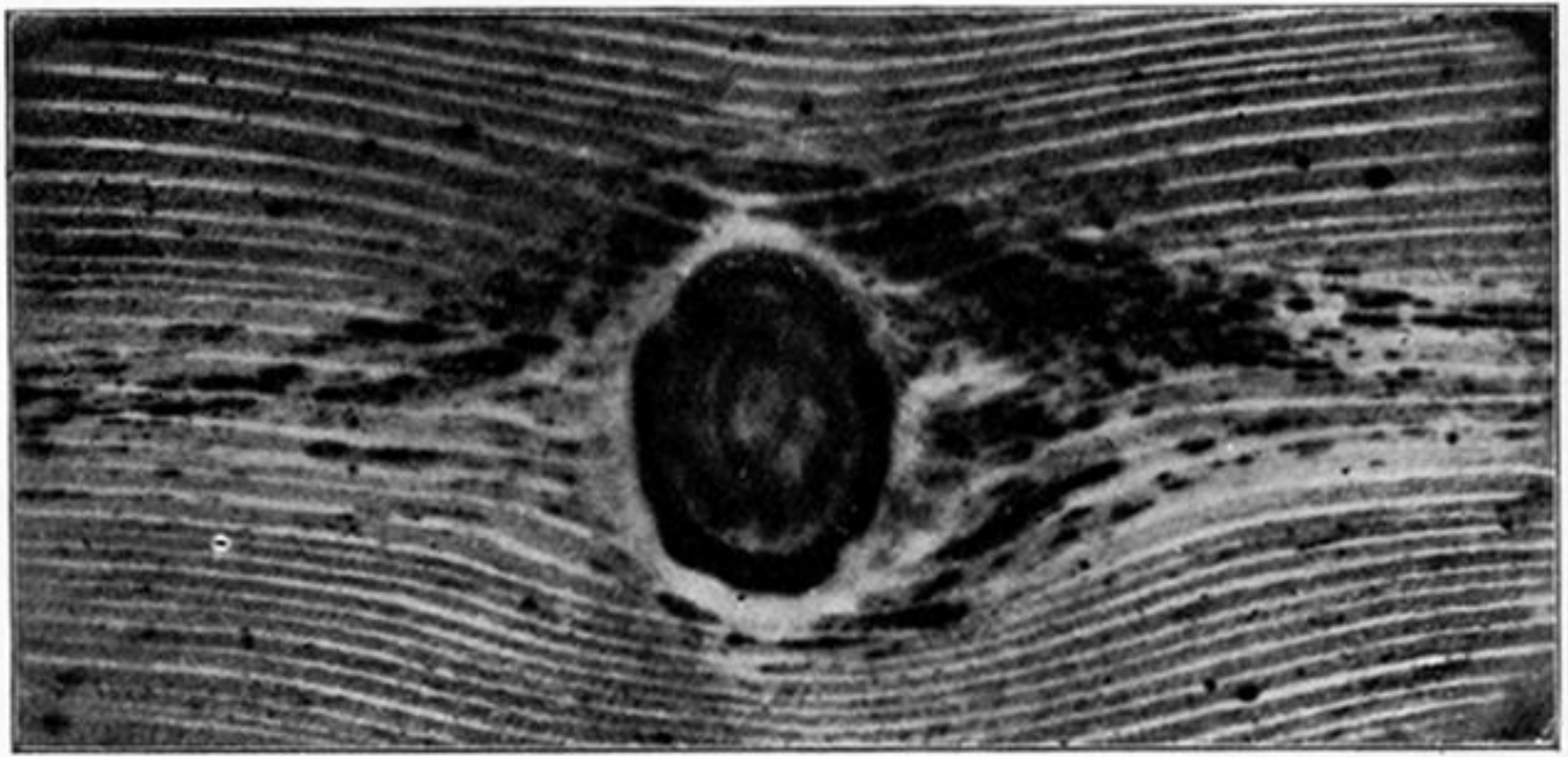


Fig. 18.—Yellow pine.

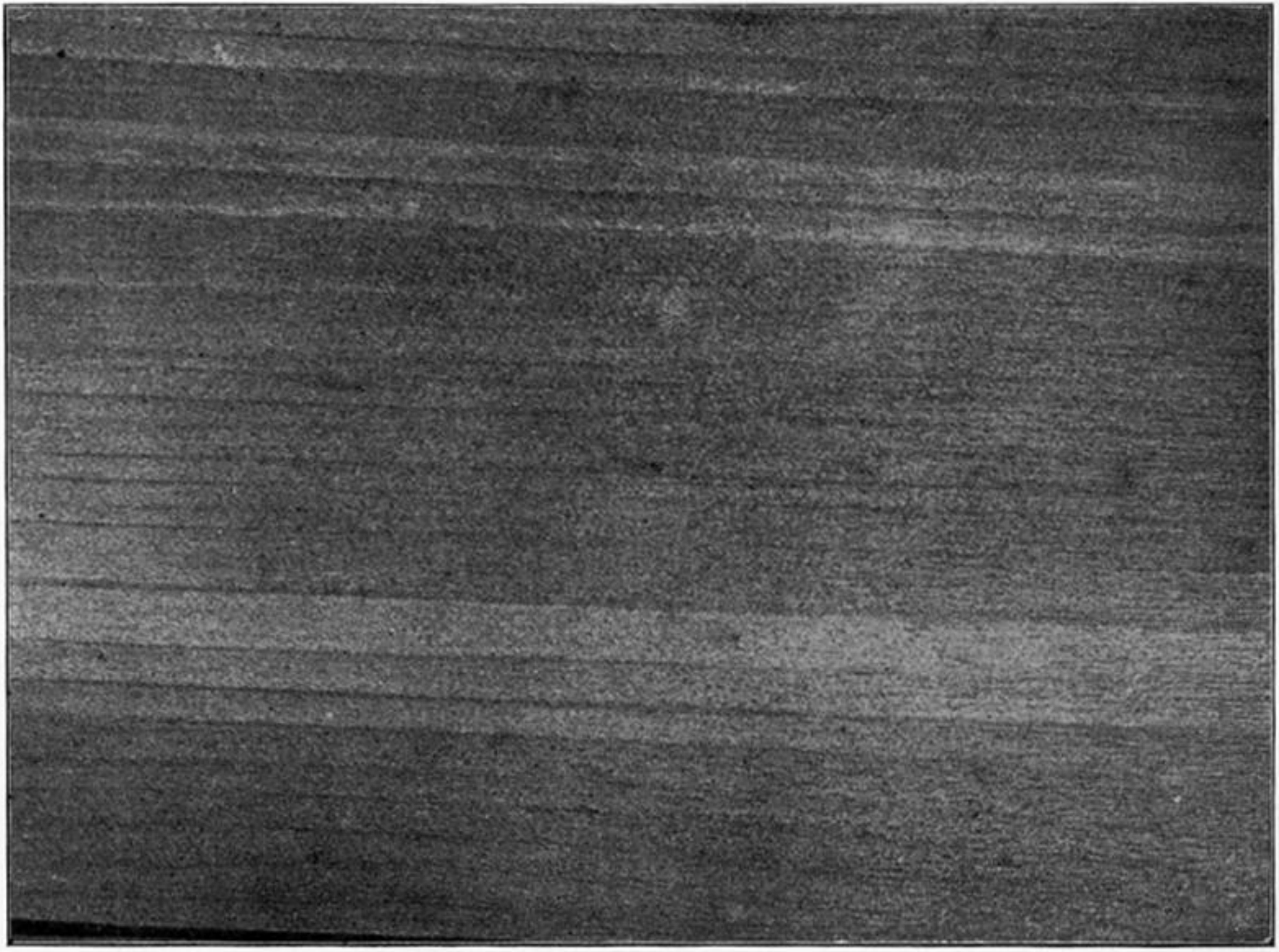


Fig. 19.—Basswood.

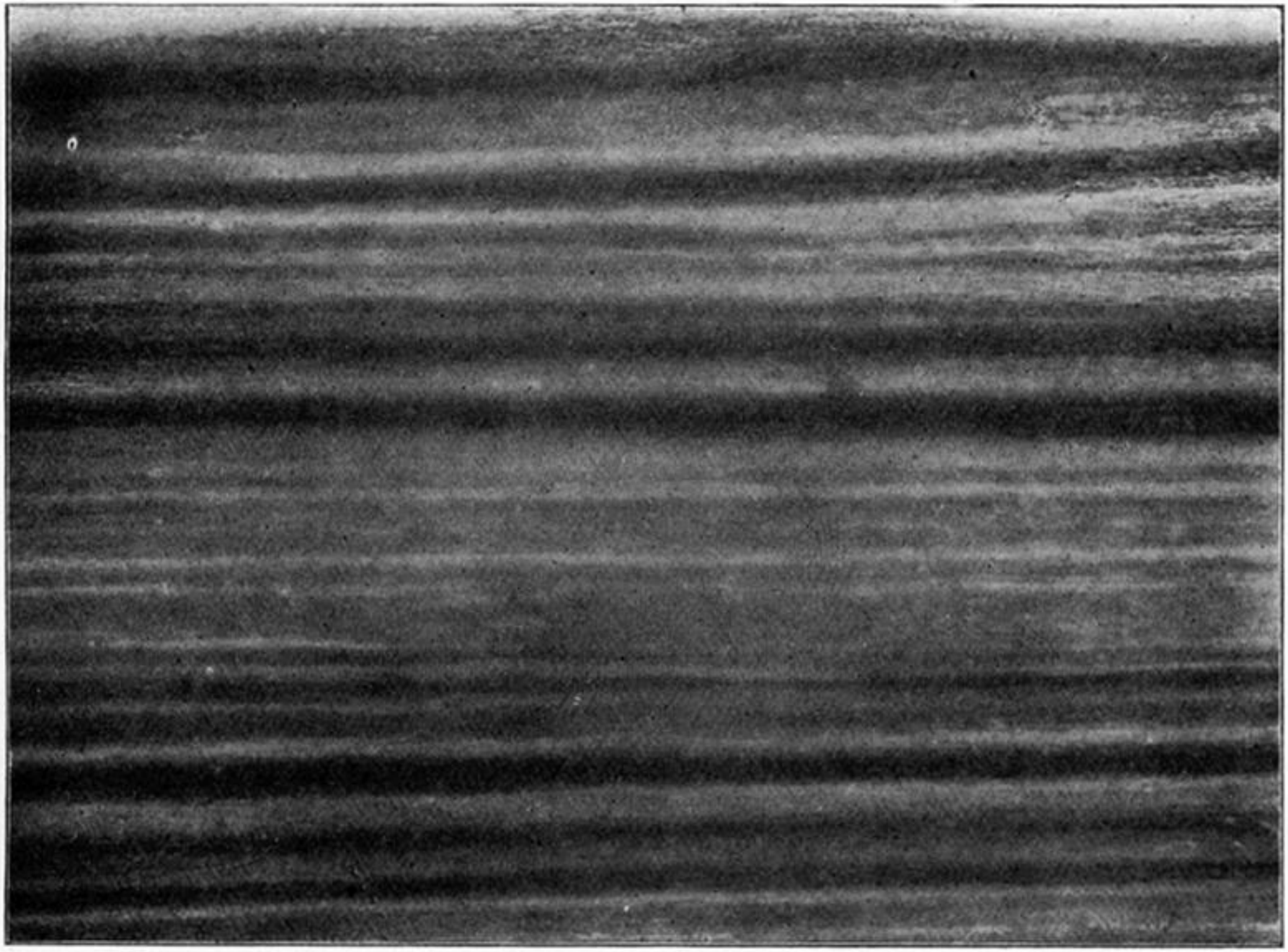


Fig. 20.—Basswood.

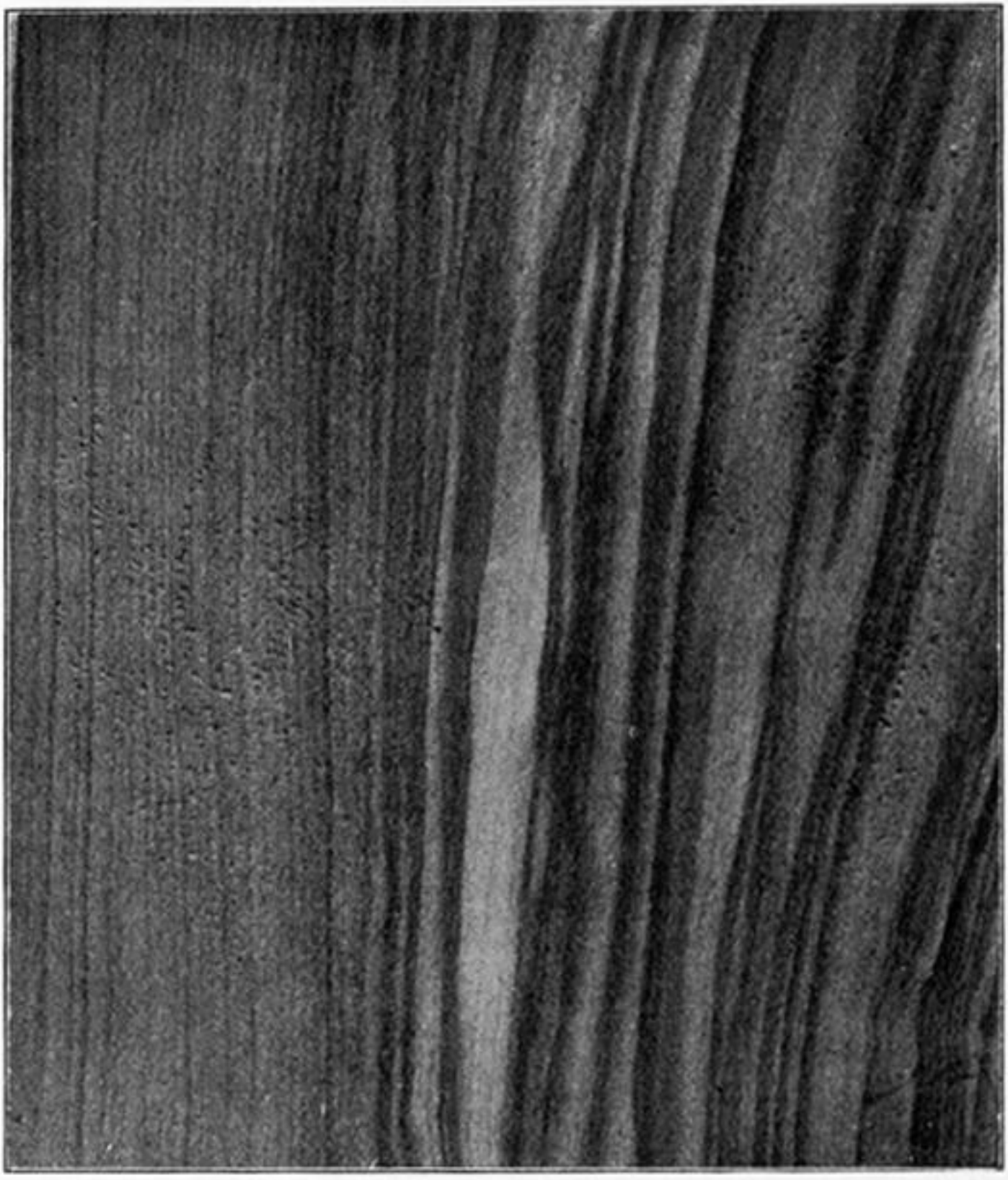


Fig. 21.—Olive.

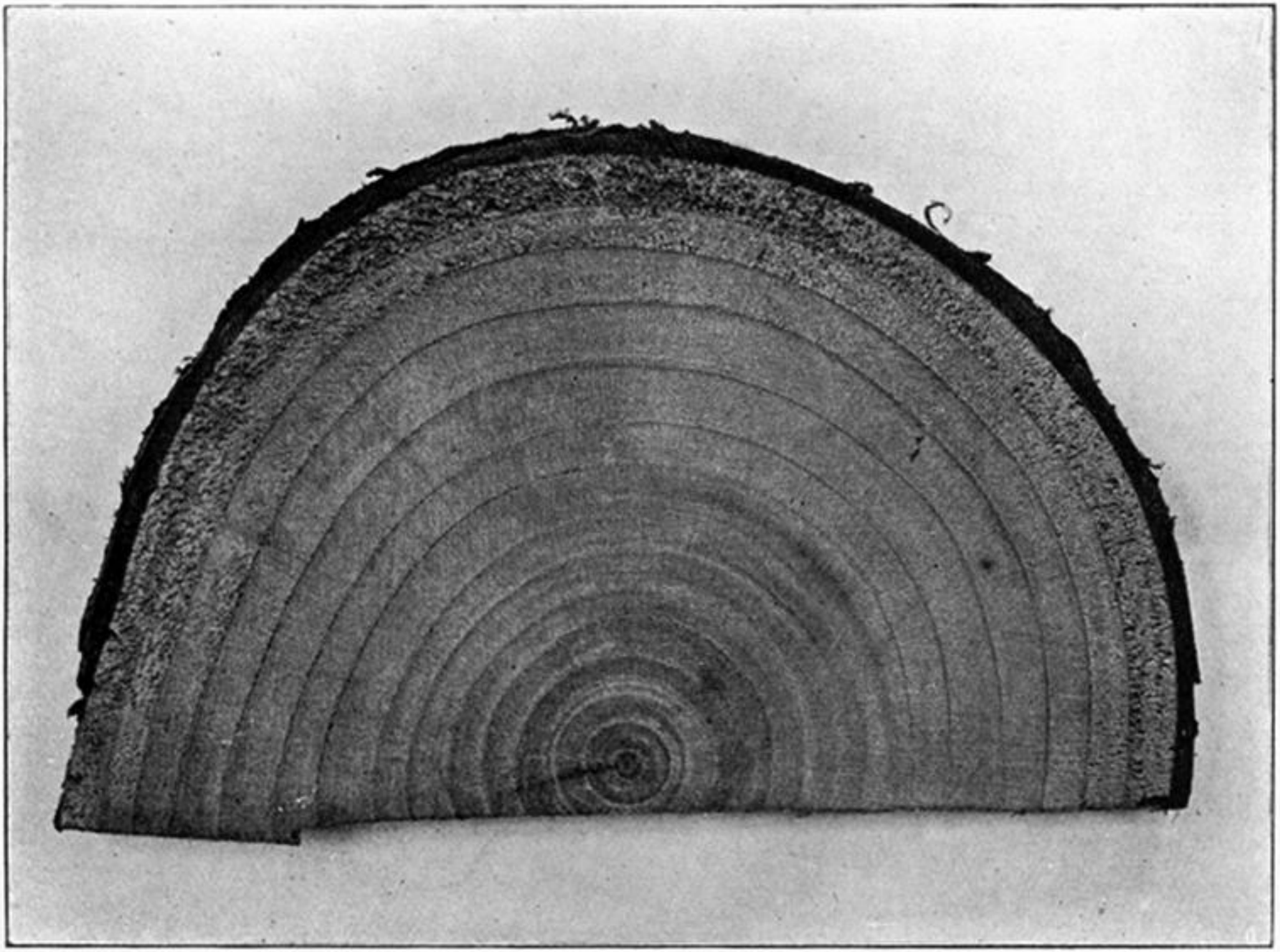


Fig. 21A.—Cherry.
(Three-quarters full size.)

Fig. 22.—Olive.

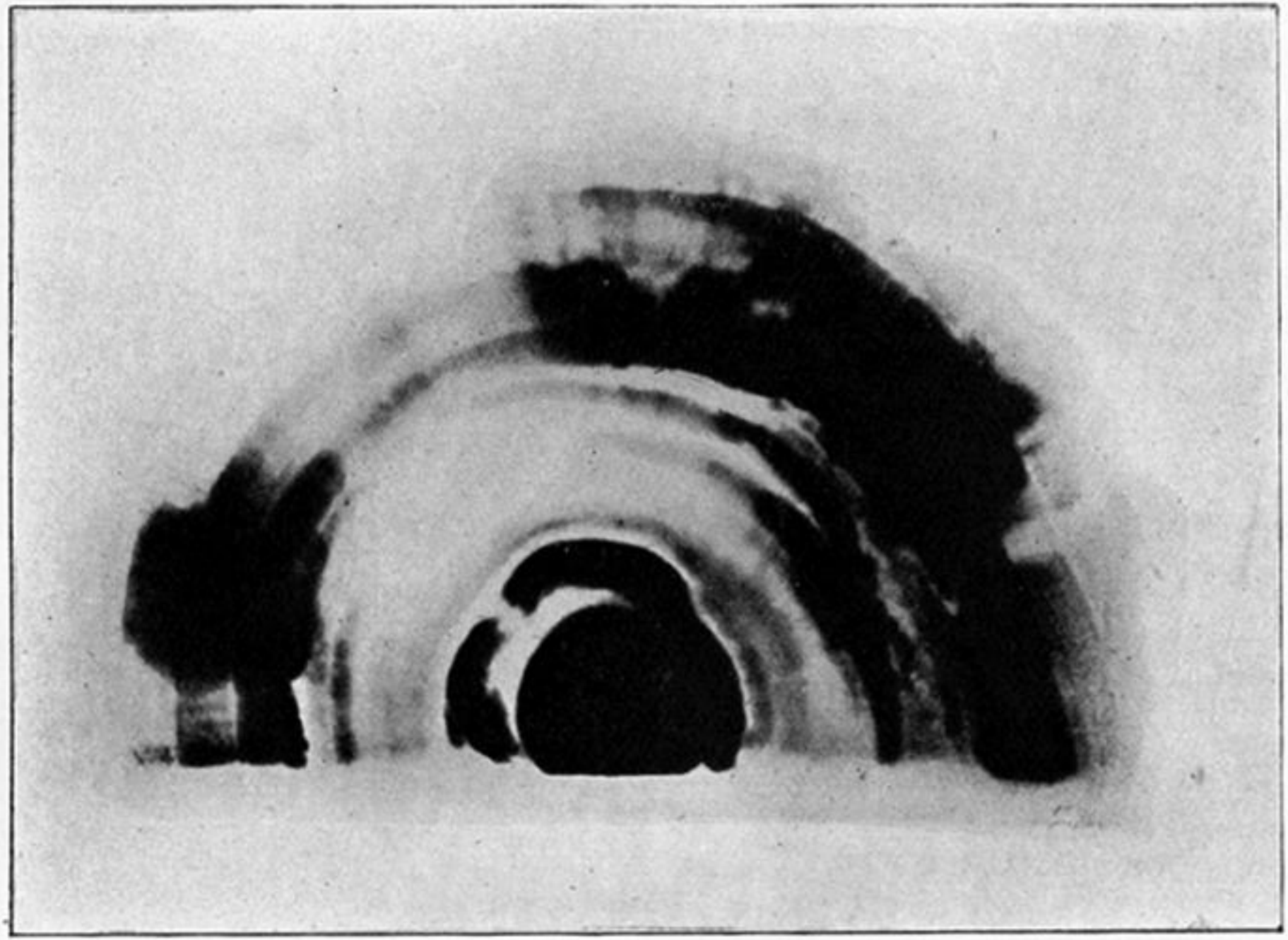


Fig. 22A.—Cherry.
(Three-quarters full size.)

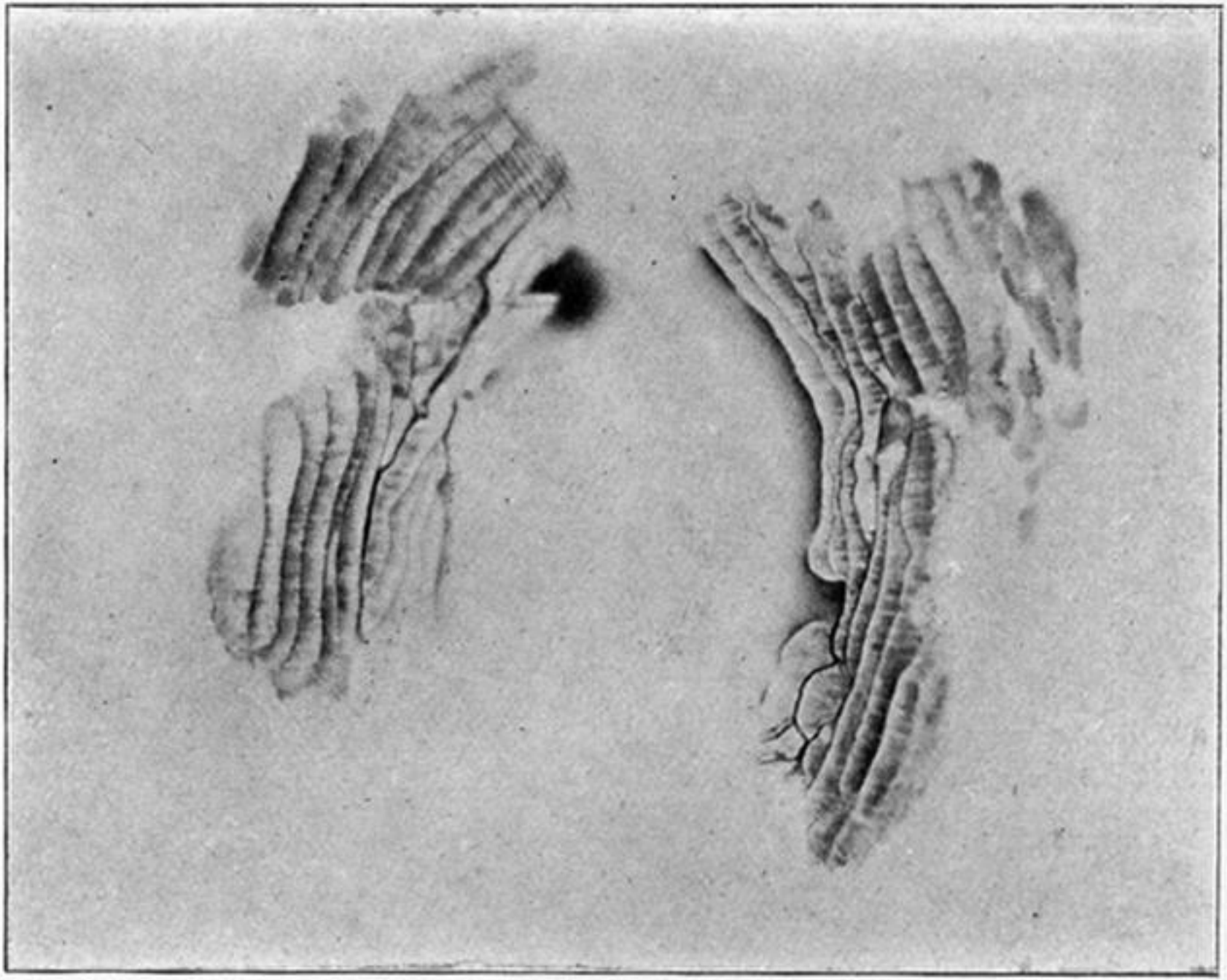


Fig. 23.—*Pinus pinaster*,

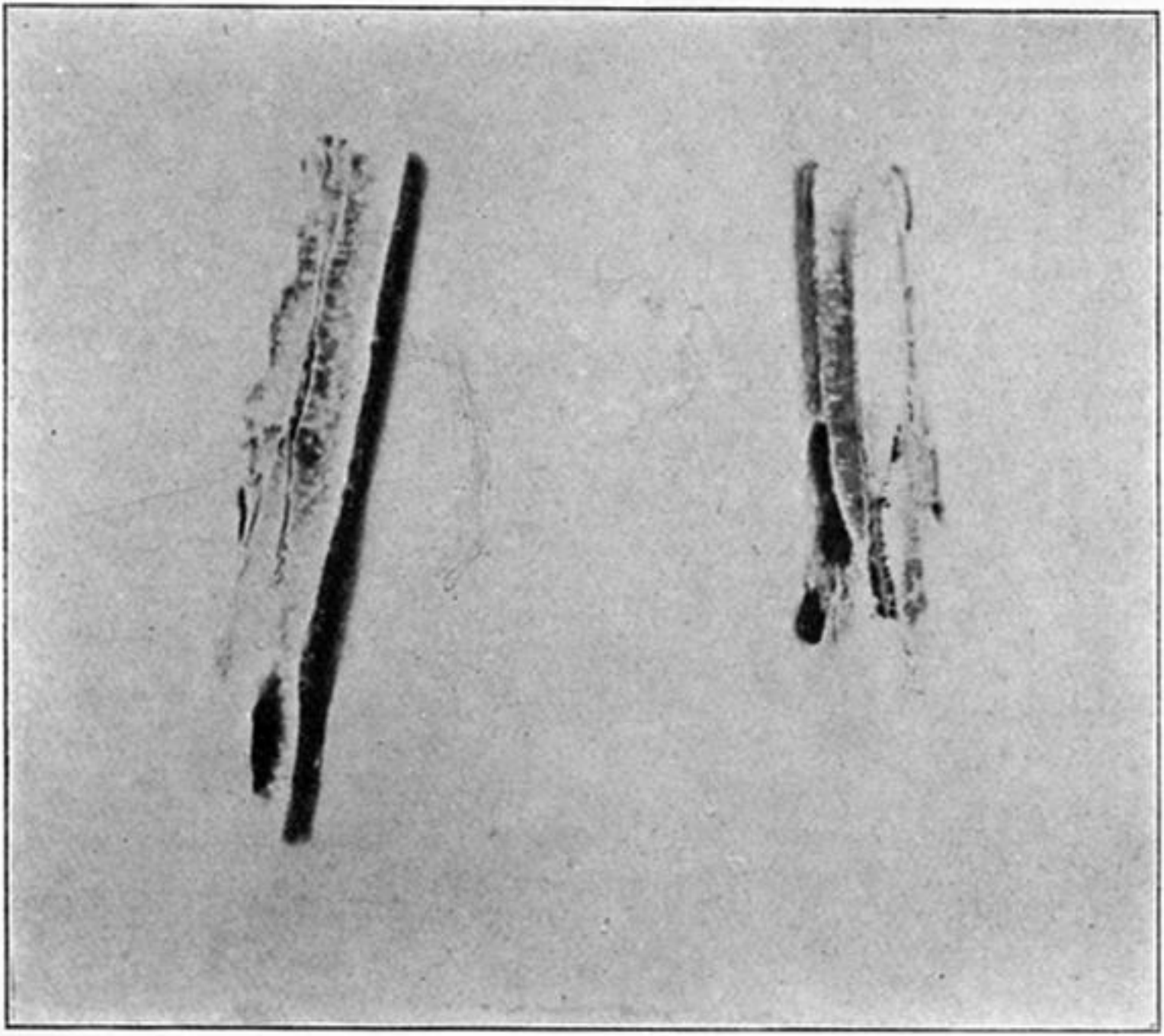


Fig. 24.—Larch bark.

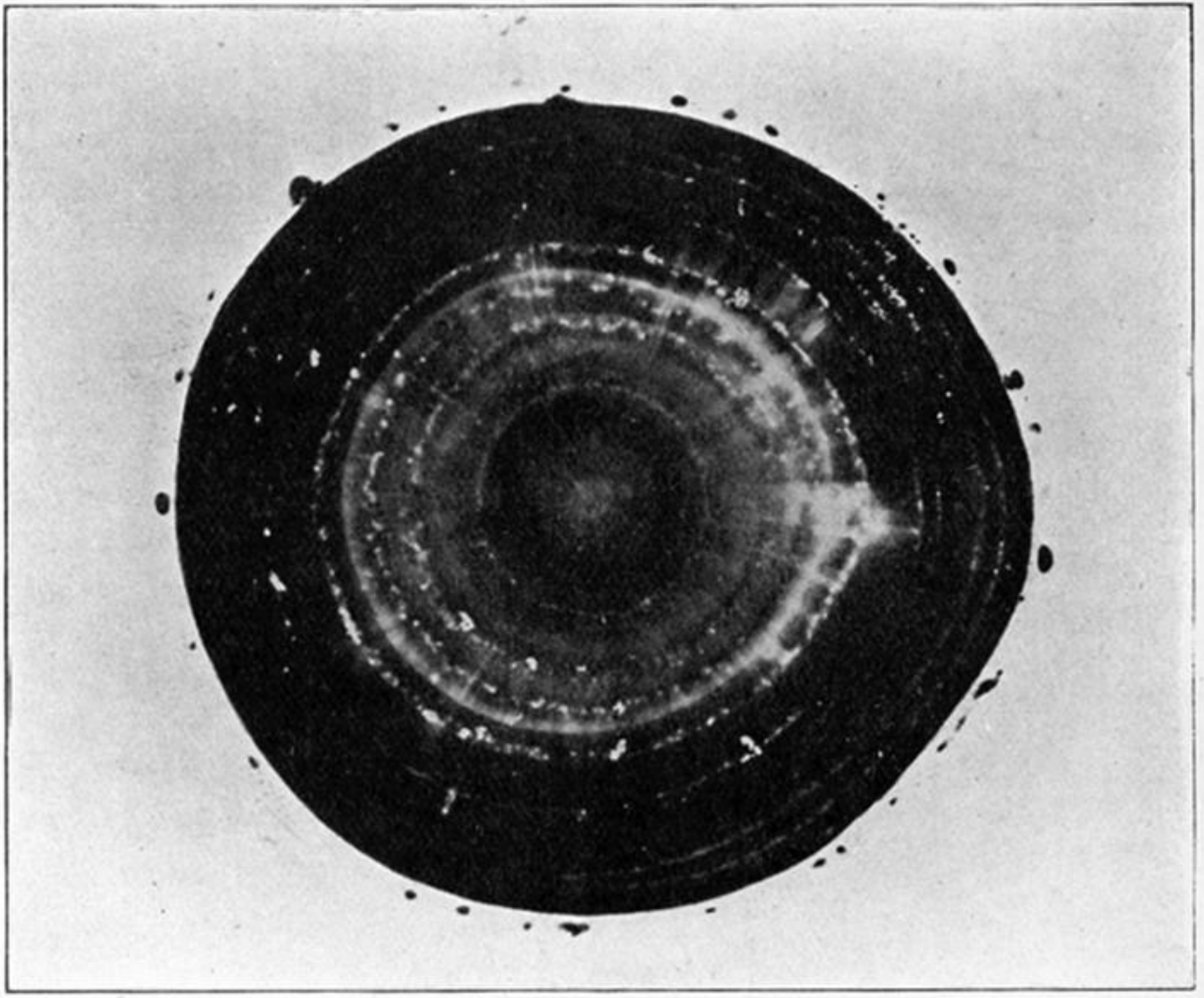


Fig. 25.—Rhizophora.

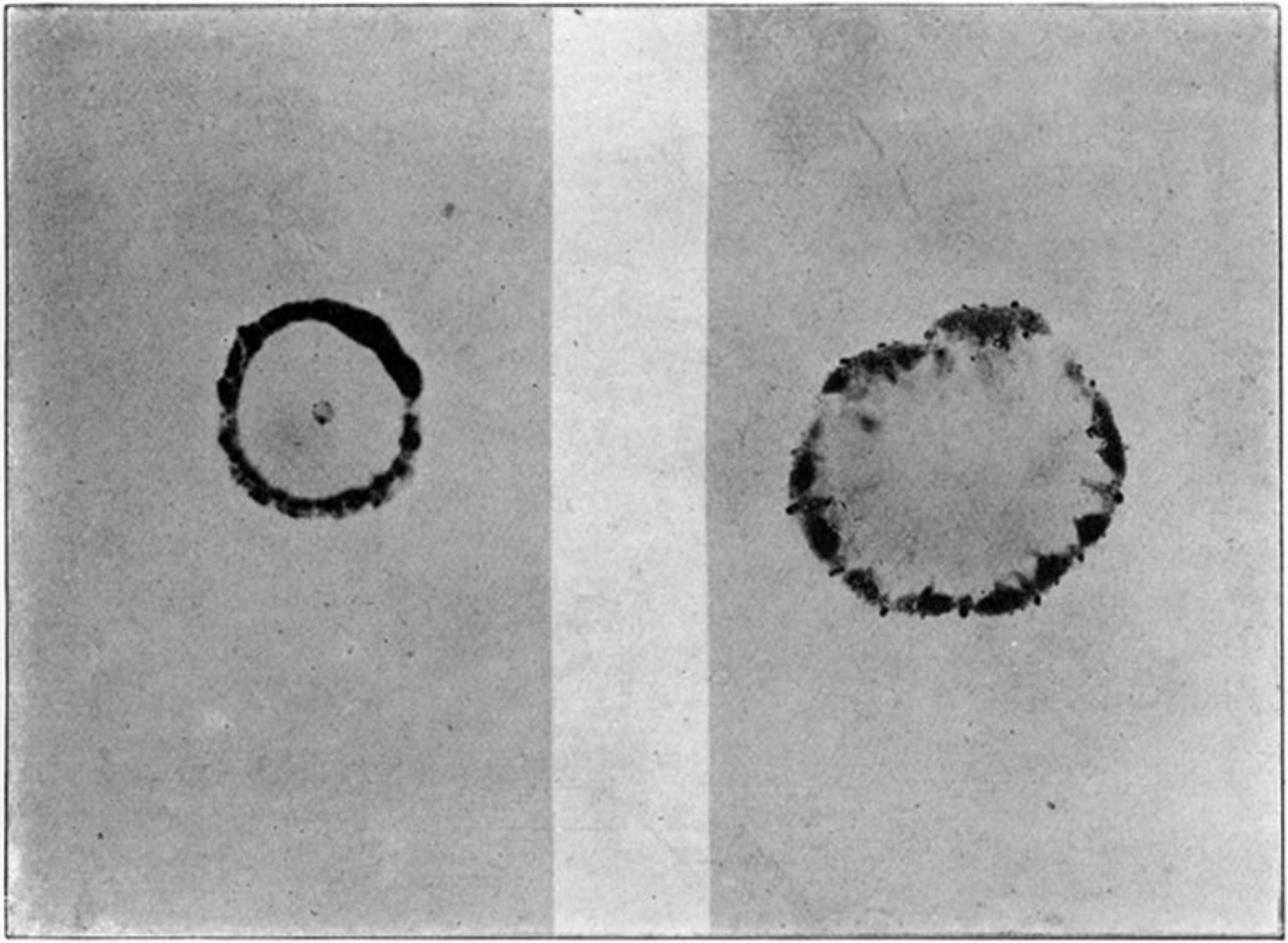


Fig. 26.—Ivy.

Fig. 27.—Sunflower.

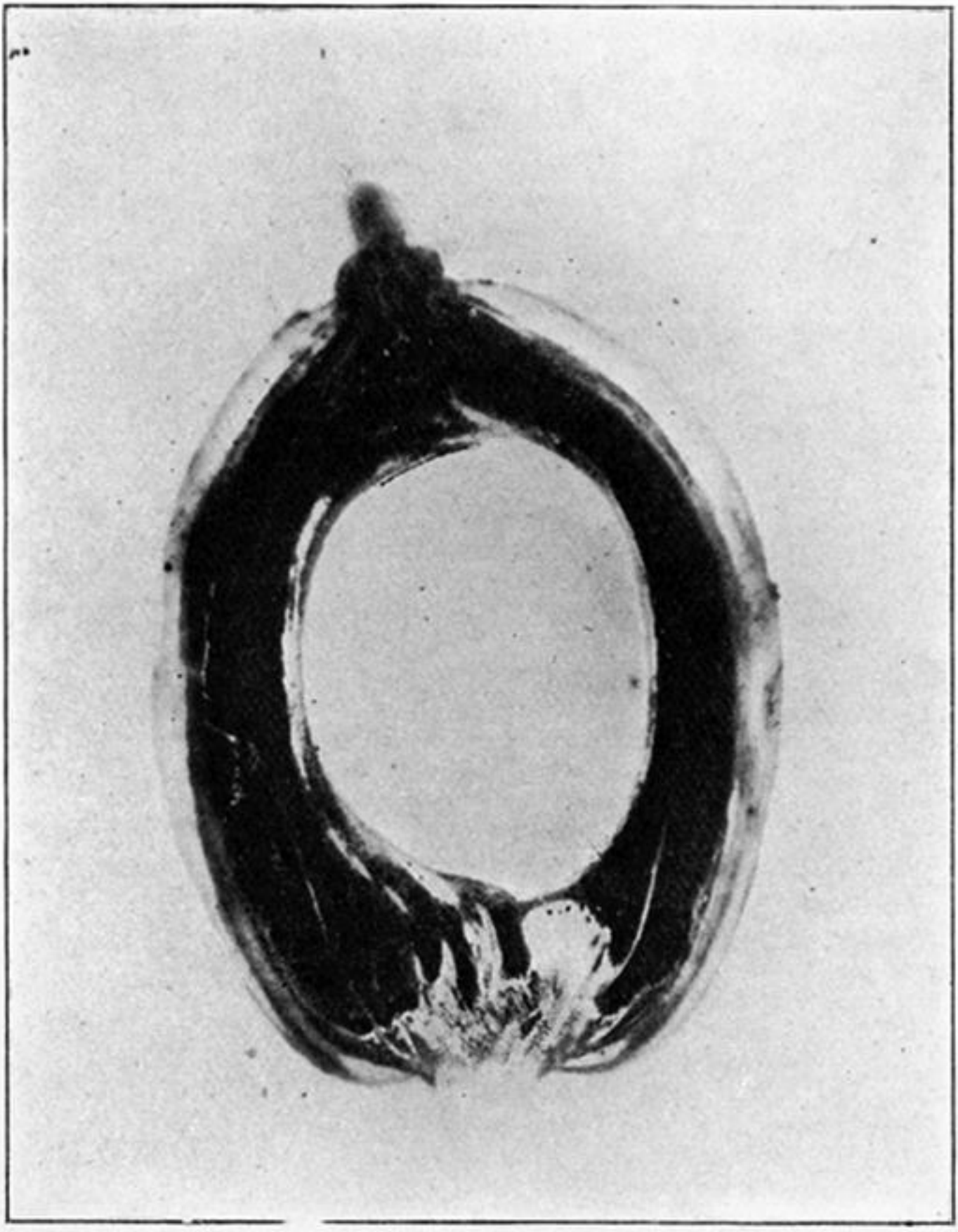


Fig. 28.—Coco-nut.

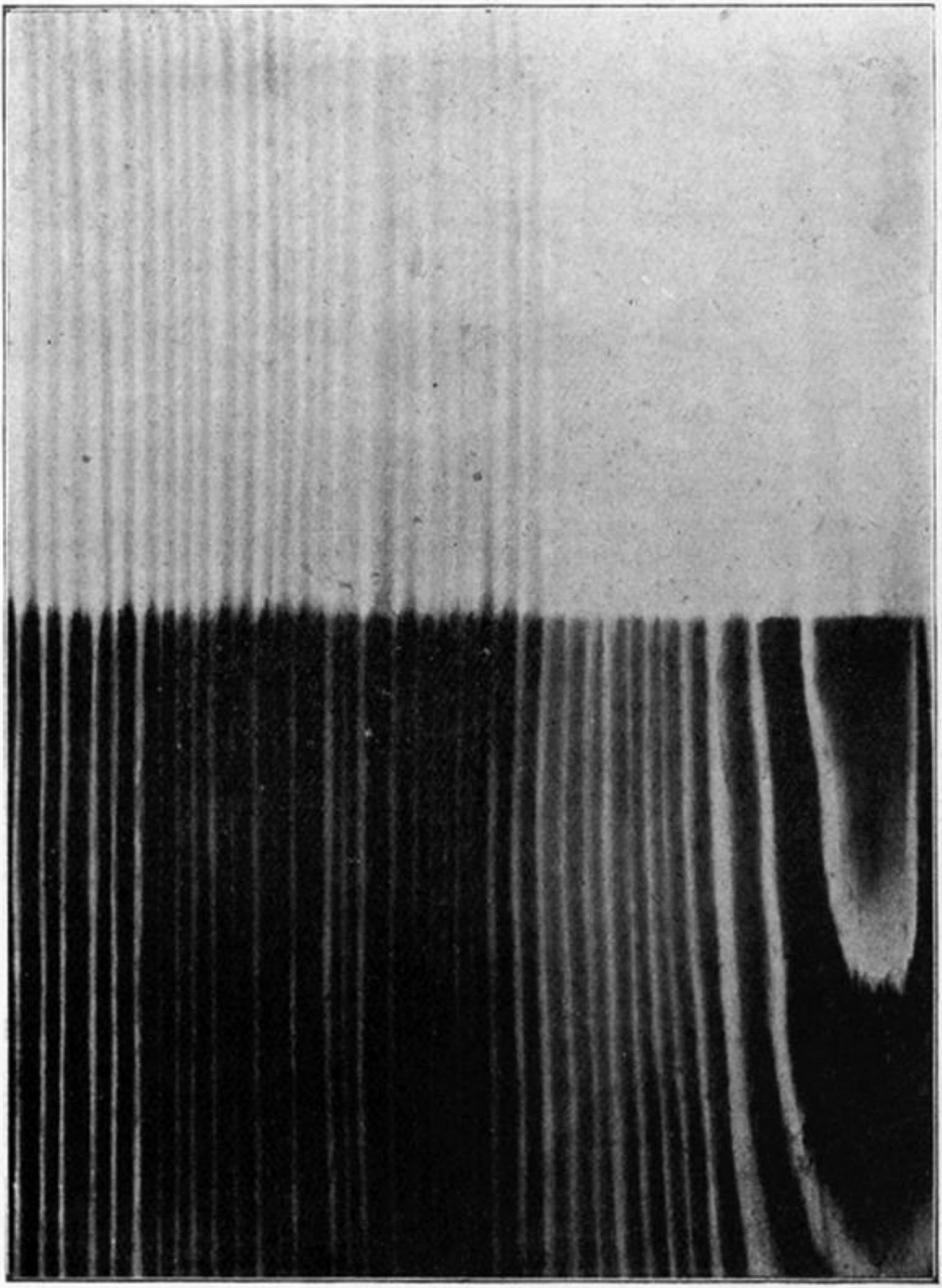


Fig. 29.—Deal.

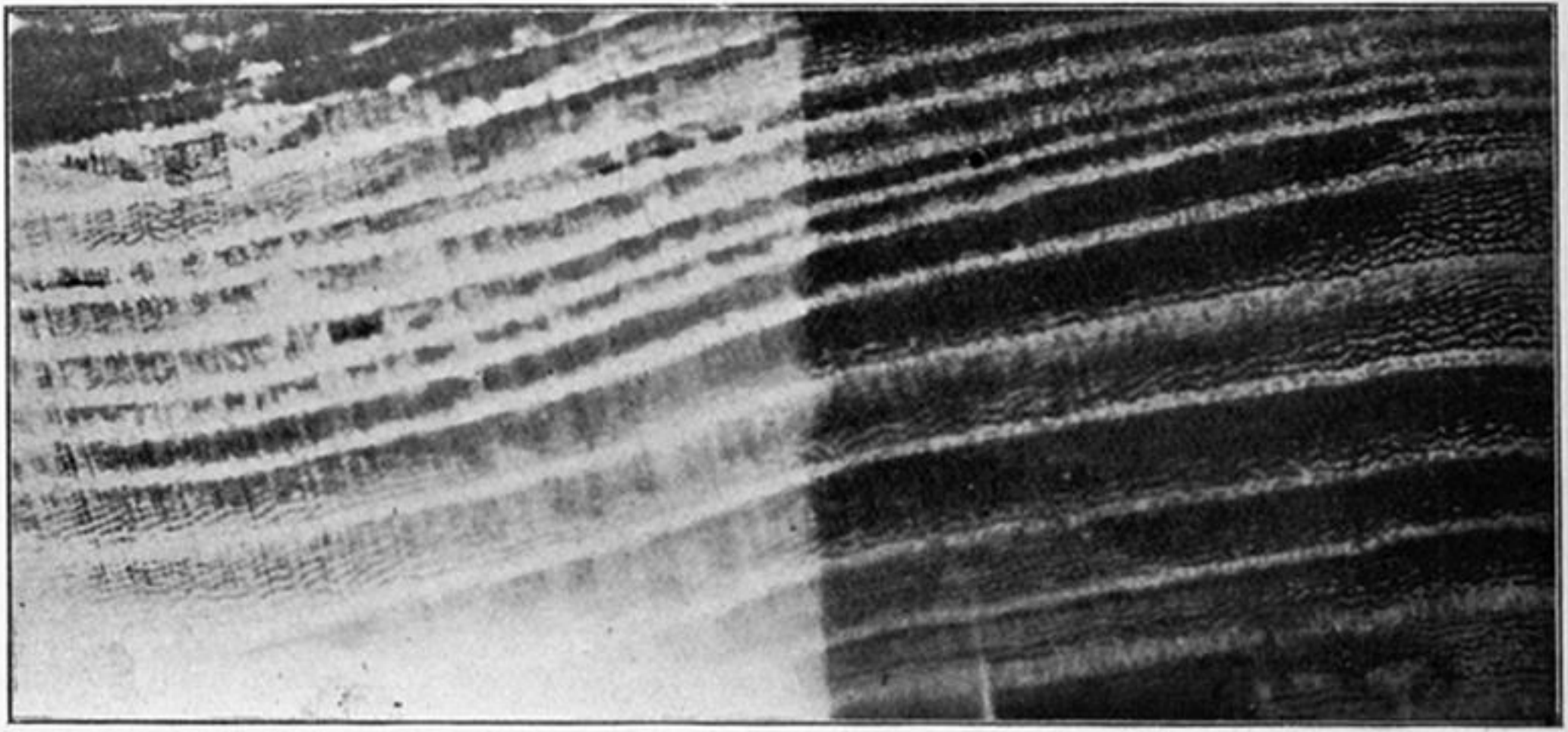


Fig. 30.—Elm.

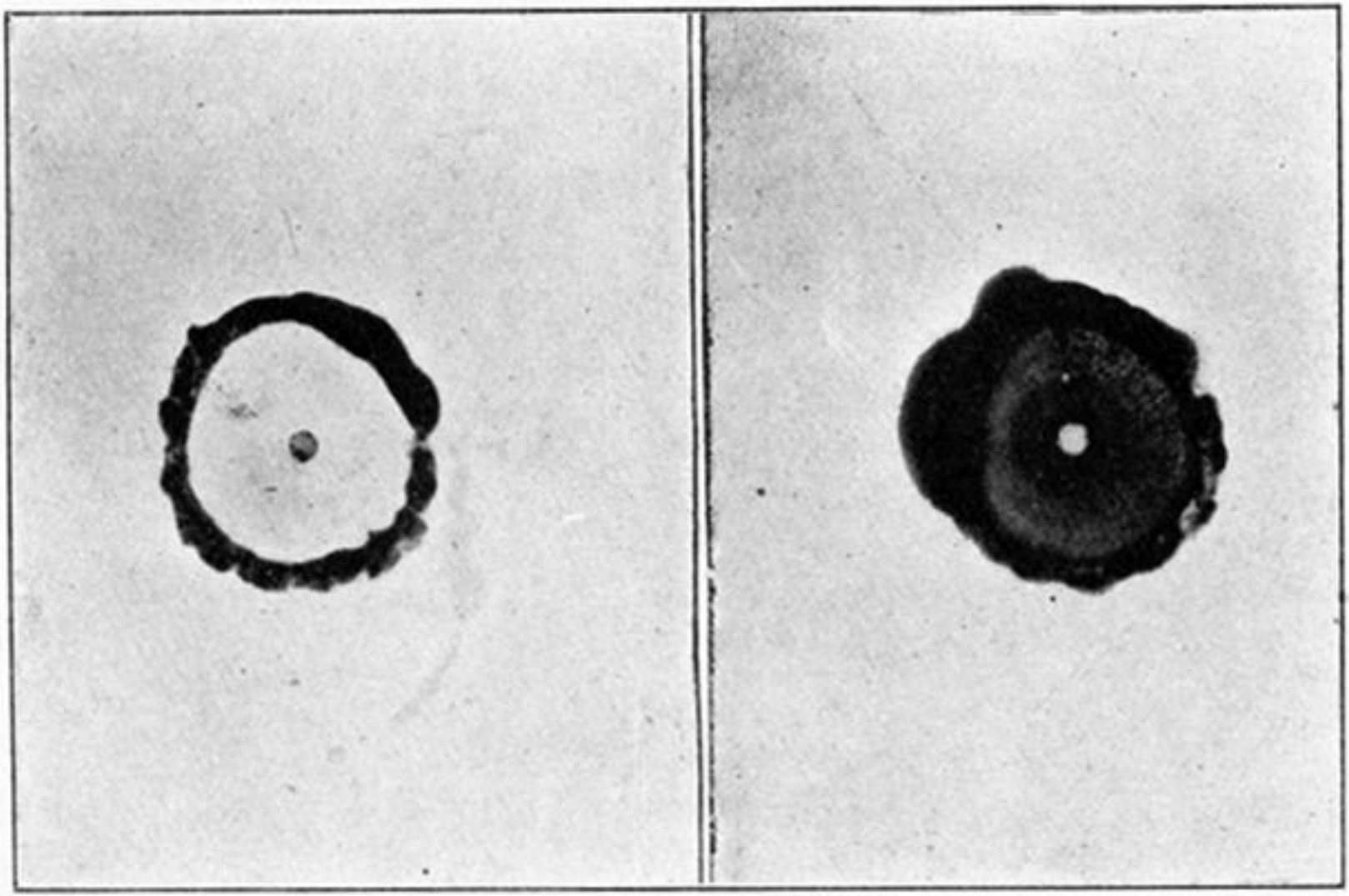


Fig. 31.—Ivy.

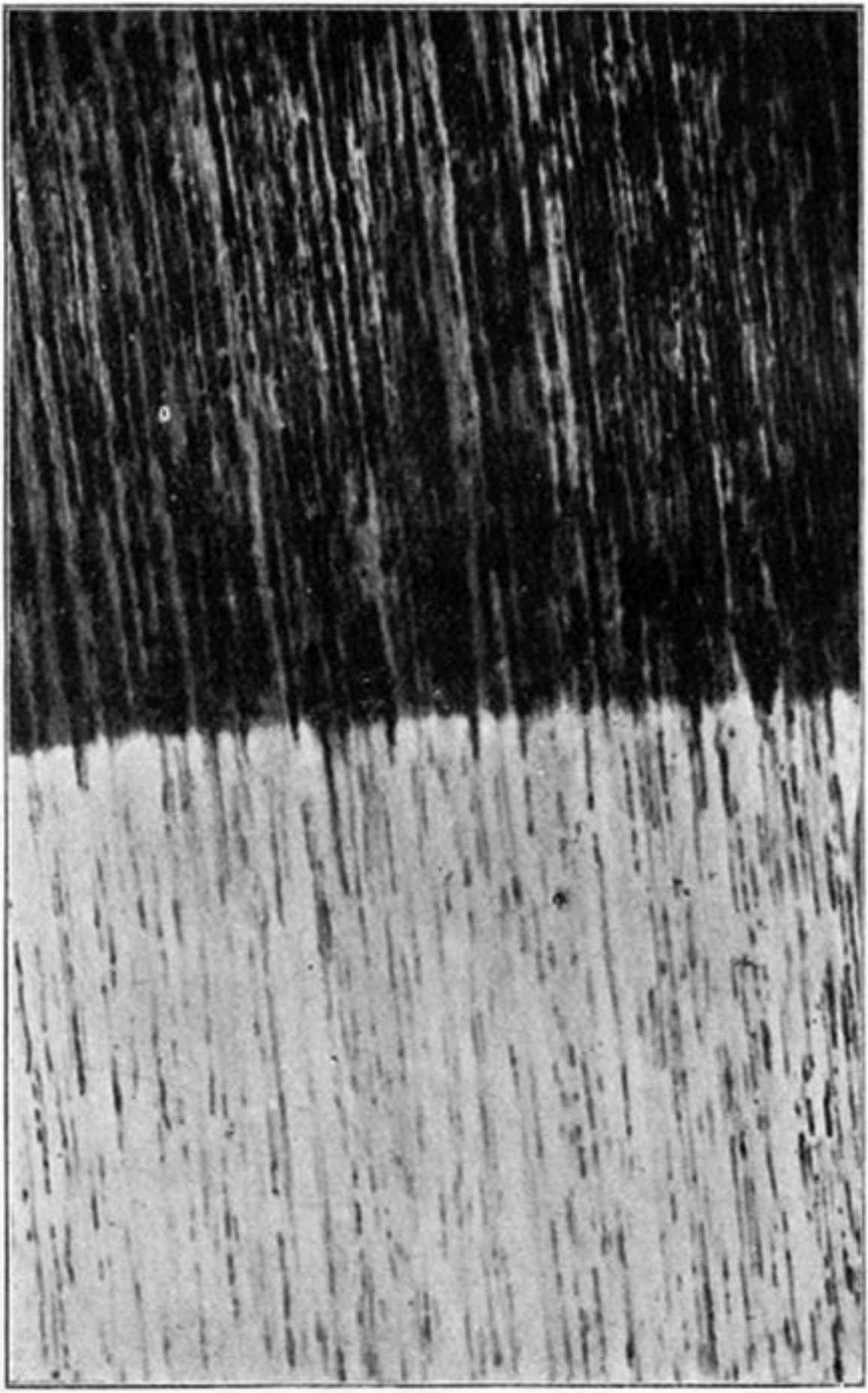
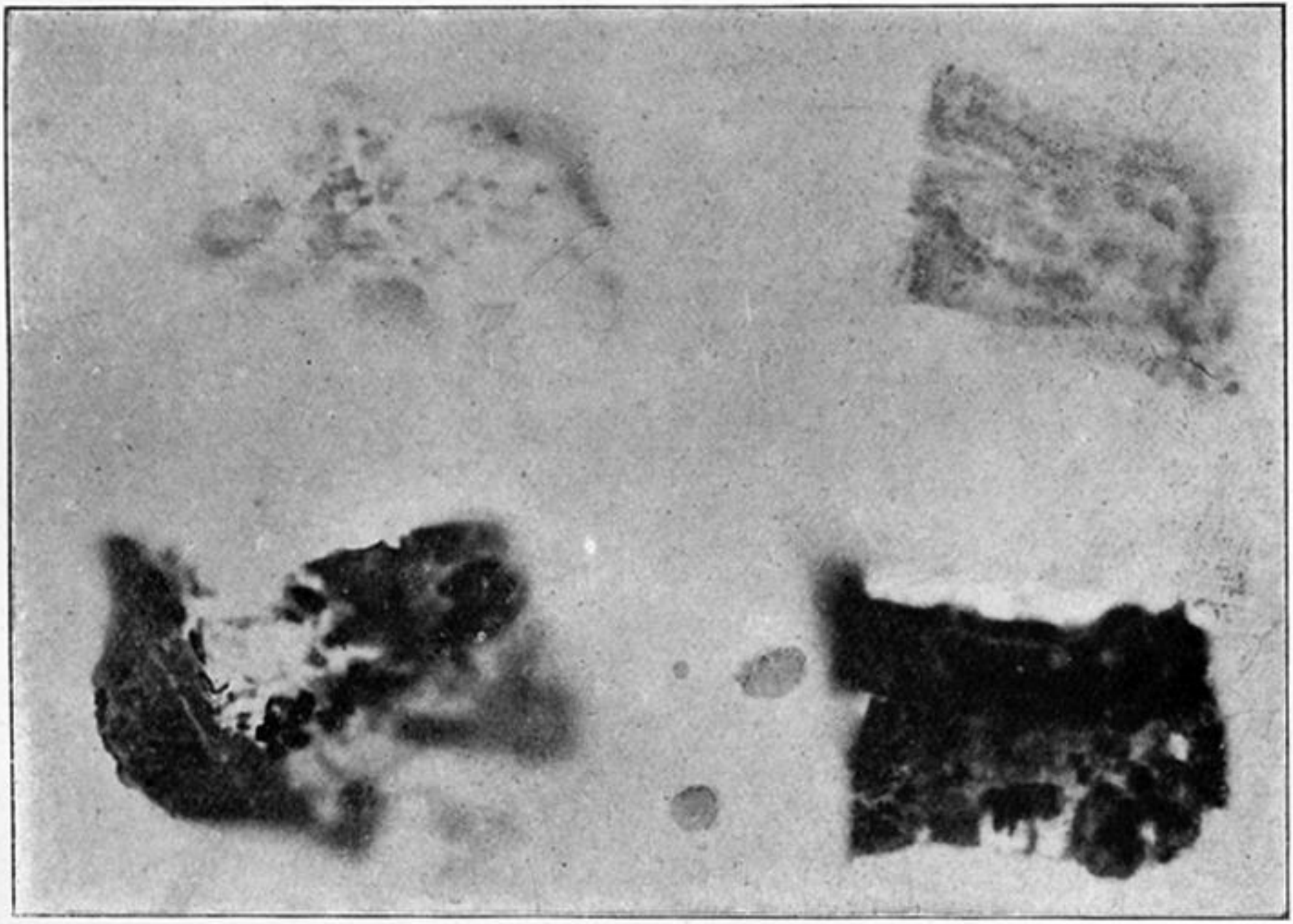


Fig 32.—Teak.



Larch. Oak.

Fig. 33.

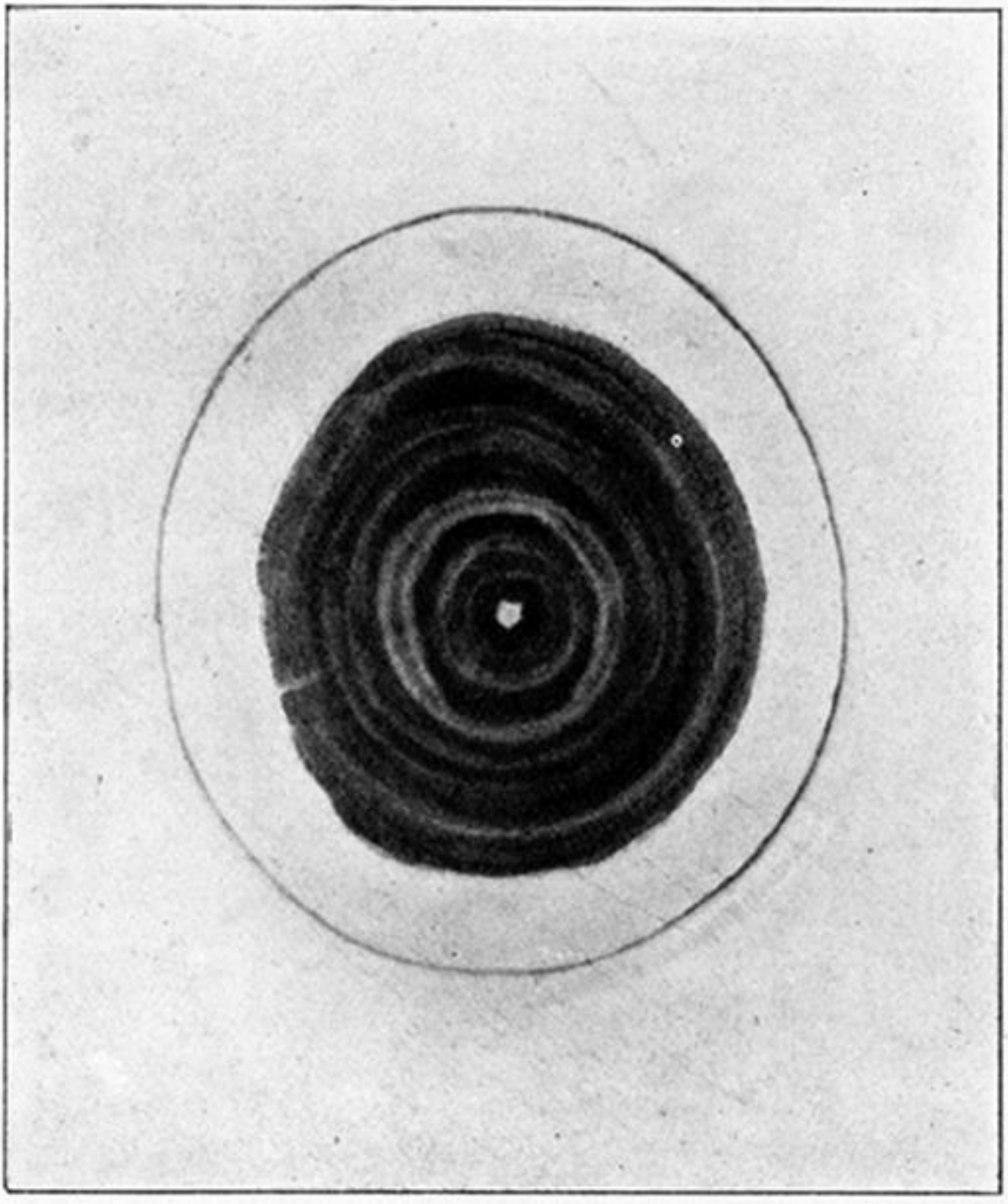


Fig. 34.—Spanish chestnut.

Fig. 35.—Japanese screen.

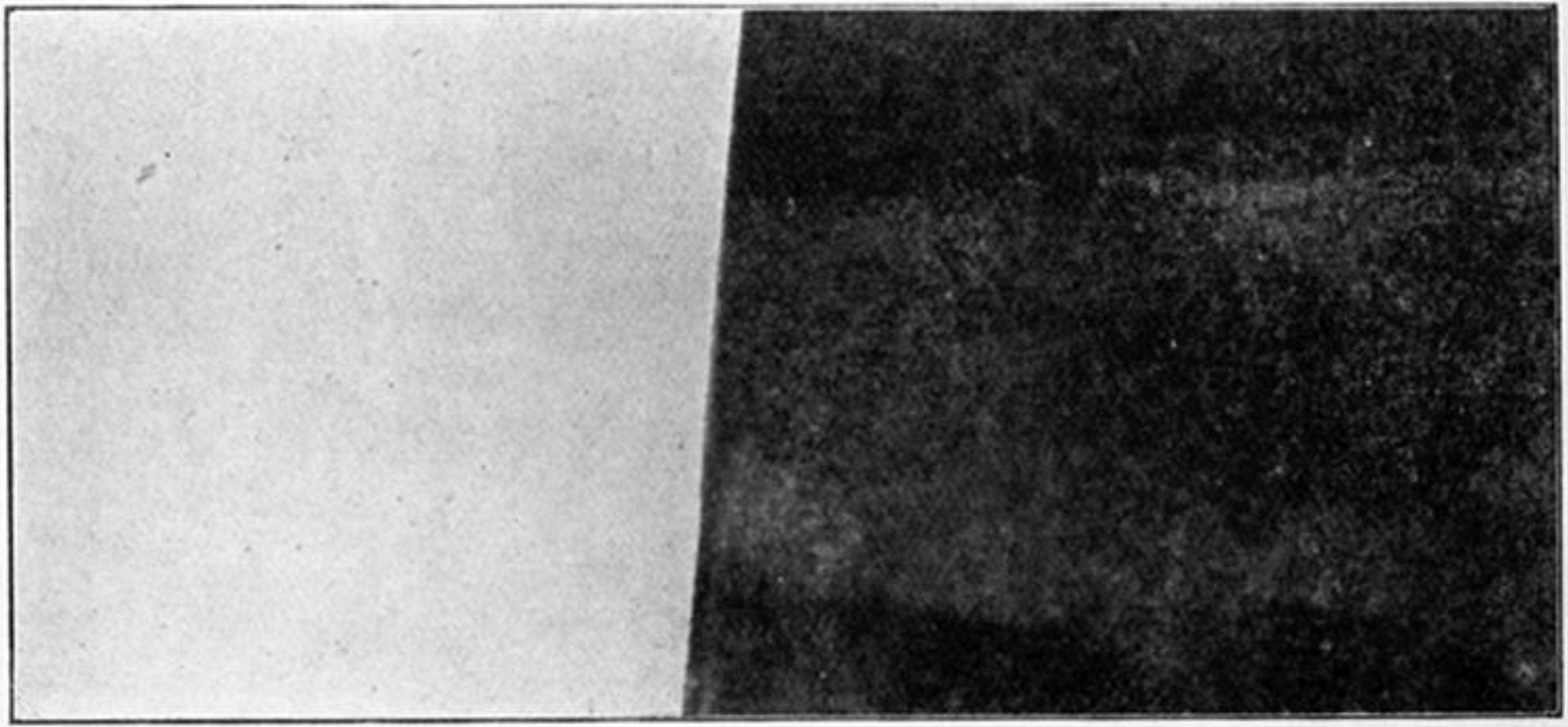
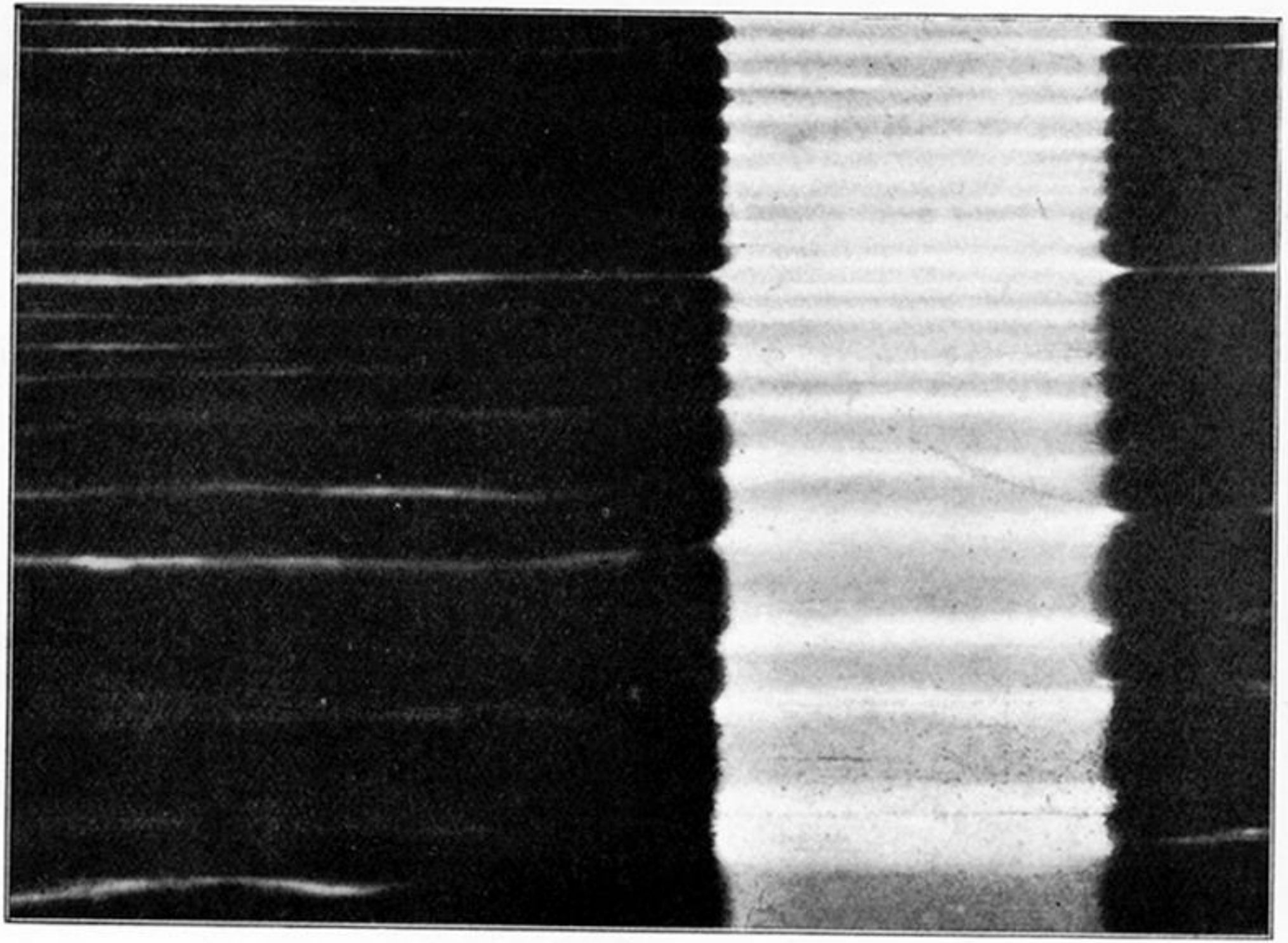
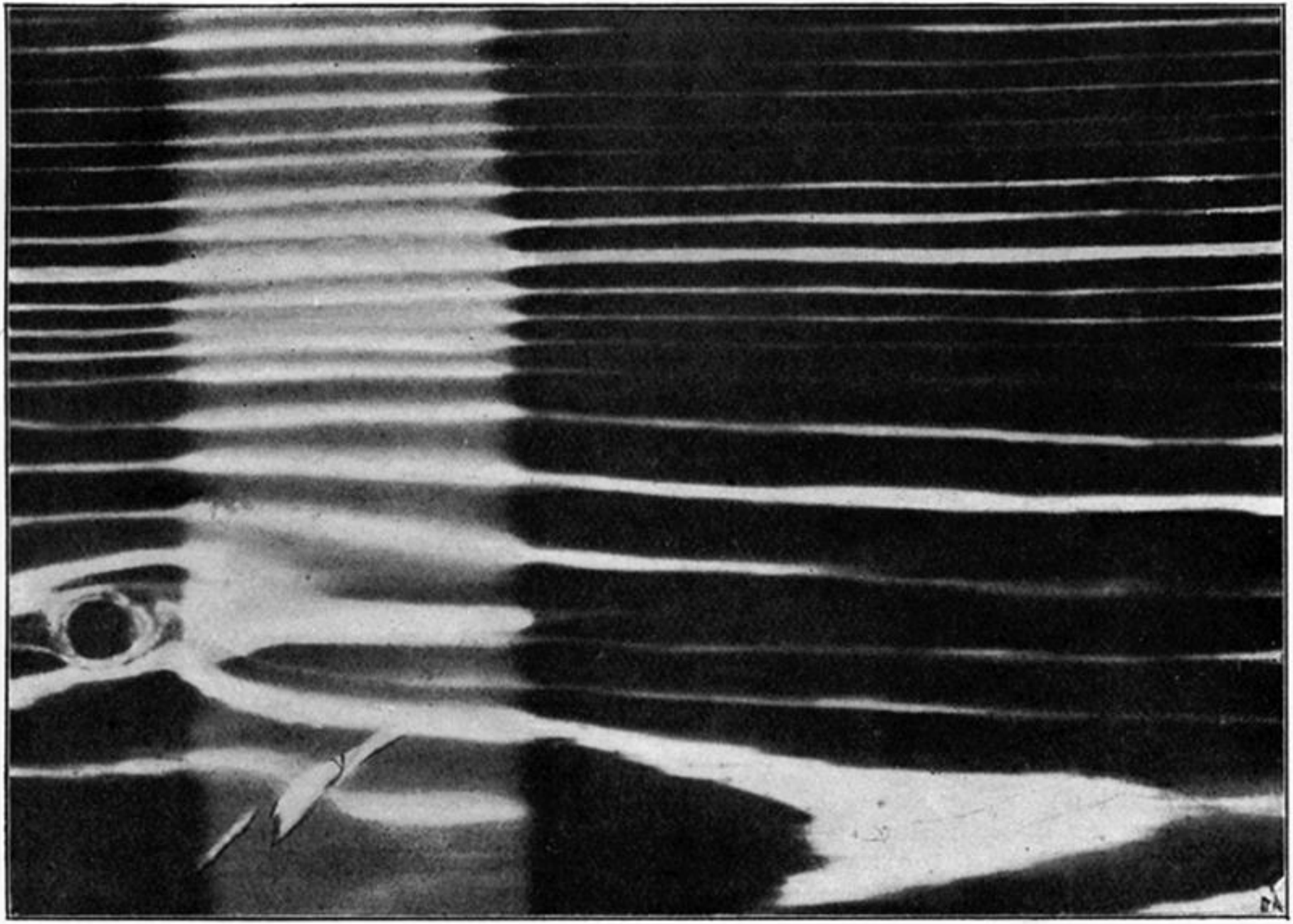


Fig. 36.—Gum guaiacum.



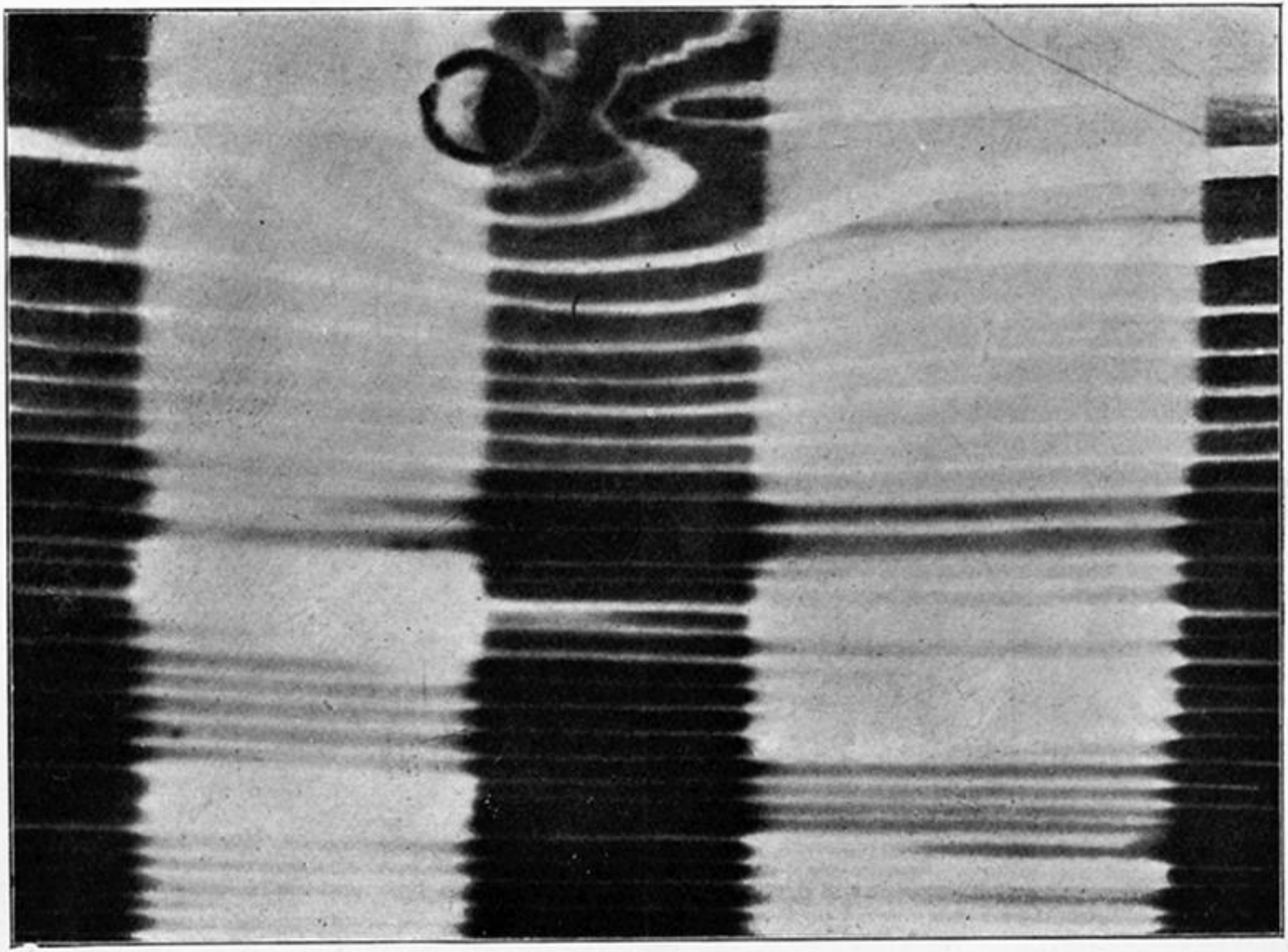
White. Red.

Fig. 37.—Deal.



Green. Blue.

Fig. 38.—Deal.



Black paper. Tin foil.

Fig. 39.—Deal.

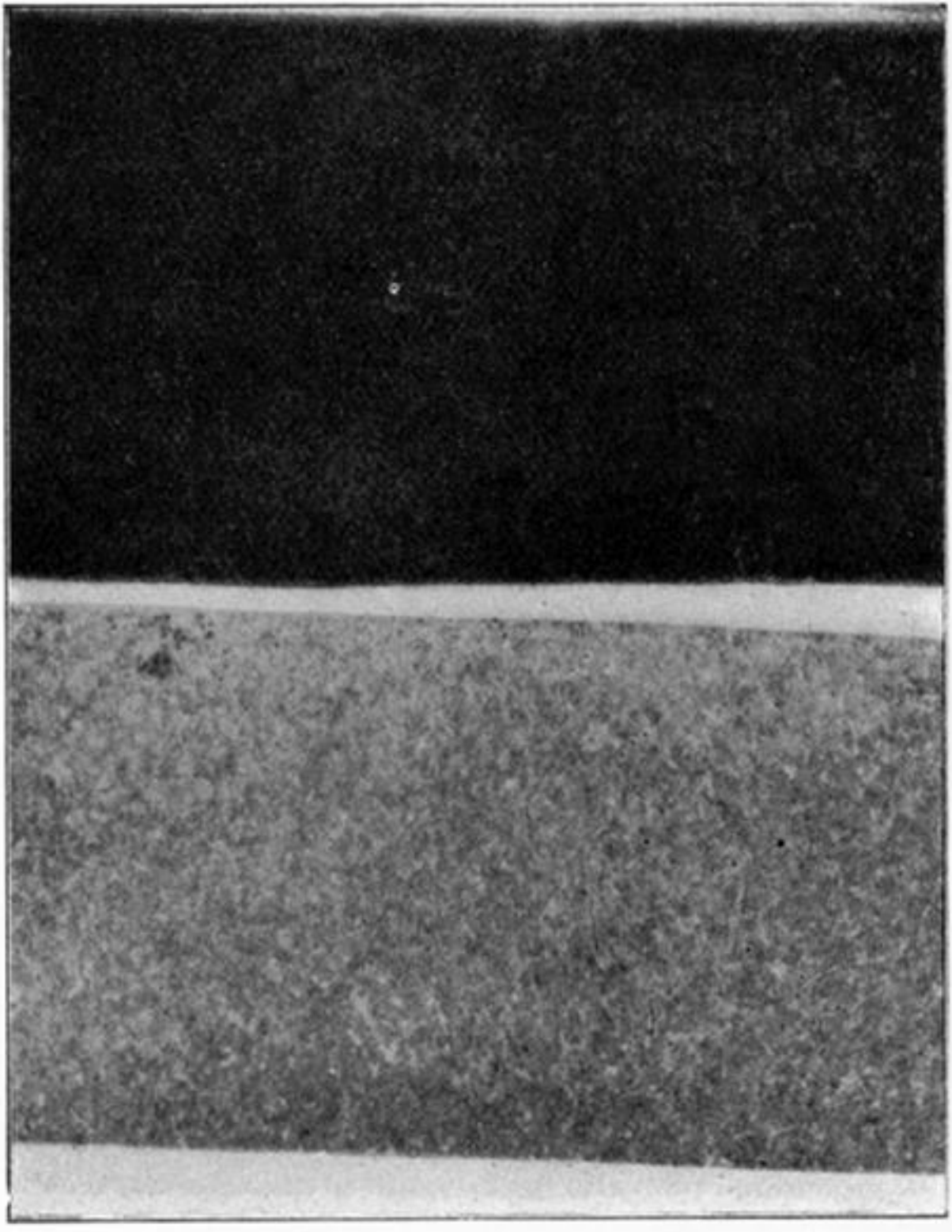


Fig. 40.