PLATE XXI.

FIG. *A*.

(Sp. No. 32136. Without analyzer, x 90.)

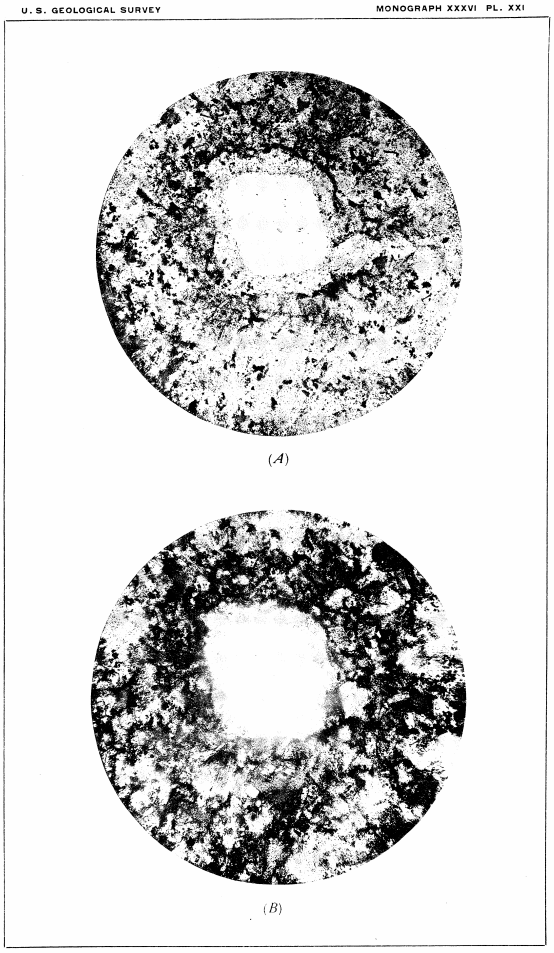
Rhyolite-porphyry with aureoled phenocrysts. The finest-grained type of micropoikilitic texture is here represented. The groundmass of this porphyry consists of rounded areas of material ("quartz épongeuse"), corresponding to that forming the zones around the phenocrysts. Between these areas there may be found in places small feldspars. These photomicrographs, represented in figs. *A* and *B*, Pl. XX, and in this figure, show every gradation in the micropoikilitic texture, from that which is with difficulty distinguishable as such to the coarser-grained unmistakable variety. (Described, p. 85.)

FIG. *B*.

(Sp. No. 32136. With analyzer, x 90.)

Rhyolite-porphyry with aureoled phenocrysts. This is the same section as is represented above when viewed between crossed nichols. The texture of the groundmass is brought out somewhat better. The feldspars especially become more noticeable. For instance, one Carlsbad twin may be seen at the lower right-hand corner of the phenocryst partly indenting the aureole. Other feldspars may be noticed through the groundmass. In other portions of the section from which this photomicrograph is taken the quartz phenocrysts have no aureoles and the groundmass possesses an imperfect microgram tie texture. This figure brings out clearly the gradation toward that texture. (Described, p. 85.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PL. XXI



MICROPOIKILITIC RHYOLITE-PORPHYRY.

PLATE XXII.

FIG. *A*.

(Sp. No. 32732. Without analyzer, x 18.)

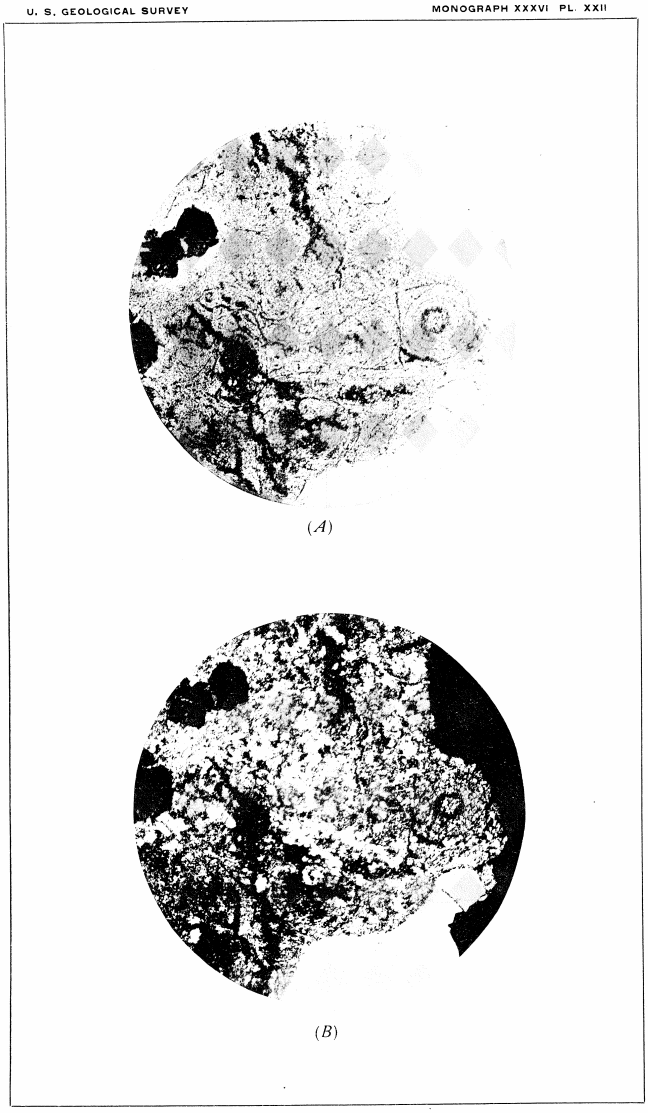
Aporhyolite showing beautifully developed perlitic parting. The perlitic cracks are brought out clearly by the chlorite which has accumulated in them. (Described, p. 87.)

FIG, *B*.

(Sp. No. 32732. With analyzer, x 18.)

Aporhyolite showing perlitic parting, when viewed between crossed nicols. The groundmass resolves itself into a fine-grained mosaic of quartz and feldspar, showing microgram tic characters. The perlitic parting is thereby almost completely obscured. (Described, p. 87.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PL. XXII



(*A*) PERLITIC PARTING IN APORHYOLITE.
(*B*) PERLITIC PARTING IN APORHYOLITE BETWEEN CROSSED NICOLS.

PLATE XXIII.

FIG. *A*.

(Sp. No. 22953. Without analyzer, x 38.)

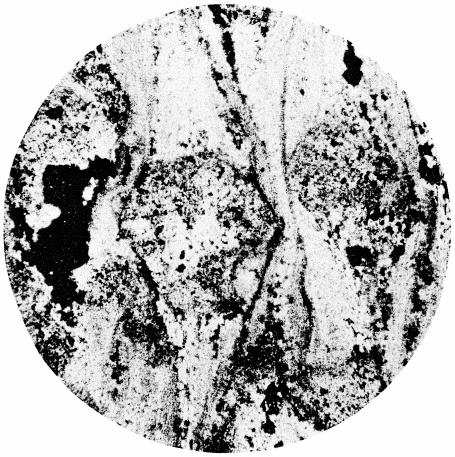
Rhyolite-porphyry rendered schistose by crushing. Granulation of the feldspars and the resulting production of schistose aggregates of secondary quartz, feldspar, and sericite is here shown. The two large areas shown near the center of the figure were formerly occupied entirely .by feldspar. The greater portion of this has now become altered, mere remnants of the original remaining. This secondary aggregate has especially well-developed parallelism. (Described, p. 93.)

FIG. *B*.

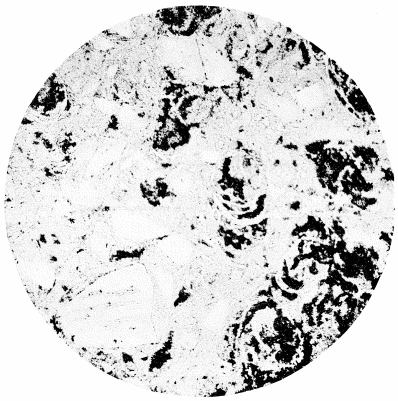
(Sp. No. 32726. With analyzer, x 18.)

Photomicrograph of aporhyolite-porphyry breccia showing the fractured character of the quartz and feldspar. Certain portions of the section show the perlitic parting, with accumulations in these areas of chlorite. (Described, p. 93.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PL. XXIII



(*A*)



(*B*)

(*A*) SCHISTOSE RHYOLITE PORPHYRY.
(*B*) APORHYOLITE BRECCIA.

PLATE XXIV.

FIG. *A*.

(Sp. No. 22968. Without analyzer, x 18.)

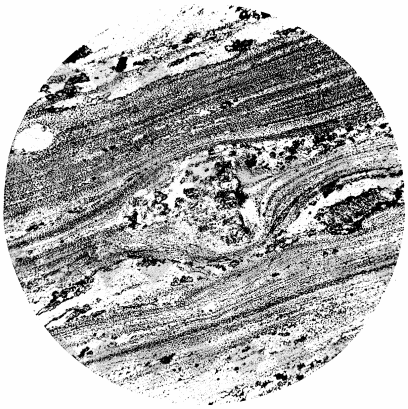
Schistose rhyolite-porphyry with well-developed flowage structure. A feldspar phenocryst which has been more or less rounded by crushing, occupies the center of the figure. There is also shown in the upper left-hand quadrant of the figure a small crushed quartz phenocryst. (Described, p. 93.)

FIG. *B*.

(Sp. No. 22968. With analyzer, x 18.)

When the section represented in fig. *A* is viewed between crossed nicols, the crushed character of the feldspar phenocrysts is thereby well brought out. The minutely granular character of the groundmass is also well shown. (Described, p. 93.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PL. XXIV



(*A*)

(*B*)

(*A*) SCHISTOSE RHYOLITE PORPHYRY.
(*B*) SCHISTOSE RHYOLITE PORPHYRY BETWEEN CROSSED NICOLS.

PLATE XXV.

FIG. *A*.

(Sp. No. 32116.)

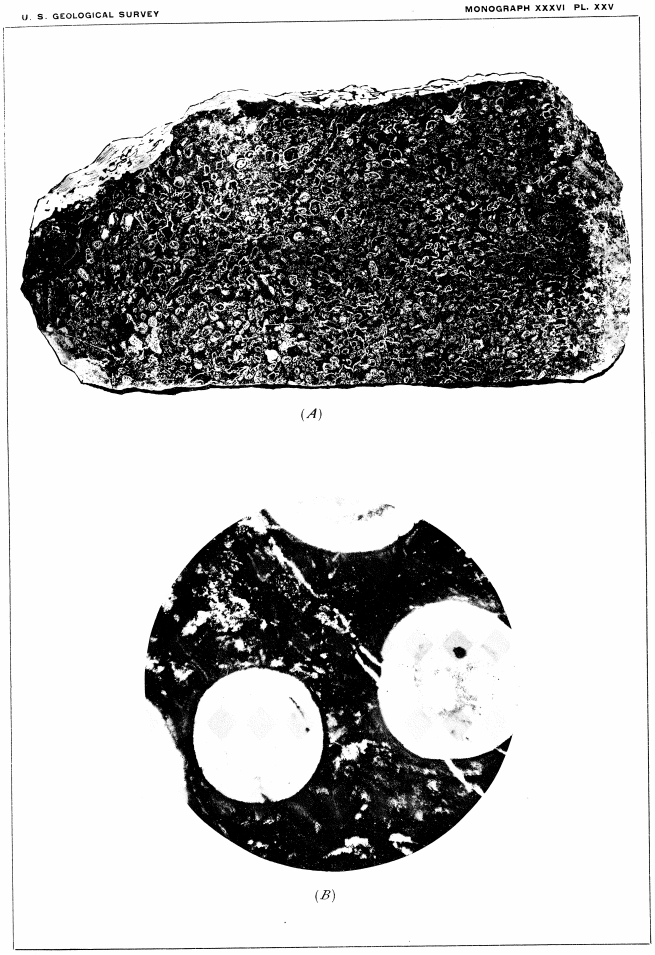
Photograph, with very slight enlargement, of the polished surface of a very fine grained hut very amygdaloidal basalt. The amygdules are of irregular shape, but in general with a rounded or tubular character. The original cavities have been filled with chlorite and quartz. The chloritic amygdules are the most common. A few of the white quartz amygdules may be seen on the left-hand side of the figure. It should be noted that owing to the softness of the chlorite some of the amygdules have become impregnated with the powder used in polishing the specimen. This could not be removed, and in many cases may be seen filling as well as outlining the chlorite amygdules. (Described, p. 95.)

FIG. *B*.

(Sp. No. 32903. Without analyzer, x 18.)

Photomicrograph of a section of the fine grained, possibly vitreous, amygdaloidal basalt represented in fig. A of Pl. XXVII. The amygdules consist of chlorite, quartz, and feldspar. The greatest interest centers in the groundmass. This consists of a fine felt of chlorite with minute epidote grains. Traversing this, one secs in places delicate flowage lines. This is believed to represent a once vitreous basalt. (Described, p. 102.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PL. XXV



(*A*) AMYGDALOIDAL BASALT.
(*B*) AMYGDALOIDAL BASALT.

PLATE XXVI.

FIG. *A*.

(Sp. No. 32541. Without analyzer, x 18.)

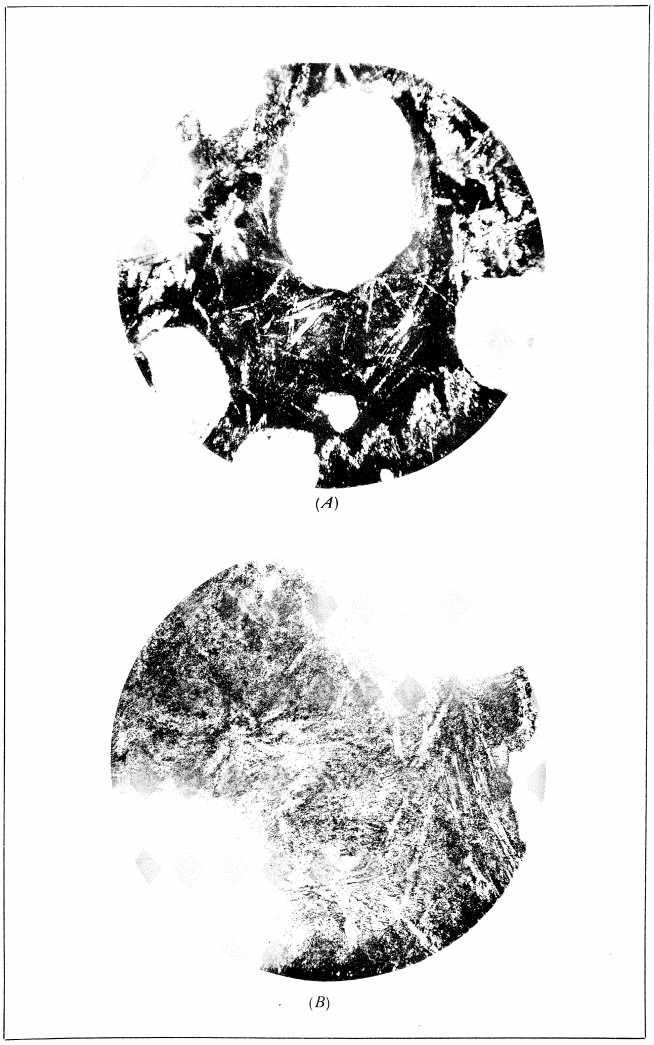
Fine-grained amygdaloidal basalt. The only recognizable original constituent in the ground-mass is the feldspar in microlites which most commonly fringe out at the ends. They are not infrequently arranged in sheaf-like aggregates. These are best seen with high-power objectives. The major portion of the groundmass consists of a fine felt of chlorite, with minute grains of epidote. It is considered to have resulted from the alteration of a vitreous base. The amygdules consist of calcite. (Described, p. 99.)

FIG. *B*.

(Sp. No. 32541. Without analyzer, x 35.)

Portion of section from which fig. *A* was taken viewed with a high power. In this the sheaf-like aggregates of feldspar can be seen. (Described, p. 99.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PART I PL. XXVI



(*A*) AMYGDALOIDAL BASALT.
(*B*) SHEAF-LIKE FELDSPAR AGGREGATES.

PLATE XXVII.

FIG. *A*.

(Sp. No. 32903. Natural size.)

Reproduction of a very fine grained, possibly vitreous, amydaloidal basalt. The amygdaloidal cavities show very little contortion. The amygdules consist of white quartz, pink feldspar, and dark-green chlorite. Compare this figure with photomicrograph fig. *B*, Pl. XXV. (Described, p. 102.)

FIG. *B*.

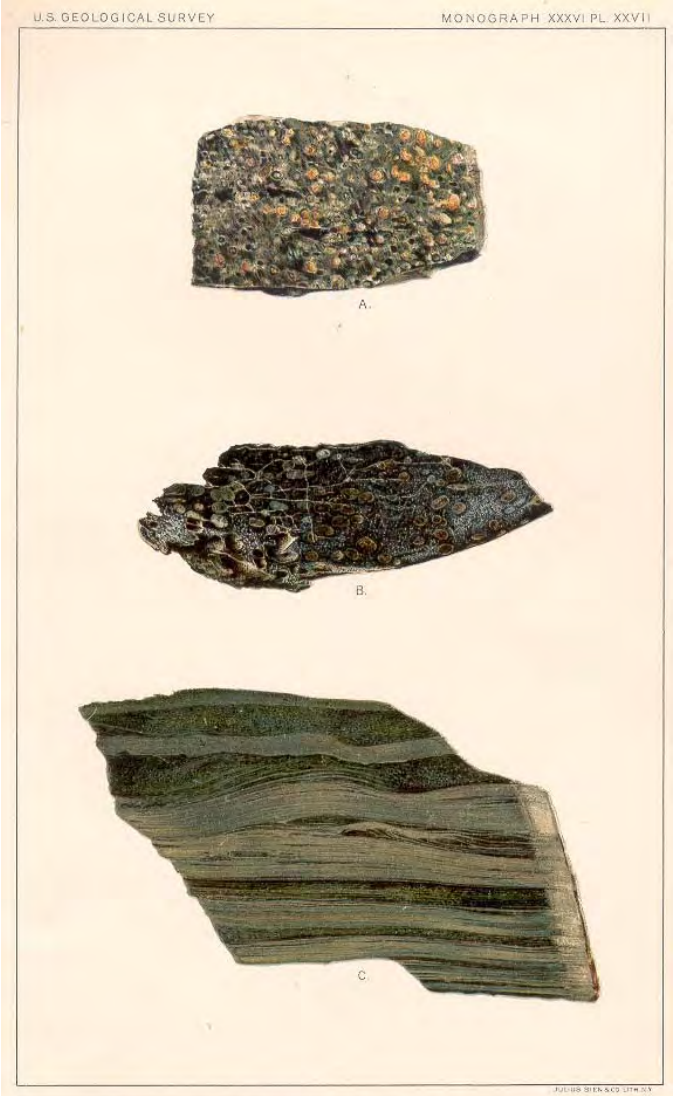
(Sp. No. 32910. Natural size.)

Colored reproduction of the pseudoamygdaloidal phase of the siderite-quartz matrix which occurs in places between the ellipsoids. The original matrix was first replaced in the zone of weathering by siderite. Deep burial of the rock resulted in the mashing of the siderite and the subsequent replacement of a great portion of it by silica, leaving a few oval areas unsilicified. Brought into the zone of weathering again by erosion, these siderite areas "are removed on the weathered surface giving a scoriaceous appearance to it, as may be seen on the figure. (Described, p. 135.)

FIG. *C*.

(Sp. No. 33507. Natural size.)

Fine-grained volcanic clastic. The water-deposited character of this specimen is unquestionable. It can be traced in the field down into a coarse bowlder conglomerate. The fragmental nature can only be seen under the microscope in the coarser-grained portions. The finer-grained material represents apparently the excessively fine-grained mud derived from the trituration of the coarser fragments. The eolian-deposited sands and dust have essentially the same appearance as the specimen here represented. The microscope, however, shows the very angular character of the fragments in the coarser-grained portions. The very fine eolian-deposited dust can not be distinguished from that which has been deposited through water. It is sometimes very difficult to determine the nature of rocks of this fine-grained character. (Described, p. 144.)



A. AMYGDALOIDAL BASALT.
B. PSEUDO-AMYGDALOIDAL MATRIX OF ELLIPSOIDAL BASALT
C. VOLCANIC CLASTIC.

PLATE XXVIII.

FIG. *A*.

(Sp. No. 32909c. Without analyzer, x 35.)

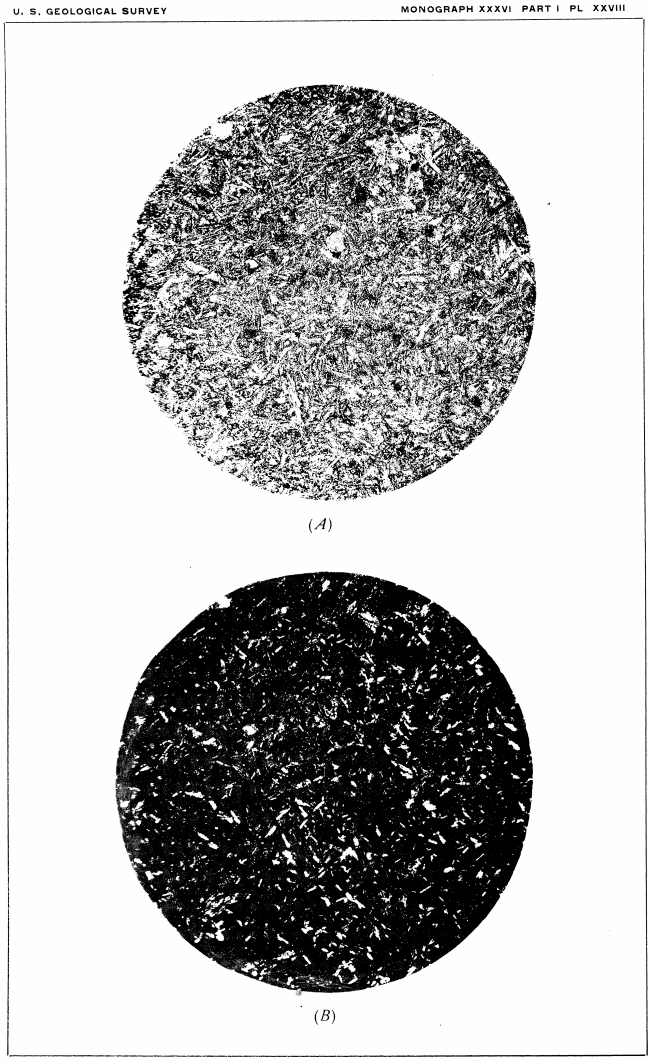
Photomicrograph of section of fine-grained basalt with well-developed igneous texture. The feldspar outlines are now occupied chiefly by flakes of muscovite and grains of zoisite. (Described. p. 127.)

FIG. *B*.

(Sp. No. 32909c. With analyzer, x 35.)

Photomicrograph of the same section when viewed between crossed nicols, showing the obliteration of the igneous texture. The lath-shaped mineral is muscovite. (Described, p. 127.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PART I PL XXVIII



(A) BASALT SHOWING CHARACTERISTIC TEXTURE.
(B) BASALT SHOWING OBLITERATION OF TEXTURE BETWEEN CROSSED NICOLS.

PLATE XXIX.

FIG. *A*.

(Sp. No. 32582. Without analyzer, x 38.)

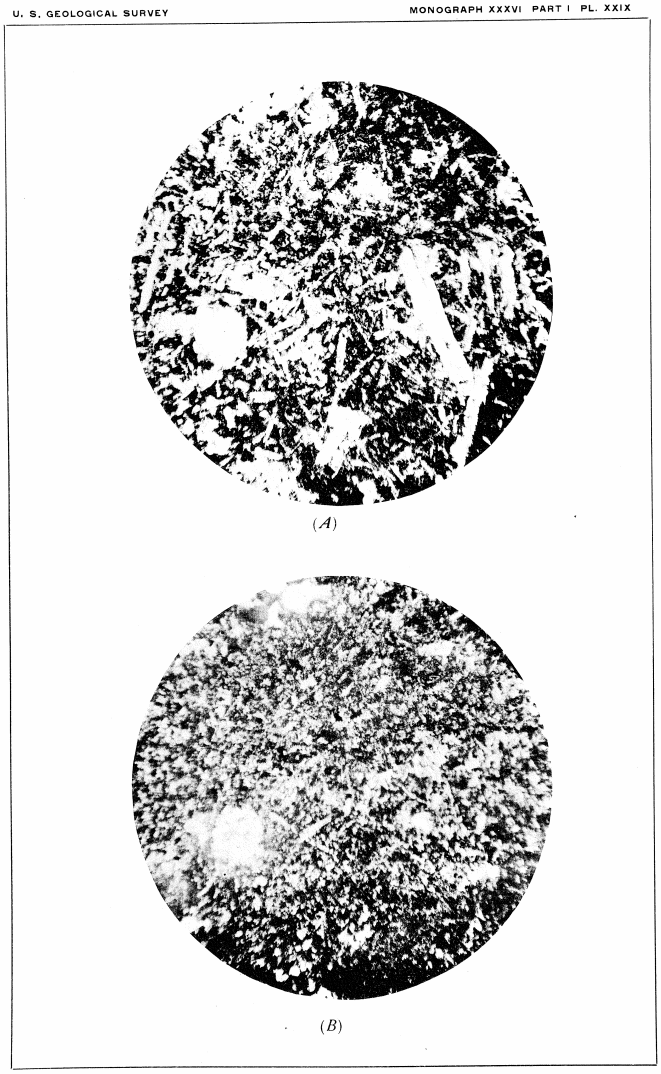
Photomicrograph showing the normal igneous texture of a basalt. The area formerly occupied by the feldspar substance is now occupied by a granular aggregate of various minerals. (Described, p. 127.)

FIG. *B*.

(Sp. No. 32582. With analyzer, x 38.)

The same section of basalt when viewed between crossed nicols. The only indication of an igneous texture is shown by the amygdules present. The igneous texture of the rock is completely concealed as soon as the aggregates occupying the feldspar areas break up into their constituent grains. (Described, p. 127.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PART I PL. XXIX



(A) BASALT SHOWING CHARACTERISTIC TEXTURE.
(B) BASALT SHOWING OBLITERATION OF TEXTURE BETWEEN CROSSED NICOLS.

PLATE XXX.

FIG. *A*.

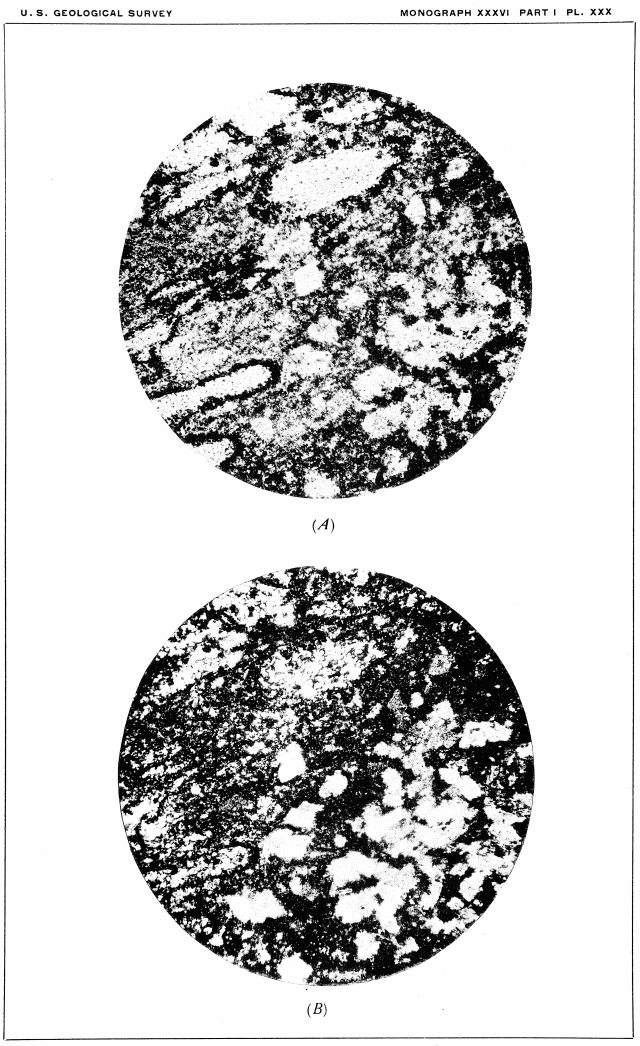
(Sp. No. 33313. Without analyzer, x 38.)

Photomicrograph of a section of basalt from a pyroclastic showing in ordinary light a distinctly amygdaloidal character. The alteration of the basalt has, however, reached such a stage that the groundmass materials have for the most part been completely altered, with the production of porphyritic rhombohedra of calcite and plates of muscovite, which may be seen in abundance in the lower right-hand side of the figure. (Described, pp. 129,145.)

FIG. *B*.

(Sp. No. 33313. With analyzer, x 38.)

Photomicrograph of the same section of basalt, showing in ordinary light a distinctly amygdaloidal character when viewed between crossed nicols. The igneous texture is almost completely obliterated by secondary products. The secondary calcite and muscovite stand out very sharply from the very fine grained groundmass. (Described, p. 129.)



(*A*) BASALT FRAGMENT IN A PYROCLASTIC SHOWING AMYGDALOIDAL TEXTURE.
(*B*) BASALT FRAGMENT SHOWING OBLITERATION OF THIS TEXTURE BETWEEN CROSSED NICOLS.

PLATE XXXI.

FIG. *A*.

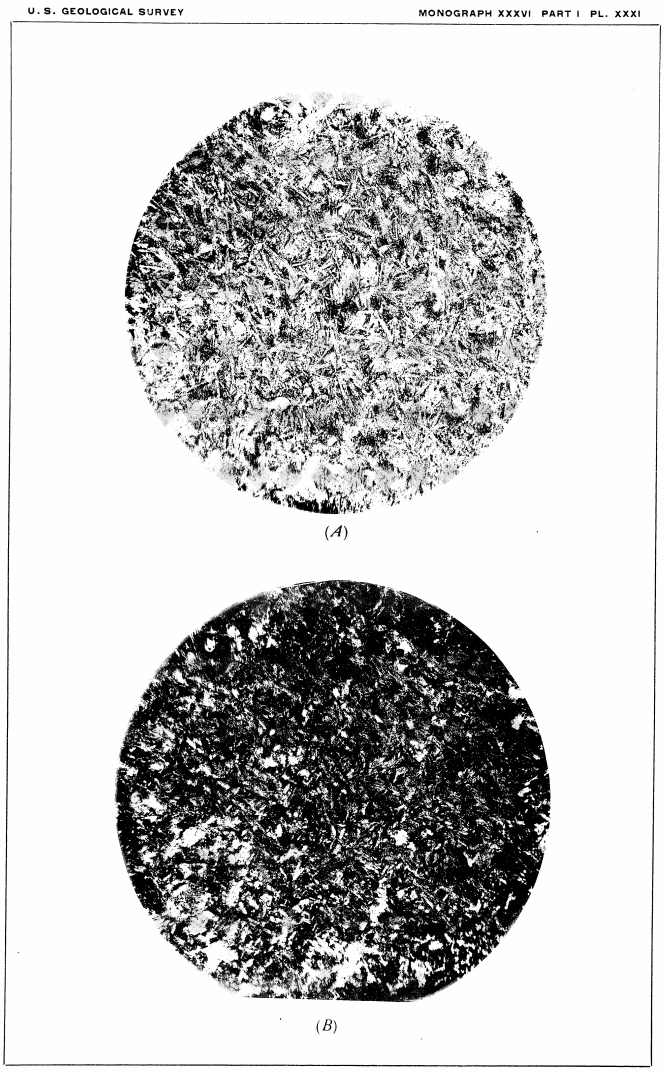
(Sp. No. 32909c. Without analyzer, x 35.)

Photomicrograph illustrating the igneous texture of the basalt from the center of an ellipsoid. This has already undergone advanced alteration, and the feldspars have been replaced by a granular aggregate of calcite, sericite, chlorite, epidote, quartz, and albite. With advancing alteration the igneous texture is destroyed, and infiltrated calcite becomes more prominent. The photomicrograph shows in the lower left-hand corner a portion of the section in which a large quantity of calcite is present. (Described, p. 131.)

FIG. *B*.

(Sp. No. 32909c. With analyzer, x 35.)

Photomicrograph illustrating the igneous texture of the basalt from the center of an ellipsoid, when viewed between crossed nicols. The igneous texture is almost completely destroyed by the breaking up of the secondary aggregates. (Described, p. 131.)



(*A*) BASALT.
(*B*) BASALT SEEN BETWEEN CROSSED NICOLS.

PLATE XXXII.

FIG. *A*.

(Sp. No. 23645. Without analyzer, x 35.)

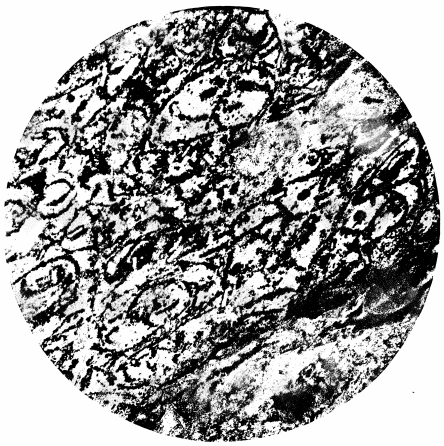
Perlitic parting in a fragment from a basalt tuff. The perlitic cracks are marked by accumulations of epidote grains. The remainder of the fragment consists of an exceedingly fine chlorite felt, with here and there a small feldspar microlite embedded in it. This was probably a fragment of basalt glass. (Described, p. 138.)

FIG. *B*.

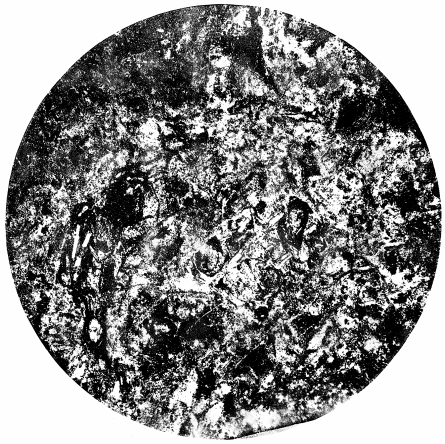
(Sp. No. 23646. Without analyzer, x 35.)

Photomicrograph of a section of basalt tuff. The illustration shows the sickle-shaped bodies which are characteristic for the fine eolian-deposited volcanic ejectamenta. (Described, p. 142.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PART I PL. XXXII



(*A*)



(*B*)

(*A*) PERLITIC PARTING IN BASALT (GLASS?).
(*B*) TUFF.

PLATE XXXIII.

FIG. *A*.

(Sp. No. 32713. Without analyzer, x 35.)

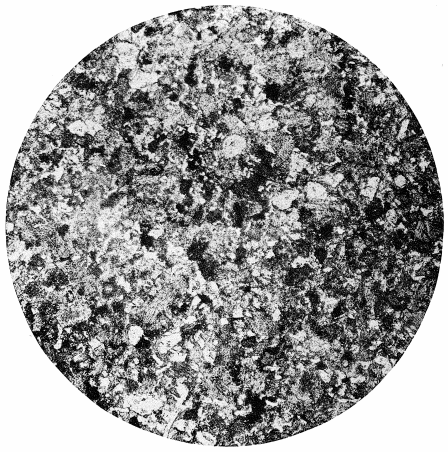
Water-deposited sand. This volcanic sand consists chiefly of feldspar and hornblende. The rounded nature of the feldspar grains is readily seen. Under the microscope some of these show secondary enlargements. The hornblende is in irregular areas, and is presumed to be secondary after fragments of augite. (Described, p. 144.)

FIG. *B*.

(Sp. No. 32711. Without analyzer, x 17.)

Water-deposited volcanic sediment. This illustration shows very clearly the gradation from the medium-grained volcanic sand in the lower portion of the section, through the finer-grained material, to the very fine grained dust. The very fine grained material was deposited following the contours of a large pebble, which is shown in the upper portion of the figure. The fragments of sand consist chiefly of basalt. There are some which were probably feldspar. (Described, p. 144.)

U. S. GEOLOGICAL SURVEY MONOGRAPH XXXVI PART I PL. XXXIII



(*A*)

(*B*)

(*A*) WATER DEPOSITED SAND.
(*B*) GRADATION IN WATER DEPOSITED CLASTIC.