Pamphlet No. 14

STATE OF IDAHO

Chas. C. Moore, Governor

BUREAU OF MINES AND GEOLOGY

Francis A. Thomson, Secretary

MICA DEPOSITS OF LATAH COUNTY, IDAHO

By

Alfred L. Anderson

Edited by

Arthur M. Piper

University of Idaho

Moscow, Idaho

Archive Version--February 1991
by the Idaho Geological Survey

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MICA DEPOSITS OF LATAH COUNTY, IDAHO

By Alfred L. Anderson.*

PURPOSE AND SCOPE OF THE INVESTIGATION

Deposits of mica of commercial value have been known to exist in Latah County for many years and have been worked intermittently since 1888. The last few years, however, the deposits have lain idle. The total production of the district has had an estimated value of $100,000. In response to a revival of interest in these mica deposits a study of conditions was carried on by the Idaho Bureau of Mines and Geology and the report at hand prepared.

The mica deposits were visited by the writer during the second week in November, 1923, and a topographic sketch map of the district (Pl. 1) was prepared duing the same period by Mr. H. L. Simon. At several of the mines and prospects the underground workings were caved and inaccessible. In the preparation of this report, the writer has supplemented the information gathered in the field by data gleaned from publication by Douglas B. Sterrett (10:pp. 377-383; 11:pp. 86-93)* of the United States Geological Survey and by Robert N. Bell (1,2,3) and Stewart Campbell (5,6,7), State Mine Inspectors for Idaho.

GENERAL FEATURES OF MICA AND OF MICA DEPOSITS

In the following paragraphs are very briefly discussed those general characteristics of mica and of mica deposits which might be of assistance to the prospector or operator.

Geology and mineralogy

Of the several kinds of mica only the white mica, muscovite, is found within the United States in sizes of commercial value and only in pegmatites, rocks whose component mineral are the same as those of granite. They differ from

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* In parenthetical notations of this form the number preceding the colon refers to the corresponding entry in the bibliography at the close of this pamphlet; the numbers following the colon denote the pages of the specific citation.

granite only in coarseness of texture, in mode of occurrence and in relative abundance of the component minerals. Pegmatites are regarded as offshoots from a granitic batholith, and if granitic rocks do not crop out in the same region they probably underlie the surface at no great depth. Only a minor portion of the known pegmatites contain muscovite in commercially profitable quantity and that portion is restricted to areas of ancient schists and gneisses, rocks in which metamorphism has produced a tendency toward slaty parting. The abscence of these metamorphic rocks in a given district indicates that all commercial deposits of mica have probably been removed by erosion; their presence indicates a zone favorable to the occurrence of mica-bearing pegmatites, but does not assure that they exist.

Pegmatite occurs in irregular masses of many shapes and sizes. It may resemble a vein or dike and persist for a great distance, it may be lens-shaped, or it may form a chimney. In thickness these masses range from a fraction of an inch to several hundred feet, and often pinch and swell within relatively wide limits. They may be parallel to the foliation or bedding planes of the schists and with these rocks be folded or otherwise deformed; on the other hand they may strike across bedding and foliation planes alike. The contact between pegmatite and wall rock may be sharply or poorly defined, and masses of the wall rocks may be wholly enclosed by pegmatite. Most pegmatites are not commercially profitable throughout and only local segregations of mica may be worked. A few veins have for short distances been composed of more than half mica.

The principal minerals of a pegmatite are feldspar and quartz, accompanied by smaller amounts of muscovite and in some deposits by other accessory minerals. The feldspars range in size from a small fraction of an inch to crystals several feet in length and are usually the most abundant mineral. Quartz occurs as irregular masses and seams in the interstices between feldspar crystals and varies in quantity between subordination and deminancy. The white mica, muscovite, occupies no definite position within the pegmatite. In this respect each deposit is peculiar unto itself. In a pegmatite with a typical granitic texture the mica may be rather evenly distributed through the rock mass, but more commonly it occurs at irregular intervals in large clusters which are loosely united by narrow seams. In many deposits it is segregated along one of the walls of the pegmatite and may be partly grown into the wall rock; segregations about "horses" of country rock engulfed in the pegmatite are numerous. Quartz seams in the pegmatite may be faced by zones of commercially profitable mica. Also, mica may be surrounded by either quartz or feldspar and in some dikes in part by both.

Physical properties, imperfections, and grades

Those qualities of muscovite which make it commercially valuable are the ability to be split into thin flat sheets of even thickness, transparency, toughness, flexibility, resistance to sudden changes of temperature, high insulating value, and resistance to decomposition. Any lack of these desireable qualities is reflected by the market value.

The imperfections of mica are several. Disturbed crystallization causes difficulty in splitting as well as tearing of the sheets and is one of the most common defects. Wavy, buckled, or corrugated sheets result when the mica is subjected to pressure after crystallization. Impurities within the mica, especially those which contain iron, may cause great variation in the insulating strength, and produce an undesireable spotted or opaque product. For many purposes mica is useless if it is not transparent in thin sheets. In some crystals splitting results in sheets which are thicker at one edge than another; mica of this sort is not suited to many uses. Blocks of mica are of irregualr outline, generally mashed at the outer edges, and must be trimmed to rectangular flawless sheets to have the highest commercial value. A high percentage of scrap which must be removed by trimming is a rather serious imperfection.

The primary grading of mica is into "sheet", "splittings", and "scrap". Sheet mica includes that which will trim into flawless rectangular sheets 1 1/2 X 2 inches in size or greater and is subdivided into seven commercial sizes. The larger sheets command proportionately higher prices. Splittings are not less than one square inch in area, not more than 0.001 inches in thickness, but may be of irregular shape. Scrap mica includes material too small to be trimmed into sheets and the irregular waste from trimming. A further classification is made on the basis of color and transparency.

Uses.

Sheet mica finds its greatest use as an insulator in many types of electrical devices and in furnace peep holes, military lanterns, diver's helmets, and windows which must resist high temperature or severe shock and strain. Mica splittings are built up, with shellac as a cement, into irregular shapes for a wide variety of uses. Scrap mica is powdered and finds a multitude of uses in the manufacture of roofing materials, paints, ornamental tile and concrete, lubricants, rubber goods, ceramic products, and many other articles.

Market.

Mica as it is recovered by mining occurs in irregular masses or in rough hexagonal prisms and is termed "run of mine" "book Mica", or "block mica". It may be marketed as run of mine

or may be cleaned, sorted, and trimmed on the ground. The rough blocks of mica are "cobbed" or separated from adhering masses of quartz feldspar, or dirt by rapping with hammers, and roughly sorted according to quality. The cobbed block is parted, with wedges and splitting knives, into sheets 1/8 inch or less in thickness. These thick sheets are then trimmed to the largest possible rectangular commercial size, and graded by size and quality. The output of any mine, if of suitable quality, commands a higher price as sheet mica and scrap than as run of mine; the gain must be charged, however, with the costs of preparation and of more careful handling during shipment. The consumers are the large cities of the east and middle west where electrical appliances and other products of which mica is a component are manufactured.

GEOGRAPHY

Location and access

The mica deposits of Latah County lie about 25 miles northeast of the county seat, Moscow, and from three to six miles north of the village of Avon. The Washington, Idaho, and Montana Railway, operated by the Potlatch Lumber Company, plies between Palouse, Washington, and Bovill, Idaho and serves Avon through the station named Vassar. At Palouse this road connects with the Spokane and Eastern Railroad (Inland Empire branch) and with the Northern Pacific Railway (Spokane-Lewiston branch); at Bovill it connects with the Elk River branch of the Chicago, Milwaukee, and St. Paul Railway. Wagon roads, in varying stages of repair, extend from Avon to the several mines and prospects.

Topography

Latah County covers parts of two distinct topographic provinces; one the western flank of the central Idaho mountain mass, the other the eastern border of the rolling Columbia Plateau. The plateau, locally known as the "Palouse country" has an elevation of 2,500 to 2,700 feet, and is embayed with irregular outline into the valleys and depressions of the older mountains. Here and there it is traversed by the deep precipitous canyons of the master streams. The mountainous province includes the flanking ridges and spurs from the Clearwater and Coeur d'Alene mountains. The Thatuna Range, the dominant topographic feature, extends westward nearly across the center of the county and reaches an elevation of 5,500 feet in Moscow Mountain. Spur ridges and isolated summits project above the plateau much as peninsulas and islands break the surface of the sea. The mountains are rounded in outline and nowhere exhibit ruggedness. The county is drained into the Pacific Ocean by the headwater branches of the Palouse and Potlatch rivers, major

tributaries of the Columbia-Snake-Clearwater system.

GENERAL GEOLOGY

Each of the two topographic provinces within Latah County coincides with the outcrop area of a distinct group of geologic formations. The mountainous province is carved from sediments of Algonkian age, intruded by granitic rocks during late Cretaceous (?) time, and metamorphosed to mica schists and quartzites. These older rocks crop out as scattered remnants of an ancient terrane that was almost completely buried during Miocene (?) time by the flows of basaltic lava which underlie the Columbia Plateau. The commercial deposits of mica near Avon occur in pegmatite dikes intruded into the schists that form the greater part of Mica Mountain, a spur ridge of the Thatuna Range. A small stock of granite or quartz monzonite crops out about half a mile east of the deposits and large bodies of it are exposed a few miles to the east, south, and west.

Metamorphic rocks.

Description.- The ancient schists of Latah County are the metamorphosed equivalent of a slate or argillite. Schistose rocks in the Hoodoo district, some five or six miles northeast of the mica deposits are thought by Livingston (8:p. 93) to be equivalent to the Prichard and Burke formations of the Coeur d' Alene district as described by Ransome and Calkins (9:pp. 29-34). It is possible that the schists of Mica Mountain should be similarly correlated, and that their intense metamorphism is due to closer proximity to igneous masses, especially pegmatites.

Most of the metamorphic rocks are characterized by schistose cleavage along surface some of which are nearly plane but more of which are wavy or knotted. Near bodies of pegmatite the ready cleavage and marked foliation of the schists is lacking and the rocks have a gneissoid structure. In the typical schist the component minerals are muscovite and biotite micas and quartz, with small crystals of garnet and tourmaline as local accessories. Miscoveite and biotite are usually both present and intergrown with one another irregular bands which altermate with others of quartz. In some places quartz is the dominant mineral and the rock is a quartz schist. The color of the rock varies between silvery white, when muscovite is the dominant mineral, and dark gray or black, when biotite is the more plentiful.

A short distance below the Munro mill (Pl. 1) an unusual texture is present in the rock, which is a quartz schist. The quartz occurs in irregular lenses and layers, generally an inch thick, made up of minute vitreous grains separated by scattered flakes of the black biotite mica. Muscovite is not present in individual flakes, but rather as books or crystals usually half an inch across and an eight of an inch thick. The rock lacks the precise foliation of the typical schists and on faces oblique to the irregular cleavage resembles a porphyry. Its texture is more gneissoid than schistose.

Structure.- The metamorphosed sediments of Latah County have been deformed by open folds and in the region of the mica deposits probably form the steeply dipping western limb of an anticline of great width. The dip of bedding and of schistosity is approximately the same and varies between 20° S. 80° W. at the eastern flank of the ridge (Pl. II) and 70° - 75° N. 55° W. at the summit. Some local deflections of bedding are found about bodies of pegmatite.

Intrusive rocks.

The intrusives of Latah County include several phases of the batholithic rocks which constitute the greater part of the mountains of central Idaho. Quartz monzonite and granodiorite make up the Thatuna Range and are the dominant phase. Granite-aplite occurs below the munro mill as apophyses or fingers forced out into the sediments from the main body of the intrusive. The pegmatite dikes which carry the mica deposits comprise the third phase.

Quartz monzonite and granodiorite.- The quartz monzonite is a light gray rock of fine to medium grain in which quartz is usually the most abundant mineral. Orthoclase and plagioclase feldspars are usually present in about equal quantities. Biotite the black mica, is the chief ferromagnesian mineral, and is usually accompanied by muscovite. In some specimens plagioclase is more abundant than orthoclase and hornblende occurs in the place of biotite; such a rock is a granodiorite. The plagioclase feldspar is usually andesine, although labradorite is present in the more basic rocks.

Granite-aplite.- The granite-aplite below Munro's mill forms several irregular dikes each no greater than several dozen feet across. The rock is fine-grained, holocrystalline, and white or light gray in color. Orthoclase is the most abundant mineral and quartz is somewhat less plentiful. Oligoclase feldspar, muscovite, and biotite are subordinate minerals. In some specimens small crystals of garnet are quite numerous. The texture is much like that of a normal granite. The plagioclase feldspar, ferromagnesian minerals, and garnet are euhedral; orthoclase crystals are subhedral, and those of quartz anhedral.

Pegmatite.- Pegmatite dikes are found both in the quartz monzonite and in the schists of the Avon district, but only those enclosed by schists contain commercial deposits of mica. A description of their mode of occurrence would be only a repetition of the material already presented under the caption General features of Mica and of Mica deposits. They are, however, extraordinary in the size and relative abundance of some of their component minerals, although no unusual types are exhibited. Feldspar, quartz, and mica are the usual dominant minerals; accessory minerals include only tourmaline, garnet, and beryl. The unweathered feldspar is milky white and is found in crystals

from microscopic size to those three of four inches in length; usually it forms the greater part of the rock. When weathered it becomes chalky. The feldspar would have an economic value if a pottery industry should be established in the county. Both muscovite and biotite are present, the biotite not in commercially profitable amount; the occurrence of the muscovite is quite fully treated in the description of the several mines and properties. Tourmaline is abundant in only a few of the dikes; at the Luella mine (Pl. I) crystals with diameters between 6 and 12 inches are common and some have a diameter between 18 and 24 inches and a length of 3 or 4 feet. One crystal has a length of eight feet. Garnet of the variety alamandite occurs in pale reddish crystals whose size ranges between microscopic and a diameter of two or three inches. It is found only in some of the pegmatites, either scattered through the rock or segregated in irregular seams or bunches near either wall of the dike. The granet is always fractured and lacks transparency and, consequently, is without value as a gem; neither could it be profitably separated for use as an abrasive. Beryl is found in two of the pegmatites in the form of hexagonal prisms between one and three inches in diameter and as long as eight or ten inches. Crystals six inches in diameter are not uncommon. Its color is not uniform, and unblemished crystals suited for gems of high quality were not seen.

Three different textures are found in the pegmatites of the Avon district. The most common is the granitic, a texture like that of a granite magnified many times. The rocks of this texture yield most of the commercial mica. The graphic texture, in which quartz and feldspar are inter-fingered in the form of heiroglyphs, is also common; it carries little mica of commercial size. The least common texture is that in which quartz is segregated into bands or lenses surrounded by an intergrowth of feldspar and mica. Indeed, some dikes are even highly feldspathic along the foot wall and quartzonse at the hanging wall. This texture occurs in a number of dikes, a fact that will be brought out in the following discussion of mines and prospects.

MINES AND PROSPECTS

The mica deposits from which commercial production has been effected in the past lie from three to six miles north of Avon and mark a belt that trends northward for several miles through T. 41 N., R. 2 W. They lie between 3,400 and 4,700 feet above sea level, along the crest and western flank of Mica Mountain, a steep-sided ridge which extends southward from the Thatuna Range. The district is not rugged and the deposits may be reached by roads which, though steep, are serviceable when in a state of repair. The location of the principal deposits and the topography of the district is shown on the sketch map, Plate I.

Muscovite

The mica deposit which has been worked under the name of the Muscovite mine covers two adjoining properties owned by Mr. F. M. Peck of Chicago, and Mr. Alexander Munro of Moscow, Idaho. It was worked intermittently from 1888 to 1918, but has lain idle since 1918 during the litigation of conflicting rights. The property is located in sec. 22.

At the time of he writer's visit in November, 1923, the underground workings were caved and only the surface features could be studied. The mica-bearing pegmatite strikes N. 10° W. to N. 10° E., and dips 70° W. in conformity with the enclosing schists; as exposed in two open cuts about 40 feet wide. A central feldspathic core grades along either wall into a quartzose zone within which numerous books of muscovite between six and eight inches in diameter are scattered. Many books of muscovite more than 14 inches across lie on the dumps. Very little tourmaline and some beryl accompany the pegmatite. The feldspar of the pegmatite is highly decomposed and clay like. Tunnels are easily driven in this clayey ground, but heavy timbering is required to keep them open.

The property was visited in 1910 by D. B. Sterrett (10) and at that time the deposit was opened by two adit tunnels respectively 150 and 200 feet below the outcrop on the crest of the ridge, and by 300 feet of drifts northward from the 200-foot adit. A third adit, about 325 feet below the outcrop had been driven toward the dike but had not reached it. In the drifts and numerous stopes the pegmatite varied in width from four to six feet, although at the outcrop it swelled to a chimney 40 feet across. A great deal of development work was performed between 1910 and 1918 and several carloads of muscovite were mined and shipped. Records are not available, however, to show the precise quantities. Mr. Monro states that the productive zone has been opened to a depth of 200 feet and 500 feet along the strike, but that the deposit as a whole has hardly been touched.

Previous to 1910 the Muscovite had produced 800 tons of crude book mica which contained about five per cent high quality sheet in sizes up to 10 x 18 inches. The remainder was divided between insulating material and scrap. Several carloads have been shipped since 1910, and the mine was producing some of the best quality of mica when it was closed down. The book mica produced from the Muscovite has a light rum or honey color and splits into uniform slear sheets. The better crystals have yielded some of the highest grade material found in the United States, and few mines have yielded so abundantly from an equal amount of pegmatic material.

Bentz

The Bentz claim, the youngest in the district, was located in 1914 about half a mile southeast of the Muscovite on the crest of a spur from the main ridge. It was worked for

three years by the Washington Mica Company, an organization of which A. H. Bentz of Avon is president, and a small amount of mica of good quality was removed.

The mica-bearing pegmatite varies greatly in width and attains a maximum of 30 feet at the outcrop; its length is at least several hundred feet. It is roughly conformable with the muscovite-biotite schist into which it is intruded. The schists vary from silvery gray to black. Near the pegmatite they carry a great deal of tourmaline, but several hundred yards to the north they are knotty and garnetiferous. The schistosity strikes between N. 10° E. and N. 10° W. and dips westward between 75° and the vertical. The pegmatite is quartzose rather than feldspathic and is in places composed wholly of granular quartz. Muscovite usually accompanies the quartz, though small quantities are enclosed by feldspar. Tourmaline occurs in scattered crystals between one and three inches in length; it is the only one of the accessory minerals present.

The pegmatite has been explored by several open cuts and about 600 feet of underground workings, but the main adit was caved near the portal and the workings were not accessible to the writer. The material on the dump indicates that considerable muscovite of commercial quality has been removed, some of it in books that would yield trimmed sheets 6 by 8 inches in size. Thick books have a deep rum color, but split sheets are clear and of good quality. More waste vein matter must be handled than at the Muscovite mine.

Luella

The Luella mine is situated in sec. 21, about 1 1/2 miles southwest of the Muscovite property. It was originally worked for several years by the Western Mica Company, but has lain idle for several years.

The deposit is unusual in several features of geology. Several branching and intersecting pegmatite dikes of very irregular thickness strike southeasterly through the country rock, which is a dark muscovite-biotite schist at a distance from the intrusives but is a highly contorted quartzose rock nearby. The several pegmatites pinch and swell sharply and frequently in both strike and dip from a maximum width of 30 feet to only a few feet. The contorted quartzose schists are garnetiferous and carry more tourmaline than the wall rocks of any other deposit in the district. The pegmatites are also unusual in the many large barrel-shaped crystals of tourmaline which are scattered through the dikes or, more often, close to either wall. Crystals between one and three feet in diameter are common and one measures eight feet in length. The tourmaline is generally fractured and resembles broken coal. Numerous crystals of garnet, half an inch or less in diameter, are scattered through the dike, or

segregated close to the walls and intergrown with them. Feldspar is dominant over quartz and the two minerals are intergrown in granitic texture. Books of muscovite are scattered throughout the dikes but attain their largest size near the hanging wall where the pegmatite is generally the most quartzose. They are white or light rum colored, cut and split freely, and attain a maximum diameter of more than a foot although they are usually not larger than eight inches. The porportion of valuable mica to the total quanity of pegmatite is much less than at the Moscovite mine.

The Luella deposit has been opened by adit tunnels on two levels and stoped out between the two; an open cut on the outcrop has also been made. The upper tunnel trends S. 70° W. for an unknown distance and is caved 160 feet from the portal. A stope, which opens from the adit only 65 feet from the portal, has removed a roughly cylindrical chimney of pegmatite about 30 feet wide, together with several smaller dikes and stringers, to a height of 40 feet. Fifty feet below the upper level a second adit was driven westerly 500 feet. About 325 feet from the portal a stope was driven to the upper level and a chimney of pegmatite 30 x 10 feet in section was removed. Fifty feet farther from the portal a second stope was located; it was, however, inaccessible. Beyond this stope the tunnel continues for 125 feet in barren schist. The pegmatites display extreme irregularity on both tunnel levels and may be expected to continue in the same fashion below the present workings.

Maybe mine and adjacent prospects

The Maybe mine, also known as the Silver White and formerly as the Last Chance, is also owned by Mr. Munro. The property lies on the west slope of Mica Mountain and about three quarters of a mile cast of the Luella. It first was worked in 1888.

At least three pegmatite dikes between 5 and 15 feet wide strike N. 5° - 70° E. through the muscovite-biotite schists and dip between 30° and the vertical. The cleavage planes of the schists strike N. 55° W. Several surface pits and tunnels, all now caved, have explored the dikes and revealed a small quantity of commercial mica. The mineralogic composition of the several pegmatites varies somewhat; feldspar is the most abundant mineral in some dikes and quarts in others. Muscovite occurs as small books in seams of the pegmatite, the larger sizes being found in the more quartzose portions. The mica is clear and light colored, and splits well into sheets of good quality. Most of the books, however, are too small to have commercial value and many contain inclusions of small garnet and tourmaline crystals. Tourmaline is abundant and is scattered throughout both quartz and feldspar; crystals a foot long and eight inches in diameter may be seen. Crystals of alamandite (garnet), half an inch in diameter, are numerous; they are scattered through the pegmatites and segregated in the mica-bearing seams of the quartzose footwall zone.

Several prospects lie southeast and east of the Maybe property. About 300 yards to the southeast a tunnel has been driven southeastward for 150 feet, the last 50 feet following a narrow pegmatite that strikes S. 70° E. The pegmatite is fine-grained and carries crystals of mica about one inch in diameter in its more quartzose parts. An adit tunnel, now caved, has been driven from a point farther up the hill and from it has been taken some light-colored muscovite in books eight or nine inches square. From a point about 200 yards south of the first prospect an adit was driven 230 feet to a pegmatite dike about four feet wide. The dike forks; one branch strikes S. 20° E. and the other S. 75° E. In the first branch some commercial muscovite in books six to eight inches in diameter was taken from scattered pockets in a quartzose zone; tourmaline and garnet are also present. The second branch contained very little marketable mica. The schistosity of the enclosing rocks strikes N. 40° W. and dips 80° E.

Levi Anderson

The Levi Anderson Mine, formerly the Steelsmith, was located in 1895. It is situated in a low rounded knob of Mica Mountain about half a mile south of the Muscovite in secs. 22 and 27. It has lain idle for a number of years.

Several pegmatite dikes of irregular lenticular outline and widths of 20 feet or less crop out uncomformably in the schists, which dip 60° W. and strike N. 10° W., the schists are now black, due to the presence of large quantities of biotite, and now silvery white, in those beds in which muscovite is dominant. Quartz is the most abundant mineral of the pegmatites and is usually segregated along the hanging wall. The books of muscovite, sometimes 10 or 12 inches across, generally occur in the quartzose hanging wall zone. They are light colored and readily cleavable. Biotite and tourmaline are accessory minerals in the pegmatites. Neither beryl nor garnet were found by the writer although it is reported that beryl exists.

The mica deposits have been explored by two adit tunnels and a surface pit. The open cut - 30 feet long, 20 feet wide, and 15 feet deep - is on the east side of the knob near its crest; it uncovers a pegmatite about 20 feet wide in which some small books of mica of commercial grade are exposed. Several short adits and an incline, caved and inaccessible, have been driven from the bottom of the pit. About 200 yards south of the open cut and slightly below it an adit has been driven northwestward 250 feet. About 200 feet from the portal a chinney-like body of pegmatite 10 feet thick dips 65° E., and has been stoped for a length of 30 feet. Its texture is granitic, with some segregations of quartz. The best and largest books of mica occur in the quartz, although a few of inferior grade occur in the center and near the footwall of the dike. The mica is clear white, splits easily, and trims into sheets of medium size. Several hundred yards north of the open cut an adit driven

southwestward encounters a pegmatite between one and two feet in thickness. A drift follows the dike 54 feet S. 20° W., then continues nearly 200 feet in barren schists. No mica of commercial value is exposed and the graphic texture of this pegmatite does not promise that any will be found.

No record of past production from the southermost adit on this property is available. The dike is not large and the mica, although in medium-sized crystals of excellent quality, is not plentiful. It is probable that no more than a small future production can be expected.

Morning Star

The Morning Star claim lies about a mile north of the Muscovite on the precipitous crest of the mountain and near its summit. It is most easily reached by means of a steep road which ascends the ridge from Monro's mill.

The country rock is a biotite-muscovite schist which dips 70° W. and strikes N. 30° E.; near the pegmatite dikes it carries a large number of crystals of small rod-like tourmaline and of garnet. A persistent dike of pegmatite crops out for several hundred yards along the east side of the ridge and conforms to the dip of the schists; its thickness is unusually regular and varies between 12 and 20 feet. This master dike is accompanied by a set of several roughly parallel dikes which divided into intersecting branches and fingers, and in places form a net. They range in thickness from several inches to a few feet. The dikes are all highly feldspathic; usually they have a graphic texture, although the granite is present here and there. In the outcrop mica is sparingly present with the feldspar, but is not of commercial size. Crystals of tourmaline as long as four inches and walnut-sized crystals of garnet exist.

The underground development includes several adit tunnels and drifts, an inclined shaft, and an open cut. An adit 890 feet long driven N. 44° W. from the east side of the ridge and 400 feet below the crest, reaches a 4-foot pegmatite dike. Some doubt arises, however, as to whether this is the major dike which it was desired to explore. A drift follows the dike northward for 36 feet but failed to disclose mica of commercial size. An adit 110 feet long was driven northwestward not far below the outcrop; it intersected two narrow pegmatites, neither of which carried mica of commercial size. The open cut, which is about 40 feet higher than the upper tunnel, exposes a narrow feldspathic branching pegmatite which carries crystals of mica some of them four inches in diameter, near the hanging wall. The shaft is located 300 feet south of the open cut on the crest of the ridge and was sunk to an unknown depth on a 4-foot dike; it is now caved to the surface. No mica of commercial sizes was exposed.

Sunshine

The Sunshine claim adjoins the Morning Star on the north and covers a pegmatite dike which is probably the same as that explored on the Morning Star. A small amount of development was done but mica was not found in commercial size or quantity. The claim rights have reverted to the government by failure to continue assessment work.

The pegmatite dips 45° W. and strikes N. 35° E. in conformity with the schists; its width is eight feet. It is highly feldspathic, has a graphic texture, and includes crystals of tourmaline several inches long. It also carries crystals of garnet over two inches in diameter, the largest found in the district.

Avon

The Avon mine lies in sec. 14, about a mile east of the Morning Star and north of Monro's mill. It was recently located by J. H. Nesbit of Avon. A tunnel driven along a narrow dike of pegmatite opened a large chimney of mica-bearing ground which yielded a considerable quantity of muscovite of excellent quality. The deposit was not visited by the writer but is reported to be of small extent.

Other prospects.

In the search for mica-bearing pegmatites many small prospect cuts have been made in all parts of the district. The only one which gave promise is a small open cut a short distance north of Munro's mill on property which belongs to Mr. Munro. The pegmatite which is exposed is 15 feet wide and dips 75° W. and strikes N. 45° W. through mica schist. It is highly feldspathic, has a coarse granitic texture, and carries mica in seams which are parallel and close to the hanging wall. The crystals of mica are white or colorless and some are as large as six inches in diameter. Commercial sizes are not numerous, however, and no production has yet been effected.

Future of the district.

As a producer of muscovite for commercial uses the Avon district of Latah County is by no means exhausted. The chief producer in the past has been the Muscovite mine, with an output valued at about $100,000. Litigation has enforced idleness on the property since 1918. It is to be regretted that the underground workings were inaccessible to the writer and that an estimation of probable reserves is therefore impossible; the concensus of opinion of those familiar with the past development of the property is that considerable production can be effected in the future. The Bentz, Maybe, Levi Anderson, and Luella claims have all produced mica in commercial quantities and are worthy of systematic development. The muscovite that has been produced has a faint rum color in books, is clear

and transparent in sheets, and splits freely into sheets of uniform texture and thickness. The better books have yielded some of the highest grade material found anywhere in the United States in sizes up to 12 x 18 inches.

A careful search for other mica-bearing pegmatites either in the Avon district or elsewhere in the county, may be successful in spite of the cover of deep soil and thick vegetation, which completely masks the rocks over large areas. The presence of large flakes of mica in the soil may indicate a pegmatite below if the flakes have not been carried far down the slopes by running water. The search should be confined to areas of schists not far removed from outcrops of granitic rocks, and it should be borne in mind that of many pegmatite dikes only a few contain muscovite of marketable quality and quantity.

The sub-surface development of the deposits is inexpensive and rapid but entails some uncertainty. The mica-bearing pegmatites are very irregular, swell and pinch abruptly within wider limits in both horizontal and vertical extension, and may enlarge to chimney-like bodies. The commercial mica occurs near the walls of the wider portions of the dikes or of the chimneys, especially in the quartzose segregates. As a result the dikes must be explored along many a barren foot to find the few scattered pockets of marketable minerals. The deposits occur in a steep-sided mountain ridge, however, so that they may be opened by short adits at brief vertical intervals and the mica removed by overhead stoping. Rapid progress can be made working the soft pegmatite dikes, even when drilling is done entirely by hand, as in the past.

In mining, some skill is required to secure a maximum of rock breakage coupled with a minimum damage to mica crystal. Small charges of 10 per cent dynamite or black powder are used to shatter the rock so that it may be removed with picks and shovels. Especially large crystals may be removed with hammers and chisels without the use of explosives. Abundant timber stands on the slopes of the mountain so that the underground workings may be properly supported at small expense against slumping of the decomposed feldspar. Very little timbering has been done in the past and, as a result, workings are caved and inaccesible. Several of the deposits could be re-opened only by driving new tunnels or by clearing and solidly timbering the old.

The promise of return is sufficient to justify a moderate program of well planned systematic further development of the deposits, both for their mica content and, in case a pottery industry should become established in the county, for their feldspar.