REPORT OF INVESTIGATIONS

EXPLORATION OF THE AVON MICA DISTRICT

LATAH COUNTY, IDAHO

BY

GLEN C. REED
REPORT OF INVESTIGATIONS
UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

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1/ The Bureau of Mines will welcome reprinting of this paper, provided the
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   Mines Report of Investigations 3898."

INTRODUCTION

The Avon mica district of Latah County, Idaho, is situated on a heavily forested spur of the Thatuna Range at an average altitude of 4,000 feet. The nearest rail connection is at Avon, a small farming settlement 7 miles to the south. The main supply point is Moscow, Idaho, which is 35 miles by graveled and graded county roads from Avon.

Discovery of mica-bearing pegmatites in 1885 was followed in 1888 by exploitation of several outcrop deposits. Although factual data are unavailable, past production appears to have been well in excess of $100,000. Recent production (September 1943 to April 1945) amounted to 65,824.78 pounds of trimmed sheet mica and 33,294.17 pounds of punch mica having a total gross value of $434,298.

The several properties of the district are variously owned by estates, individuals, and the State. When active, all were under lease or sublease to individual operators.

The deposits are in an area of pre-Cambrian schists adjacent to a small granitic outlier of the Idaho batholith. The pegmatites are nearly concordant in dip and strike to the foliation of the enclosing schists. The more persistent bodies are usually tabular, lenticular, or pipe-like. Individual dikes range in length from 10 feet or less to 300 feet.

The recoverable crude-mica content of the pegmatites ranges downward from a maximum of 115 pounds per ton of pegmatite mined. Material discarded in rifting and trimming operations further reduces recovery to a maximum of 5 pounds per ton of pegmatite mined. The average recoverable sheet content of the recently operated deposits is estimated at 2 pounds per ton of pegmatite mined... Available data indicate that about 21 percent of the district's recent production of trimmed sheet mica has been "Group A" material suitable for exacting condenser requirements. A few of the dikes contain local concentrations of beryl.

Reserves of the three known major deposits of the district are estimated at about 600 to 1,000 tons of combined "indicated" and "inferred" crude block mica. One of these deposits is inferred to contain between 150 and 450 tons of beryl.

It is believed that these mica reserves are minable only under a cost-market price ratio similar to that established during 1943 and 1944. A small part of the reserves can be "high-graded" under the present price structure. Profitable recovery of the beryl would require a market price four to five times that paid in 1944.

Preliminary examination of the Avon mica district was made by the Bureau of Mines in the summer and fall of 1942. A study of the Muscovite mine and a brief reconnaissance of the surrounding district led the Bureau to recommend that the district be explored by angle-dozer trenching.
The Colonial Mica Corporation, agent for the Metals Reserve Company, was urged to establish a mica-buying agency at Moscow, Idaho. This agency, inaugurated in September 1943, ended its work in May 1945 upon the lowering of Government support prices for strategic mica. Trimmed sheet and punch mica having a gross value of $434,298 was purchased foroperators of the Avon district up to April 1945.

A formal exploration project was initiated by the Bureau of Mines in September 1943. Bad weather so affected operations that a recess had to be taken in February 1944. Exploration was resumed in July 1944 and continued to completion in October 1944. The present report presents and appraises the results of the investigation. Supplementary maps showing mica occurrences and mine workings of the district are on file in Washington, D. C., Spokane, Wash., and Albany, Ore., offices of the Bureau of Mines, where they may be inspected by authorized persons.

Acknowledgment is made to Robert M. Gammell, mining engineer, who originally examined the district and recommended the project, as well as to S. H. Lorain, chief, Albany Division, Mining Branch, and Lowell B. Moon, chief, Mining Branch.

HISTORY, OWNERSHIP, AND PAST PRODUCTION

The early history of the Avon mica deposits is vague. Evidently there are no accurate records of production prior to 1942. Bulletins of the Idaho Bureau of Mines and Geology and the Federal Geological Survey give generalized fragments of information, from which the following is largely drawn.

The first mica discovery in the district was reputedly made in 1885. This was followed in 1886 by limited exploitation of the Mascovite deposit, which was operated intermittently to 1919. The greater part of its production was absorbed by the demand for stove mica. Early production is reputed to amount to 980 tons of cobbed block mica. This figure appears to be in reasonable agreement with what has been learned of the Mascovite ore bodies through recent production. With the exception of a brief attempt to recover boryl from the deposit in 1937, the property was idle from 1919 to 1942. As far as known, no boryl was marketed. The pegmatites in the Mascovite mine property comprise the principal deposit discovered in the area to date.

Other properties of comparatively minor importance were opened and operated on a small scale between 1886 and 1919. Among these are the Last Chance claim, located and worked in 1888; the Steelsmith property, located in 1895; and the Doerr property, located in 1914.

2/ Forrester, J. D., Mica and Boryl Occurrence in Eastern Latah County, Idaho: Idaho Bureau of Mines and Geology, Pamphlet 53.
Table 1 tabulates the various properties that contributed to the district's production during the period 1942-1945. This table was prepared in an attempt to clarify the somewhat complicated ownership and lease structure currently existing in the district. Table 2 summarizes the total production from the district for the period October 1942 to April 1945.

PHYSICAL FEATURES AND COMMUNICATIONS

Mica Mountain is a low, southward-extending, spur ridge of the Thatuna Range. It rises to 4,500 feet above sea level and 2,000 feet above the nearby farm lands of the Palouse River Valley to the southwest. The area is densely covered with second-growth timber and underbrush. A few intermittent springs can be found in the more pronounced drains; however, the water supply obtainable at the higher altitudes is meager. In normal winters, snow exceeding 3 feet in depth is common on the north and west slopes.

The nearest rail connection is at the small farming settlement of Avon, on the Washington, Idaho, & Montana Railroad. This road connects with a branch of the Chicago, Milwaukee, & St. Paul at Bovill, 10 miles east of Avon, and with a branch of the Northern Pacific Railroad at Palouse, Wash., 40 miles west of Avon. Avon is 35 miles by graveled and surfaced highway from Moscow, Idaho, the nearest major supply point. Moscow is 87 miles by highway from Spokane, Wash.

The mica district is accessible from Avon by 7 miles of graded country road. The last 6 miles of this road were constructed by the U. S. Forest Service under the Mine Access Road program. A limited amount of spot surfacing was completed in the fall of 1944; nevertheless, the road is passable only by tractor from March to May because of mud.

LABOR AND LIVING CONDITIONS

The principal operators of the district have found it difficult to obtain and keep adequate crews. Few experienced miners were to be found in the immediate area. Consequently, the greater part of the labor supply was recruited from local agricultural and logging sources. The release of miners from the nearby Coeur d'Alene and Butte districts was, in most instances, difficult to accomplish in spite of the assignment of an adequate labor priority to the mica mines. The Coeur d'Alene wage scale has been adopted in the district. Under this scale, wage rates ranged from $7.75 to $8.75 per day plus time and one-half for work in excess of 40 hours per week.

Living conditions in the district were uniformly poor. They evidently contributed largely to the difficulty of maintaining adequate crews. Because of the transient nature of the operations, company investment in living accommodations was restricted to the barest essentials.
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<th>Property</th>
<th>Owner</th>
<th>Permits or leases</th>
<th>Sublessee</th>
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1/ Based on excavation measurements by the U. S. Geological Survey and the Bureau of Mines.
DESCRIPTION OF THE DEPOSITS

General

The mica deposits of the Avon district are in pegmatites injected into pre-Cambrian schists.1 These schists are bounded on the east and south by a granitic body presumed to be an outlier of the Idaho batholith. The schists range from tawny, fine-grained to coarse rocks containing quartz, feldspar, muscovite, garnet, and biotite. Near the pegmatite contacts the schists are frequently altered to a light buff to gray, medium to coarsely granular rock composed of feldspar, quartz, muscovite, biotite, garnet, and tourmaline. Alteration is most strongly developed adjacent to the dikes exposed in the open-pit workings at the Muscovite mine, where it was seen to extend up to 20 feet outward from the pegmatite contact.

Where not obliterated by regional metamorphism and alteration, the bedding of the enclosing sediments usually appears to parallel the imposed foliation. However, several scattered outcrops present a large angular divergence in both dip and strike between bedding and foliation. The predominant foliation of the schists strikes to the north and dips steeply to the west. Locally, the schists are contorted into tight, secondary flexures having no common orientation.

The pegmatites are often markedly sinuous in both lateral and vertical extent. They are concordant to the enclosing schists, with only minor local exceptions. They occupy openings or zones of weakness evidently formed by folding stresses in contradistinction to fracture zones derived from shearing stresses. The more persistent pegmatite dikes are usually tabular, lenticular, or pipelike. The strike length of individual dikes or lenses ranges from 10 feet or less up to 300 feet. These dikes may be echeloned or otherwise disposed at intervals along nearly continuous zones of weakness. The longest zone found in the area is over 2,300 feet in length. However, the pegmatites comprising this particular zone are entirely devoid of commercial mica. The tabular bodies characteristically range from 1 to 6 feet in width. A notable exception occurs at the Muscovite property, where pegmatites exceeding 30 feet in width have been exposed.

The Oros

The more common constituents of the pegmatites are quartz, feldspar, muscovite, biotite, apatite, garnet, tourmaline, and magnetite. However, the pegmatites of the district can be broadly grouped on the basis of dominant mineralogical composition. The groups are (1) feldspar pegmatites, (2) feldspar-quartz pegmatites, and (3) quartz pegmatites. Some of the pegmatites are relatively uniform in composition. In others, composition varies considerably from place to place within the pegmatite mass. They may have marked segregations of the basic component minerals, or these components may be intergrown in widely varying proportions. Mica has been found in commercial quantities only in those pegmatites or portions of pegmatites of intermediate

1/ See footnote 3.
(group 2) composition. The quartz pegmatites often contain a moderate percentage of muscovite of good quality; however, the crystals seldom exceed 1 inch in diameter. The feldspar pegmatites of the district rarely contain commercial mica. In the few places where mica is found in the feldspar pegmatites, the mica crystals are usually concentrated near quartz segregations. The apparently close relations between concentrations of commercial mica and quartz-feldspar have been observed in all parts of the district.

MICA

Muscovite crystals, commonly referred to as "book" or "block" mica, usually are disposed irregularly through the pegmatite mass. Locally they are found entirely isolated in the schist wall-rock 2 or 5 feet from the parent pegmatite. Block mica is most often found intimately interlocked in seams or irregular masses in the pegmatite near the pegmatite-schist contact.

Marked color variations are seen in the mica produced from the different deposits of the area. These colors are designated by the trade as "ruby", "light rum", and "clear". Occasionally, green and silver micas are found; however, these are classed as nonstrategic. Most of the mica produced from the district has been classified as the ruby and light rum varieties.

Structural imperfections result in the rejection of about 95 percent of the mica crystals as mined. The most common inclusions are mineral staining, crumpling, and various crystal distortions. Crystal distortions common to the micas of the district are referred to as "ruled", "wedge", "fishbone", and "A-structure."

The "quality" of the mica is determined by visual appraisal of the various imperfections. Mica acceptable for purchase by the Colonial Mica Corporation was classified as follows:

Group A: No. 1 quality and No. 2 quality.
Group B: No. 2 inferior quality.

Only material classed as "Group A" meets the exacting requirements for use in condensers. "Group B" material was purchased at subsidy prices to encourage production of the higher-quality material. Table 2 presents the results of qualification of a part of the mica produced from the Avon district.

The yield per ton pegmatite of both block and sheet mica differs considerably from mine to mine and from place to place in the same mine. Table 3 presents the average yield obtained from a number of mines and prospects of the Avon district. The average yield from the district is about 49 pounds of block mica per ton of pegmatite mined. The average yield of sheet mica per ton of pegmatite mined is about 2.1 pounds.
TABLE 3. - Qualification of trimmed mica produced in the Avon district, 1943-1945. Compiled and calculated from Colonial Mica Corporation records

<table>
<thead>
<tr>
<th>Mine</th>
<th>Mica qualified at Asheville, S. C.</th>
<th>Total pounds sheet mica qualified</th>
<th>Percent of sheet mica qualified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group A</td>
<td>Group B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. 1, percent</td>
<td>No. 2, percent</td>
<td>No. 2 inf., percent</td>
</tr>
<tr>
<td>Mascovite:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underground</td>
<td>0.9</td>
<td>14.5</td>
<td>75.8</td>
</tr>
<tr>
<td>Open cuts...</td>
<td>3.1</td>
<td>27.2</td>
<td>60.7</td>
</tr>
<tr>
<td>Dumps ......</td>
<td>2.5</td>
<td>31.8</td>
<td>54.9</td>
</tr>
<tr>
<td>Doerr ..........</td>
<td>1.1</td>
<td>19.7</td>
<td>57.5</td>
</tr>
<tr>
<td>Steelsmith ...</td>
<td>3.0</td>
<td>36.5</td>
<td>50.3</td>
</tr>
<tr>
<td>Last Chance ...</td>
<td>1.5</td>
<td>22.9</td>
<td>70.1</td>
</tr>
<tr>
<td>Bentz ..........</td>
<td>.2</td>
<td>7.8</td>
<td>77.5</td>
</tr>
<tr>
<td>Luella ......</td>
<td>4.2</td>
<td>34.9</td>
<td>47.7</td>
</tr>
<tr>
<td>District average...</td>
<td>1.6</td>
<td>19.8</td>
<td>68.9</td>
</tr>
</tbody>
</table>

\* Material rejected during qualification of the trimmed mica. This material is variously classified as "thins", "washer", "skimmings", and "scrap.

2/ A part of the district's production remained to be qualified at the time of computation of table. Consequently, complete qualification may modify the tabular values given.

**BERYL**

Beryllium oxide is widely, though not uniformly, distributed throughout the Mascovite pegmatites. It is assumed that it is all contained in hexagonal beryl crystals, although its occurrence in some of the dike material may be determined only by analysis. It appears to be chiefly confined to the quartz-feldspar zones of the pegmatites. However, several beryl crystals 2 inches in length were found entirely enclosed by schist wall rock in the underground workings of the Mascovite mine. Associated minute stringers of gray quartz cut the adjacent schist.

The beryl crystals are badly shattered by post-mineral stresses. Unfortunately, they usually break into small fragments when the rock is blasted. They also break down under the relatively slight impact of screening. Consequently, they cannot be recovered economically at current market prices by the combined screening and hand-sorting operation used for mica recovery.

A general sample weighing 3,600 pounds was cut from the pegmatite exposed in the No. 5 level of the Mascovite mine. This sample contained 0.15 percent BeO. About four-fifths of the total BeO was contained in beryl crystals. These crystals comprised 1.56 percent of the general sample.

Metallurgical investigations on the Mascovite pegmatite were carried out by the Bureau of Mines. Flotation testing at minus 48 mesh was done on a head sample containing 0.14 percent BeO. The tests indicated that 77.8 percent of the BeO can be recovered in a product assaying 10.5 percent BeO.
It is estimated that about 1,000 pounds of beryl crystals have been recovered from the Muscovite operation. A single beryl purchase of 374.5 pounds was made by the Colonial Mica Corporation in 1944. This beryl contained 10.10 percent BeO.

Very few beryl crystals have been found in the pegmatites of the Steelsmith, Doerr, Last Chance, Lucky Jim, and Luella properties. Spectroscopic analysis of 65 samples cut from scattered pegmatite exposures in the direct gave negative results for BeO.

FEDERAL ASSISTANCE

Four agencies of the Federal Government combined efforts in a more or less integrated program to stimulate production from the Avon mica district. These were the Metals Reserve Company, U. S. Forest Service, Geological Survey, and Bureau of Mines.

Colonial Mica Corporation

The Colonial Mica Corporation, agents for the Metals Reserve, was organized in April 1942. Domestic mica production was stimulated by the adoption of four interrelated phases: (1) Price stabilization and subsidy, (2) advance of capital against future production, (3) establishment of branch buying agencies and custom-rifting facilities, and (4) supplying nonexpendable equipment at nominal rentals.

Prices paid to producers for strategic sheet mica varied considerably from 1943 to 1945. They were established for and announced at quarterly intervals. The following tabulation briefly indicated the general market trend over this period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Product classification</th>
<th>Price, per pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to May 24, 1943</td>
<td>1&quot; x 1&quot;, full trim</td>
<td>1/41.40</td>
</tr>
<tr>
<td></td>
<td>1-1/2&quot; x 2&quot;, 3/4 trim</td>
<td>5.00</td>
</tr>
<tr>
<td>May 24 to Jan. 31, 1943</td>
<td>1&quot; x 1&quot;, full trim</td>
<td>6.00</td>
</tr>
<tr>
<td></td>
<td>1-1/2&quot; x 2&quot;, 3/4 trim</td>
<td>6.00</td>
</tr>
<tr>
<td>Feb. 1 to Dec. 31, 1944</td>
<td>2-1/2 sq. in. area, full trim</td>
<td>8.00</td>
</tr>
<tr>
<td></td>
<td>Punch mica</td>
<td>.30</td>
</tr>
<tr>
<td></td>
<td>No 3/4 trim purchased.</td>
<td></td>
</tr>
<tr>
<td>Jan. 1 to March 31, 1945</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optional: Sliding scale based upon grade and quality ranges from $0.25 to $38.65 per pound. Purchase of punch mica entirely discontinued.</td>
<td></td>
</tr>
</tbody>
</table>

1/ Approximate.

Properties meriting assistance were initially financed by granting an advance. These advances, at 4 percent interest, were returnable from future production. Repayment of the advances was at the rate of 20 percent of the gross value of the mica marketed.

6/ Settlement assay, Colonial Mica Corporation records.
The conveniences of branch buying agencies combined with custom-rifting facilities were offered to the producers. Crude block mica was accepted; this was rifted and trimmed at cost and purchased at the market price. Some items of nonexpendable mining equipment were obtainable from the Colonial Mica Corporation at a nominal monthly rental of 2 percent of the equipment's initial value. These included compressors, rock drills, mine cars, rail, and pipe.

**U.S. Forest Service**

Under the Access Road Program, 5.4 miles of low-class 2 road were built into the heart of the Avon mica district. Construction, under the supervision of the U. S. Forest Service, commenced in August 1943 and was completed in December 1943. Snow was removed and the roads were maintained in the winter of 1943-44. A limited amount of spot surfacing was done in the summer of 1944.

**Geological Survey**

In October 1943, the Geological Survey undertook a detailed study of the mines and prospects of the Avon district. A preliminary report\(^1\) on the Muscovite mine has been published.

**Bureau of Mines**

During the 9 months of formal exploration, the Bureau of Mines completed 37,746 linear feet (44,379 cu. yd.) of angle-dozer trenching and 3,779 cubic yards of stripping preliminary to mining. In addition, 4,790 feet of minor-type connecting road was constructed. This road was specifically laid out to serve the dual purpose of providing a usable road and of prospecting.

A number of new deposits were discovered. However, virgin discoveries of strategic worth were comparatively few. The exposure of extensions of known structures and the exposures of previously undiscovered parallel structures constituted the greater part of the Bureau's contribution to the district's recent production.

Negative results obtained from exploratory trenching removed some areas from further consideration. For example, the surface limits of the Muscovite structure were sharply delineated, enabling underground work to be directed to the more favorable areas.

Two mine dumps on the Muscovite property were sampled by the Bureau of Mines to determine their recoverable mica and beryl content. A series of deep angle-dozer trenches was made in the dumps. These were channel-sampled at regular intervals. All mica and beryl was screened and hand-picked from the samples. Volume measurements and sampling indicated that these dumps contained 8,470 tons of material from which 71.1 tons of block mica might be recovered economically by combined plant-screening and hand-picking. The

recoverable beryl content was similarly estimated at less than 0.2 percent, or 16 tons of beryl.

Up to April 1945, the Idaho branch of the Colonial Mica Corporation had purchased 65,824.78 pounds of trimmed sheet mica having a gross value of $424,309.71. About 58 percent of this production was initiated by Bureau exploration.

MINES AND PROSPECTS

Between September 1943 and April 1945, 14 mines and prospects contributed in widely varying degrees to the district's production. Most of these operations were intermittent and short-lived. With few exceptions, the easily accessible parts of previously exposed pegmatites were mined out and the workings abandoned. Little effort was expended in either development or exploration. This was due largely to the prevailing uncertainty regarding market prices for sheet mica which were established on a quarterly basis. Exploration was undertaken by the Bureau of Mines at all of the properties described in the following section. In some cases this exploration comprised the initial opening of the property.

Brief descriptions of the more important mines and prospects are given herewith. Property ownership and lease structures are correlated in table 1. Grade, recovery, and production data are given in tables 2 and 3. The relative percentage production of trimmed sheet mica for the district's major properties is shown in table 4.

<table>
<thead>
<tr>
<th>Property</th>
<th>Pounds</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mascovite</td>
<td>56,334.88</td>
<td>86.3</td>
</tr>
<tr>
<td>Last Chance</td>
<td>2,932.19</td>
<td>4.5</td>
</tr>
<tr>
<td>Doerr</td>
<td>2,210.87</td>
<td>3.4</td>
</tr>
<tr>
<td>Steelsmith</td>
<td>1,420.78</td>
<td>2.2</td>
</tr>
<tr>
<td>Fitzgerald</td>
<td>1,088.36</td>
<td>1.6</td>
</tr>
<tr>
<td>Others</td>
<td>1,337.70</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>65,824.78</td>
<td>100.00</td>
</tr>
</tbody>
</table>

**Muscovite**

The Muscovite mine (fig. 1) is in the N. 1/2 of sec. 22. It is reached over 7.7 miles of low-class farm and mine access roads from Avon to the south. The property is owned by B. S. Boegly and G. M. Myers of Spokane, Wash. It was subleased through the Thatuna Mines Co. to Victory Metals, Inc., in 1942. Victory Metals, Inc., is a small organization composed largely of employees of Western Air Lines at Salt Lake City, Utah. Company operations began in October 1943 and continued to March 1944 through the assistance of $20,000 development advance granted by the Colonial Mica Corporation. Surface rights were subleased by Victory Metals, Inc., to C. J. Montag & Sons, general
contractors of Portland, Oreg., in November 1943. Underground operations at
the property were turned over to C. J. Montag & Sons on a profit-sharing ar-
arrangement in March 1944. It has been learned recently that C. J. Montag &
Sons have purchased the Victory Metals' sublease.

Open-cut mining and surface exploration have partly exposed four distinct
structures comprising the Muscovite pegmatites. These are the footwall, cen-
tral, hanging-wall, and hanging-wall outlier pegmatites. They occupy a curving
zone about 550 feet long. This zone ranges in width from 47 feet at its south-
ern limit to a maximum of 100 feet at the arch of a westward-sweeping fold near
its northern extremity. The zone trends to the north.

The footwall member is 260 feet long; its width is 3 to 15 feet. The
member is separated from the central pegmatite by 3 to 11 feet of schist and
from the hanging-wall pegmatite by 15 to 27 feet of schist.

The central pegmatite is the largest of the bodies and comprises about
94 percent of the plan-sectional area of all pegmatite exposed in the zone.
Its greatest length, including one of its branch members, is about 315 feet.
Near the northern limit of the zone the structure widens to 50 feet and ab-
ruptly splits into two branches curving sharply to the west. A secondary
knot has been developed on the west branch immediately north of the split.

The hanging-wall pegmatite is 15 to 23 feet west of the footwall struc-
ture. It has a continuous length of 110 feet. A series of small lenses to
the north appear to be an extension of the same zone, thus making the over-
all exposed length of the structure about 225 feet.

The hanging-wall outlier is a series of small, discontinuous lenses
ranging in width from 2 inches to 1 foot. They are disposed along a zone
about 115 feet long lying 20 feet west of the hanging-wall pegmatite. The
zone is essentially parallel in strike and dip to the hanging-wall pegmatite.

The several pegmatites comprising the mineralized zone vary greatly from
place to place in the same structure as well as from each other in both pro-
portionate mineralogical composition and quality of contained mica. As de-
scribed by the Federal Geological Survey,8 all the pegmatites except the
central body are broadly homogenous. The central body, however, is distinctly
zoned into an interior albite-quartz core partly surrounded by a shell of
albite, quartz, microcline, muscovite, beryl, and schorl.

Strategic-quality mica has been produced from the entire length of the
footwall dike. As mining progressed, local variations in "richness" were
seen from place to place. The block mica extracted was, on the average,
distinctly superior in grade and quality to mica taken from the other struc-
tures on the property. Early as well as recent production from both open-cut
and underground workings has come largely from the footwall structure. Only
a little beryl accompanied the dike.

8/ See footnote 7.
With the exception of the west branch, the central pegmatite contains little mica of strategic quality. As a result of zoning, large sections of the body are almost completely devoid of muscovite. Open-cut operations on the west branch of the dike produced about 5 tons of block mica. The small amount of beryl in the member appeared to be more or less concentrated along the north schist-pegmatite contact.

Of the several pegmatites exposed, the hanging-wall dike appears to contain the most mica. All but a small part of the contained block mica is worthless because of imperfections resulting from post-mineral movement and intense alteration. Ruling, hair cracks, crumpling, and inclusions are developed to an unusually high degree. The dike contains about 1.5 percent beryl in highly fractured crystals, many of which crumble to powder when slightly disturbed.

The hanging-wall outlier contains virtually no recoverable mica at either surface or underground exposures. No beryl was seen along its exposed length in the open cut.

The Muscovite pegmatites have been mined by surface and underground methods over a vertical range of 285 feet from the outcrop to the No. 5 level. In general, the broader structural and compositional features disclosed by the surface operations have been roughly repeated downward to the lowest opening.

All recent underground production was taken from the workings of the No. 5 adit. In the East tunnel, the Nos. 1, 2, 3, and 4 levels are inaccessible. Small parts of most of these upper workings have been revealed by the recent open-cut and underground operations.

The No. 5 adit intersects the hanging-wall pegmatite 405 feet north-east of the portal. Drifts north and south from the crosscut exposed the body along a strike length of 50 feet. At this point stope No. 1 was carried 67 feet above the sill. The pegmatite, extracted over a length of 25 feet, was "rich" in both mica and beryl. The stope was finally abandoned because of the relatively low quality of the block mica recovered.

The hanging-wall pegmatite was again mined by stope No. 2. This stope, ranging from 65 to 100 feet long was carried 80 feet above the sill. It was likewise abandoned because of the low quality of the block mica recovered.

The hanging-wall outlier is exposed in the short west crosscut at the south end of stope No. 2. The structure carries no mica at the exposure, although a few small crystals of beryl have been found.

The central and footwall pegmatites are exposed in the North drift about 220 feet north of the main crosscut. Stope No. 3 on the footwall structure was carried about 90 feet up the dip to a caved sublevel. The stope length was about 40 feet. The larger part of the recent underground production was taken from stope No. 3. Immediately north of the stope a raise was driven upward along the footwall of the central pegmatite. This development was comparatively nonproductive until a short branch raise was driven into the footwall pegmatite to the west.
The footwall structure was again exposed by a short drift 35 feet east of stope No. 1. The sill was driven 105 feet north of the main crosscut and stope No. 4 was started.

Mining, more or less adapted to the ground conditions encountered, was by square set, square set and fill, and horizontal cut and fill. During the first stages of the operation, complete sorting was attempted in the stopes and at the chute lips as the cars were loaded. All broken material was drawn from the stopes. This system was modified later owing to operating delays caused by stope sorting and the need for waste filling for support. Finally, only the largest books were recovered and sacked in the stope. The broken vein material was trammed to a surface head-bin and there sorted over a power-driven vibrating screen. Essentially all block mica in the trammed ore was recovered. Some of the crystals were impaired in the loading and drawing of chutes and head bin. This was partly overcome by maintaining the shoveled ore in the chutes near the level of the shoveling floor.

Underground excavation at the Muscovite mine was measured by the Bureau of Mines from October 1943 to May 1944 and by the Federal Geological Survey from May 1944 to May 1945. The resulting data are presented in Table 5.

**TABLE 5. Excavation, grade, and recovery data, Muscovite mine, Lathe County, Idaho**

<table>
<thead>
<tr>
<th></th>
<th>Oct. 8, 1943 to Mar. 29, 1944</th>
<th>Mar. 30, 1944 to Mar. 31, 1945</th>
<th>Total or average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Broken:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schist</td>
<td>1/865.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pegmatite</td>
<td>793.5</td>
<td>5,826.5</td>
<td>2,662.0</td>
</tr>
<tr>
<td>Total</td>
<td>1,659.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Stope width:</strong></td>
<td>3/8.86</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Vein width:</strong></td>
<td>4.38</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Overbreak:</strong></td>
<td>4.48</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Block mica:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Produced</td>
<td>4/66,059</td>
<td>693,441</td>
<td>2,759,500</td>
</tr>
<tr>
<td>Per ton vein</td>
<td>4.16</td>
<td>5.95</td>
<td>5.74</td>
</tr>
<tr>
<td><strong>Sheet mica:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovered</td>
<td>3,591</td>
<td>30,249</td>
<td>33,840</td>
</tr>
<tr>
<td>Per ton vein</td>
<td>4.52</td>
<td>5.19</td>
<td>5.11</td>
</tr>
<tr>
<td>Per ton vein percent</td>
<td>.23</td>
<td>.26</td>
<td>.25</td>
</tr>
<tr>
<td><strong>Mica per ton excavation:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block</td>
<td>1.99</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sheet</td>
<td>.11</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sheet</td>
<td>2.16</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Recovery, sheet from block</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>percent</td>
<td>5.43</td>
<td>4.36</td>
<td>4.45</td>
</tr>
</tbody>
</table>

1/ Includes some caved ground.
2/ From Geological Survey estimates.
3/ Sills included.
4/ Includes estimated 4,500 lb. inventory from Victory Metals, Inc., rifting plant.
Upon the basis of investigations conducted by the Bureau of Mines, a small gasoline-powered screening plant was erected to recover block mica block mica from the Nos. 3 and 4 dumps. The plant was operated intermittently from March to September 1944.

Dump material fed into the plant head bin by angle-dozer tractor was passed over a vibrating screen. The screen undersize went to discharge over a belt conveyor, whereas the oversize dropped to a picking belt, where the block mica was recovered by hand-sorting. Picking-belt rejects passed onto the conveyor and were discharged with the screen undersize. Plant rejects were spread out from the conveyor discharge by angle-dozer tractor. Both dumps were sorted, and all commercial block mica was recovered.

The block mica salvaged from these dumps was rifted and trimmed into 6,039.74 pounds of sheet and 2,908.42 pounds of punch. Sale of these products at Federal-support prices grossed $37,862.29. No beryl was recovered.

Steelsmith

The Steelsmith mine is in the N. 1/2 of sec. 27. It is reached over 7.6 miles of low-class farm and mine access road from Avon, to the south. Statistics covering the early production of the property are not available; however, accessible workings and dumps indicate a past production of relatively minor importance.

In October 1943, the Tonopah Mining Co. of Lewiston, Idaho, initiated a small-scale underground operation at the property under a lease arrangement. Surface rights on several exposures were let under various subleases. Both surface and underground exploration for minable deposits was unsuccessful; consequently, all operations at the property were terminated in the fall of 1944.

The major deposit of the Steelsmith property is a flattened, chimneylike structure plunging about 58 degrees downward to S. 37° E. The major axis of the body strikes S. 25° E. and is concordant to the enclosing schists. This axis is about 50 feet long at the tunnel level. The body's greatest width is 20 feet.

The structure is distinctly zoned into a quartz core enclosed by a quartz-feldspar shell. The shell comprises 50 to 64 percent of the plan-sectional area of the structure. It contains sporadically distributed block mica of good grade and quality. The mica is often noticeably concentrated in the quartz-feldspar adjacent to the schist wall rock; the quartz core is essentially devoid of commercial mica. The greater part of the mica produced from the property has been taken from the shell.

During the earlier operation, a part of the quartz-feldspar shell was mined by stoping from the tunnel level and sinking from the outcrop 95 feet above the level. A part of the remaining shell was mined by the Tonopah Mining Co. in 1943-1944. The mica recovered constituted about 82 percent of the property's recent production. The remainder was produced from unrelated surface prospects.
Surface trenching near the chimney outcrop disclosed a quartz-feldspar dike containing a few small pockets of block mica. This dike is 130 feet long and ranges from 2 to 5 feet in width; it strikes N. 18 W. and dips about 75 degrees to the southwest. Underground exploration for this structure was financed by the Colonial Mica Corporation. Although several small pegmatite stringers were found, they contained no minable concentrations of mica.

Surface trenching and stripping on the property exposed a number of pegmatite pods and lenses containing local concentrations of strategic quality mica. Two of the structures opened appeared to have mica in sufficient quantity to warrant limited exploitation. A small advance made by the Colonial Mica Corporation permitted further opening by bulldozer excavation. The mineralized zones of both areas were cut down to a depth of 10 to 15 feet. A small amount of block mica was recovered by hand-picking along the walls and floors of the cuts. The deposits were found to be too low in mica content to warrant mechanized mining, and the operation terminated.

The pegmatites investigated were elongated lenses uniformly concordant to the enclosing schists. The lenses ranged up to 150 feet in length and from 6 inches to 8 feet in width. The wider segments of the lenses were usually at the crests of flat arches and rolls.

Feldspar predominated in the composition of the bodies. Schorl was seen as a minor accessory mineral. Several small crystals of beryl were found during trenching; however, the results of systematic sampling for beryl were entirely negative. The block mica found in the lenses was invariably associated with pods and stringers of gray quartz. Mica crystals up to a maximum of 7 inches in diameter were seen; the average diameter of the crystals mined was about 3-1/2 inches.

One of the areas was systematically sampled by hand-trenching to a depth of 3 feet. The sampling indicated that the pegmatites contained about 0.9 percent block mica. The subsequent mining operation showed the sampling to be in considerable error.

Doerr

The Doerr mine is in the S. E., 1/4 of sec. 22, along the eastern margin of the known productive area. It is reached over 6 miles of low-class farm and logging roads from the main highway at Avon to the southwest.

During the period 1915-1917, the richer parts of a small ore shoot were mined to a depth of 50 to 60 feet below the surface; early production records are not available. In August 1943 the property was leased to C. J. Montag & Sons of Portland, Oreg., and F. dicholborger of Spokane, Wash. Open-cut methods were applied to the extraction of the remaining upper portions of the ore shoot. The extension of an existing adit was financed by the Colonial Mica Corporation. This adit was extended to intersect the presumed dip projection of the ore shoot about 135 feet vertically below the floor of the open cut. The vein was not found at the projected position; consequently, all work at the property was terminated in May 1944.
Open-cut mining and subsequent surface trenching delineated a pegmatized zone about 230 feet wide and 1,200 feet long striking S. 5° W. and extending into the adjoining Bentz property to the south. This zone consists of a series of disconnected pegmatite lenses of widely varying composition and size. The largest lens exceeded 180 feet in length and ranged from 1 to 8 feet in width. The property's entire past and recent production came from the north end of this lens.

The productive segment of the lens was about 60 feet in length. In general, block mica was irregularly disposed throughout the quartz-feldspar mass. However, occasional mica concentrations were found in the wall zones. Schorl was an abundant accessory mineral; several small crystals of beryl were found.

The central and south portions of the dike graded into feldspar, with small local segregations of gray quartz. A few of these quartz segregations were accompanied by concentrations of block mica. The pockets were cleaned out by hand and produced a small amount of salable material. The central and south portions of the dike were essentially nonproductive.

Trenching immediately north of the open-cuts exposed a presumed continuation of the pegmatized zone. Gray quartz and subordinate feldspar predominated in the individual lenses. Mica crystals 1 inch or less in diameter were found in some of the lenses. One pegmatite was estimated to contain about 3 percent of "silver" mica in shoots up to 5 inches in diameter. Occluded air bubbles make this mica worthless for strategic purposes.

Bentz

The Bentz prospect is in the S. E. 1/4 of sec. 22 adjoining the Doerr property to the north.

Surface trenching exposed the southern segment of the extended pegmatized zone found on the Doerr property. Several sporadic quartz-mica segregations were found in the segment. These were all relatively small; however, they carried mica of acceptable quality. The lenses were further explored by a power shovel under a short-lived lease arrangement. They were found to be too small and low in mica to justify mechanized mining. Consequently, the lease was terminated, and the operation was carried on for a short period by small-scale hand methods.

Monroe

The Monroe mine (fig. 1) near the northern end of the district, is in the S. E. 1/4 of sec. 15. It is reached over 7 miles of low-class farm and logging roads from the main highway at Avon, to the southwest.

The several pegmatites explored at the property were found to be disposed along a 1,400 foot zone striking N. 5° E. Most of the lenses were found to carry small amounts of strategic-quality mica in the wall zones. The grade of the deposits explored appeared too low to justify even small-scale
mining. Production from the property was limited to a minor amount of block mica salvaged during exploration.

A short adit, financed in part by the Colonial Mica Corporation in 1944, was driven into a bank exposure of mica-bearing quartz pegmatite. This work revealed a small lenticular pegmatite and several related pods all very low in block mica. No minable ores were found. Surface trenching, both immediately above the adit and 180 feet to the north, exposed other lenticular pegmatites, none of which contained mica in commercial quantities. Trenching 620 feet south of the adit opened and explored three related pegmatite lenses. These bodies, disposed along a length of 500 feet, comprise the southern extremity of the Monroe zone. The largest of these bodies had an extreme width exceeding 20 feet. With local exceptions, none of the pegmatites opened and explored are of the intermediate quartz-feldspar composition usually associated with the more important mica concentrations of the district.

Lucky Jim

The Lucky Jim mine (fig. 1) at the northeast extremity of the district is in the N. W. 1/4 of sec. 14. It is reached over 2,600 feet of steep trail from the end of the road at the Monroe mine to the south. The deposit was presumably discovered and opened during World War I. At that time an adit 180 feet long was driven 40 feet vertically below outcrops of quartz-feldspar pegmatite. The adit exposed several lenses of intermediate quartz-feldspar composition. The largest of these lenses is 85 feet long and has a maximum true width of 14 feet. It strikes N. 37° E. and dips from 35 to 62 degrees to the northwest.

In 1944 a single stope was started at the north end of the lens. About 30 tons of vein material were removed from the stope. The stope and drift backs are in pegmatite having an unusually high content of block mica. However, the crystals are small; their quality is uniformly poor owing to pronounced ruling. The other pegmatites exposed by the adit are small, discontinuous bodies and stringers containing little or no mica.

Surface trenching and stripping disclosed several pegmatite lenses. The southernmost pegmatite exposed appears to be the dip extension of the large lens opened in the adit. A second body, immediately to the north, may extend downward to the 3-inch stringer cut in the end of the adit. Mica is sporadically distributed in both lenses. Although the mica content appears to be considerably lower on the surface exposures of the pegmatites, the quality of the crystals is similar to that found underground.

Fitzgerald-Carlson

The Fitzgerald-Carlson prospect (fig. 1) in the N. W. 1/4 of sec. 27 is near the southwestern limit of the productive area. It is reached over 1,250 feet of truck road branching from the main access road to the southwest.

Surface trenching exposed a complex series of pegmatite dikes extending over an area 300 feet long and 200 feet wide. The schists in this area are
contorted into a series of tight folds. Consequently, abrupt and marked changes in strike and dip were found in the individual pegmatites and enclosing schists. The predominant strike is about N. 20° W.; observed dips ranged from vertical to 28 degrees northeast. Strike continuity from any single lens to another is difficult to determine. Several, at least, appear to be identical structures over strike lengths of 80 to 100 feet.

Most of the dikes exposed are of the intermediate quartz-feldspar type. They all contain mica of acceptable quality. However, the crystal concentrations in the individual lenses are small and few in number. A single lens 35 feet long and 3 feet wide contained an estimated 8 percent block mica of unusually good quality. It was the only pegmatite of the series opened and explored in the immediate area that appeared to contain block mica in commercial quantity. During a subsequent mining operation on this lens the grade was found to decrease markedly immediately below the horizon exposed by trenching.

The small size and sporadic distribution of the mica-rich pockets in this area appear to justify little other than small-scale "high-grading" operations.

Maxine No. 2

The Maxine No. 2 prospect is reached over 2,500 feet of truck road branching from the main access road to the south. It is in the N. W. 1/4 of sec. 27.

A small float train containing feldspar, quartz, and mica was exposed during construction of the connecting truck road. Subsequent trenching and stripping exposed two pegmatite bodies. In one of the lenses feldspar was the predominant mineral. It contained little mica and none of acceptable quality.

The second lens of intermediate quartz-feldspar composition was found to be about 55 feet long and 11 feet wide. It strikes N. 60° W. and dips about 60 degrees to the northeast. This lens carried a fair concentration of block mica of good quality.

A rude "high-grading" operation was established on the exposure immediately after discovery in August 1944. Although nearly all of the following excavation was made in the weathered mantle and float train of the deposit, the work resulted in the production of an appreciable amount of block mica of strategic quality.

Thatuna-Campbell

The Thatuna-Campbell prospect (figs. 1 and 2) is in the S. W. 1/4 of sec. 22. It is reached over 3,400 feet of truck road branching from the main access road to the southwest.
Figure 2. THATUNA—CAMPBELL
Figure 3.

THATUNA—CAMPBELL ADIT
An adit 125 feet in length was driven by early prospectors to explore and develop a bold quartz-pyromatite outcrop. This work disclosed a lenticular pegmatite 68 feet long and about 25 feet across at its greatest width. Its long axis strikes N. 69° W.; the walls dip from 73° to 88 degrees to the south. Tiny crystals (1 inch dia. or less) of block mica are sporadically distributed throughout the mass. No mica of commercial grade or quality is to be seen in either the adit or outcrop.

Initial trenching of the area was at a small caved prospect trench 130 feet southeast of the adit portal. Several large feldspar-pegmatite lenses were disclosed along a zone striking N. 70° W. Most of these contained only subordinate amounts of quartz and associated mica. The largest lens was about 65 feet long and 20 feet wide. A very small amount of good quality block mica measuring up to 6 by 4 inches was found in the lens. This mica was associated with small pods and stringers of gray quartz. A single stringer dike of quartz-feldspar was found near the southeastern end of the zone. This dike, 1 foot wide and 50 feet long, contained an estimated 5 percent of commercial mica. Individual books were up to 15 square inches in area.

After the initial trenching, the entire area (36,000 square feet) was stripped to facilitate mining. Dragline equipment, a storage bin, and a soring screen were set up near the adit portal. The feldspar pegmatites were partly mined to a depth of 6 feet; the quantity of mica recovered was insignificant, and the operation was abandoned. No attempt was made by the operators to mine the quartz-feldspar stringer.

Fitzgerald-Olson

The Fitzgerald-Olson mine (fig. 1) is in the N.W. 1/4 of sec. 27. It is reached over 650 feet of trail from the road terminus at the Tahuna-Campbell prospect.

Area scouting resulted in the discovery of a long-abandoned open cut and a caved tunnel portal. The cut was about 40 feet long, 12 feet deep, and had a maximum width of 20 feet. The bottom and sides of the pit were obscured by sloughing, although a small stringer of quartz-feldspar was found at the west rim. Book mica of good quality was found discarded in the pit dump.

Trenching and stripping conducted immediately west of the cut disclosed an irregular pegmatite having a surface area of about 420 square feet. The pegmatite occupied a zone of weakness at the crest of a small fold in the enclosing schist. Strategic quality mica was concentrated near the schist-pegmatite contacts along the limbs of the mass. The more feldspathic parts of the body contained good mica crystals adjacent to sporadic sorthegions of gray quartz.

A small-scale surface operation extracted the easily accessible material in October and November 1944. The caved adit 78 feet vertically below the surface outcrop was reopened. It was found that the adit cut several small lenses of feldspar pegmatite, none of which contained mica of strategic quality. None of these lonsos appeared to be dip extensions from the surface deposit.
The Last Chance claim is in the S.W. 1/4 of sec. 22. It is reached over 0.7 mile of truck road branching from the main access road to the southwest. The property is the site of one of the earlier mica discoveries of the district; it was presumably located and operated in 1883. Nothing is known concerning the earlier operation of the property. A caved tunnel portal and large dump 25 feet below the pegmatite outcrop, partly removed by glory-holing, indicate a degree of organized and concentrated effort. The property is now held in an estate administered by the Spokane & Eastern Trust Co. of Spokane, Wash.

Early in 1944 the property was leased to B. Meiers of Deary, Idaho. Small-scale surface operations continuing to December 1944 resulted in the production of a substantial amount of strategic mica.

The greater part of the mica produced from the Last Chance was taken from an extended dike about 300 feet long at the western end of the property (figs. 1, 5, and 6). After exposure by trenching and stripping, the dike was found to occupy a shallow synclinal fold plunging about 45 degrees to the northeast. A number of minor folds are superimposed along its limbs and crest. In general, the dike dips from 50 to 49 degrees northeast; its strike ranges from S. 22° E. on the west limb to N. 53° E. on the east limb. It ranges from 1 to 9 feet in true width.

The composition of the dike, although variable, is predominantly quartz-feldspar. Crystals of schorl up to 3 inches in diameter are found near the mica-rich zones. Beryl crystals up to 5 inches in diameter are seen; they probably constitute little more than a trace in the dike mass. In the productive east segment of the dike, scales and tiny crystals of torbernite,2/ a hydrous phosphate of uranium, were found on cleavage surfaces of both feldspar and mica.

Only relatively small segments of the dike contain strategic-quality mica in minable concentrations. The productive zones are largely confined to the limbs of the rolls forming the minor folds. The crests of some of the rolls contained an unusual amount of mica. However, most of the mica at the crests was badly crumpled and distorted by post-mineral stresses.

Trenching and stripping at the site of an early prospect pit disclosed a flattened pipelike body containing block mica of exceptionally good quality. This pit is near the eastern end of the property, about 650 feet east of the caved adit portal.

The "pipe" occupied the crest or open loop of a tight fold. Striking N. 77° W., the major axis of the body was about 75 feet long. It has a maximum width of 30 feet. The central part of the body was a core of quartz pegmatite, which contained a small amount of block mica of excellent quality. Most of the mica taken from the deposit lay in the outer shell of the

2/ Qualitative determination by R. E. Head, Bureau of Mines.
Figure 6.- LAST CHANGE
pegmatite and along the pegmatite-schist contact. Garnet crystals up to 3 inches in diameter were sporadically developed in the schist wall rock.

A series of small outlier lenses was exposed from 70 to 140 feet southwest of the pipe pegmatite. The largest lens had a strike length of 40 feet and a maximum width of 4 feet. In spite of their small size, they contained a fair amount of block mica of good quality and grade. These pockets were also surface "high-graded."

McCornack

The McComback prospect is 500 feet west of the main access road in the N. W. 1/4 of sec. 28. It is at the southwest extremity of the Avon district and just beyond the limits of the known productive area.

An adit 170 feet long has been driven northward into a series of massive feldspar pegmatites. In a 25-foot zone near the portal, pegmatitic material has been injected into the schists in a series of thin sheets. With the exception of local folds the schists and pegmatites strike about N. 45° E. and dip from 65 to 87 degrees to the northwest. The exposed pegmatites contain a very small amount of scrap quality mica together with minor amounts of tourmaline and quartz.

The surface above the adit and to the southwest was explored by trenching and stripping. Massive feldspar pegmatites were disclosed. Occasional segregations of quartz and accompanying block mica were found. Owing to their small size and sporadic distribution, these quartz-mica segregations appeared to have little economic value, although the contained mica was usually of acceptable quality. The property has been idle in recent years. Nothing is known of its earlier production, which presumably was small.