

STATE OF IDAHO
C. Ben Ross, Governor

BUREAU OF MINES AND GEOLOGY

BIENNIAL REPORT
ON THE
ACTIVITIES OF THE BUREAU

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CONTENTS

	<u>Page</u>
Present organization and functions - - - - -	1
Activities of the Bureau in 1931-32 - - - - -	2
U. S. Geological Survey Cooperation - - - - -	2
Value of cooperative work - - - - -	3
Bayhorse project - - - - -	3
Leadore and Gilmore districts - - - - -	3
Elk City-Buffalo Hump project - - - - -	3
Boise Basin project - - - - -	4
Yellow Pine-Edwardsburg project - - - - -	4
U. S. Bureau of Mines Cooperation - - - - -	5
Research problems - - - - -	5
Fellowships - - - - -	6
State Mineral Resources Investigation - - - - -	7
Latah County - - - - -	7
Personal conferences and correspondence - - - - -	7
Determinations of minerals - - - - -	7
Assays - - - - -	7
Information for prospectors - - - - -	7
Drilling for gas and oil - - - - -	8
Miscellaneous activities - - - - -	8
War Department - - - - -	8
Ground Water - - - - -	8
National conferences - - - - -	8
U. S. Forest Service - - - - -	9
Future work - - - - -	9
The uses of geological study in mining - - - - -	9
Publications - - - - -	10
Conclusions - - - - -	12

Moscow, Idaho
December 13th, 1932

Honorable C. Ben Ross, Governor of Idaho
and
Members of the Legislature of the State of Idaho

In accordance with law, I submit below a report of the activities of the State Bureau of Mines and Geology for the 1931-32 biennium, with recommendations upon the future work of this Bureau.

Respectfully,

John W. Finch, Secretary

STATE BUREAU OF MINES AND GEOLOGY
BIENNIAL REPORT

Present organization and functions

The Bureau was established by legislative act in 1919. Its duties by law are to study and report upon the geology and mineral resources of the State as an aid to the mining industry; to prepare, or cooperate in preparing, topographic maps which may be used as a base for geological mapping, for agricultural and reclamation works, power developments, and highways; to make hydrographic surveys deemed by the Board to be advantageous to mining, agriculture, water power utilization, or for projects in cooperation with other departments of the state or federal governments; to inspect drilling for oil and gas and record the results thereof; to carry on research upon the problems of the State's mineral industry; to publish results of investigations; to cooperate with bureaus of the U. S. Government on a fifty-fifty basis in field and laboratory study and research.

The Secretary is the executive officer acting under the direction of a Board of Control, of which the Governor of the State is chairman, with one member from the State Mining Association, two from the State University, and with the State Inspector of Mines, all serving without salary. The Board, excepting the Governor, is therefore made up entirely of men directly connected with the mining industry.

Certain changes in the personnel of the Board and in the duties of the Bureau would be advantageous. Inasmuch as the Bureau's usefulness is not restricted to mining, it would be better if there were one member on the Board, in addition to the Governor, who could represent agriculture and other industries, and it is hoped that the legislature may some time approve such a change. Also, the Bureau should not be restricted to cooperation with the U. S. Bureau of Mines and the U. S. Geological Survey only. It should be able to cooperate with any appropriate federal organization, for instance, the Department of Agriculture the Forest Service (to share cost of topographic mapping), the War Department (to save cost of topographic mapping by aerial photography). Request for such cooperation has already been made by the War Department. They desire to cooperate with the Bureau in investigations of metalliferous deposits needed by them in times of emergency.

Mention is made above of the organization and duties of the Bureau because the Secretary, in his visits over the State to inspect cooperative field work, to observe progress in the utilization of natural resources, and to discuss these matters with local people, has found that the residents of the State very generally confuse the Bureau with other departments, particularly with the office of the Inspector of Mines, and on account of these misunderstandings do not give the Bureau credit for the substantial service it is rendering.

The present Secretary entered upon his duties September 1, 1930. He had studied parts of the State as geologist and engineer from time to time over a period of thirty years, and was familiar with such areas and with publications on other regions. But large sections are geologically unknown and he was attracted by these great areas in which are believed to prevail general conditions favorable to the existence of valuable mineral deposits. The State therefore offered better promise of economic results from systematic, scientific investigation than any of the other western states where such studies had already been made and the mineral resources had been largely discovered and utilized. The Bureau had an organization ready to carry on such work.

ACTIVITIES OF THE BUREAU IN 1931-32

U. S. Geological Survey Cooperation

Incidental to the general financial depression and shrinking markets, prices of base metals and silver abruptly decreased and reached low levels, causing first curtailment and finally suspension of operations at the great mines of northern Idaho, which had been the backbone of the mining industry of the State. These mines had been so successful that the exploitation and search for new deposits of gold had been neglected. As gold commands an unchanging market price, it is the obvious metal to seek in times of financial depression. Therefore, wishing to encourage and lend aid to the finding and production of gold, cooperative work with the U. S. Geological Survey was concentrated at the beginning of the biennium in those parts of the State where gold had been produced in the past and where conditions were thought to be favorable for the existence of undiscovered deposits. The federal survey was glad to join in this policy. Field parties were organized and placed in charge of highly trained and experienced geologists from Washington and from the Bureau staff to work in three areas mutually agreed upon. In one of these, field work has been carried to completion and good progress has been made in the others.

Concurrently with this, the Bureau sought to stimulate prospecting for gold. A host of prospectors from the mines of north Idaho, and many miners from other states, sensing the opportunities in the interior of this State, flocked into the territory under study by the Bureau and into surrounding areas. In consequence, the production of gold has increased to several times that of recent years. Much of it has come from placers, but, with so many men in the hills, new gold veins have been found. This is important. Developments have started and output from them will appear within the next year.

The Bureau and the federal survey are preparing preliminary progress reports upon the main features of the three field projects in order that the cooperative work may synchronize with the new gold-mining movement and give mining people the results of scientific conclusions to forestall wasted effort of prospecting in the wrong places and to point out the regions and the geological setting in which ore is most likely to be found.

Value of cooperative work. The obvious advantages of cooperation with federal bureaus are - (1) The saving of 50 per cent of costs, or the doubling of speed and total results; (2) superior work. Three-quarters of a century of experience in the federal survey has standardized and brought to a high efficiency methods of field and laboratory work. (3) Engraving and printing of the texts of reports are done by the U. S. Geological Survey better than by any other establishment in the world. Much better done, of course, than the State could possibly do it. Therefore, by cooperation, there is a high total output of field work and a fine product in ultimate reports. The State, as a matter of fact, pays much less than half of total costs, because the government carries all the expense of clerical help in Washington, engraving, printing, and distributing reports.

Bayhorse project. Before the geological work of the Bureau became concentrated in the gold areas, study of the Bayhorse quadrangle was started in 1929 as a cooperative project, in charge of Mr. Clyde P. Ross, as a part of a systematic plan to cover, step by step, the geology of the unstudied regions of central Idaho. The final laboratory and office work has been under way through the 1931-32 biennium and a bulletin with geologic map will soon be issued from Washington. In this quadrangle, gold deposits are expected to be of secondary importance, but other metals may be found when prices stimulate search for them.

Leadore and Gilmore districts. Before the collapse of base metal prices, the Bureau and the federal surveys were cooperating in the preparation of topographic base maps in these districts which are important fields for geological study as an aid to future mining. Not being primarily promising for gold, but for lead and silver, geologic work was postponed, but the preparation of base maps was continued and completed for later use.

Elk City-Buffalo Hump project. Detailed geologic study in this area was approved by the Board of Control early in the biennium, and cooperation with the U. S. Geological Survey was arranged by conferences in Washington in February, 1931. Dr. Philip J. Shenon, of the federal survey, was placed in charge of the field party. He was assisted by Dr. John Reed of Washington and Mr. Donald Emigh of the School of Mines. The first year was spent in such studies as could be made without a topographic map. Topographic base map was ready for the use of field geologists at the beginning of the second summer's field season and geology has now been entered upon it ready for the engraver. The field work is finished.

A preliminary report on this district is being prepared for use of mining people in time for the next prospecting season. The final report will be issued from Washington and will contain much scientific material derived from study of rocks and ores by the microscope and other laboratory methods. Studies which require time for completion will embody full discussion of rock formations and their relations to ore deposits and of those rocks and structure belts along which ores are likely to be found, and comments will be made upon other areas that are not so favorable.

The field work appears to have made possible certain radical revisions of former interpretations of the ore deposits. For example, prospecting and development have been discouraged by the prevailing belief that commercial ores were secondarily enriched and confined to the shallow zone of oxidation. This fallacy arose partly from the failure of the mills of the old days to make good recovery from the deeper sulphide ores, and partly from a misconception of the geology of the deposits. Modern metallurgy makes high recovery of gold from the sulphides abandoned in former days and it has been shown that the value of

ore depends very little upon secondary enrichment. This is of the utmost practical importance and, when fully understood, should stimulate a real revival of mining in the whole region of the Clearwater Mountains and the interior Salmon River country.

Boise Basin project. This was authorized in the second year of the biennium. For the past season, because of lack of a satisfactory base map, work on detailed geologic mapping was deferred and attention was centered upon a careful study of vein structure and composition of ores, relations of veins to certain igneous rocks and the characteristics of the deep sulphide ores and those of the oxidized zone.

Field work is in charge of Dr. Alfred L. Anderson, of the School of Mines faculty, assisted by Mr. C. Alfred Rasor. During the winter he will make microscopic and laboratory studies of the ores and will prepare a preliminary report, to become available at an early date, which will be helpful to mine operators. Present indications are that a fuller understanding of the nature of the veins of the region, and the processes of their origin, will lead to important new production.

Valuable earlier work has been done by distinguished geologists, but they were restricted in the details they could assemble and consider on account of the lack of an accurate base map. Without such details, full understanding of the ore deposits is impossible. Sufficient appropriation is being requested to complete this survey in an effective way.

The same fallacy became established in the Boise Basin as in Elk City, that only ores near the surface were valuable. It has already been shown that this idea is without foundation. Near the end of the summer high-grade ore was found at a depth of 1,100 feet. Modern ore dressing and metallurgy, properly used, make a very nearly complete recovery of gold from the deep sulphides.

Yellow Pine-Edwardsburg project. This gold belt has features of special interest. The region is becoming accessible for mining by Forest Service roads. Besides gold, it contains important deposits of unusual metals such as mercury and antimony. Some of the gold deposits are in volcanic rocks and were formed at a time and under geologic conditions materially different from those in Buffalo Hump. No thorough, systematic study has been done in the field, except in small areas, therefore a satisfactory explanation of the gold deposits has not been published. Topographic and geologic mapping has been done in detail by Mr. D. C. Livingston in the localities around Thunder Mountain and Stibnite. Mr. Clyde P. Ross also made some general study of the Thunder Mountain district a few years ago.

The final work in the balance of the area, which should reveal the conditions responsible for the ores, cannot be completed without a topographic map. It is located in the most rugged section of the State. The preparation of this base map can be carried on for the next year concurrently with geologic study and made available for geological mapping. A preliminary report can be issued next year which will serve as a temporary guide for prospecting and mining as is being done this winter on the two other projects. Field work for final report should be completed the following season.

Work has been delayed somewhat by periods of serious illness of each of the two geologists appointed in charge of field parties in the two past summer seasons. A particular effort will be made to choose a geologist as chief of part, the coming season who has sufficient physical endurance for the rough mountain work.

U. S. Bureau of Mines Cooperation

It is the aim of this division of the Bureau to contribute in any way possible toward the speediest and best utilization of the State's mineral resources; the initiation of new enterprises and improvement of old ones; reduction of waste and expense; and the increase of profits by invention and improvement of technical processes. Prices of base metals, for instance, may remain at low levels for some time to come and profits may depend upon reduction of costs by improvements in technology. Toward all these general ends, Mr. A. W. Fahrenwald, in charge of mining and metallurgical research, directs the work of this staff.

The nature of cooperation with the U. S. Bureau of Mines differs from that with the U. S. Geological Survey. Special problems arising in the mining and treatment of ores in the State require immediate attention as they appear, and prompt results, if research can produce them. The federal bureau is not always interested in such local problems and is not able to assign experts to cooperate on special and temporary investigations. The plan arrived at by mutual agreement has been to place Mr. Fahrenwald in charge of research in the particular and local needs of the State's mining industry and leave to the federal bureau investigations of general value to the State upon which are expended amounts equal to those expended by the State.

In the past biennium, research has been done upon a great variety of ores sent in from different parts of the State, and specific recommendations have been given to several different companies which enabled them to start successful operations. These companies sought help in the treatment of gold ores.

Among other things, research in metallurgy has confirmed the geological conclusions that commercial ores of the Elk City-Buffalo Hump and Boise Basin region extend into the deep zones of unaltered sulphides. High recovery of the gold by new and modern methods has been made from samples of the ores.

Research problems. In 1931, research was concluded upon several aspects of grinding ores and the effects of grinding on recovery and costs. Results of this work were published and the articles upon them appear in the list of publications shown at the end of this report. Experiments in fine grinding have continued to the present. Research in flotation was resumed in 1931 and is now going on, particularly in its application to gold ores, and lately new studies in amalgamation and cyanidation have been started. Problems related to concentration that have been studied are: (a) Measurement of mineral-solution contact angles, and (b) Measurement of mineral-solution contact electric potentials. Another investigation has been sedimentation studies in relation to ore dressing processes.

A part of these investigations is of a fundamental scientific nature. Others are in the nature of testing investigations. Some of them involve both. Mr. Fahrenwald makes the following comments upon the work of his division:

"In view of the unprecedented low prices of all metals, excluding gold, and the tremendous difficulties under which the mineral industry is now staggering, it is necessary, if many operations are to continue, that production cost be lowered. This can only be done by the introduction of more highly efficient process-machines and methods. Such improvements are more likely to come as a result of scientific studies in the laboratory than from cut and try methods of testing.

The history of twelve years of research in behalf of this Bureau, I believe, bears out this assertion. There is not an operating company of any consequence in the State of Idaho that the Bureau has not assisted, in many cases to a substantial degree, at one time or another. The Bureau is constantly cooperating with the larger companies and many of the smaller ones have built and are operating plants on the basis of technical advice received at or from its laboratory, or from men trained in it.

Our work has also been the basis of improvements effected in other plants outside the State in this and other countries. For example, Mr. Tye, Assistant Superintendent of Concentration, Cananea Consolidated Copper Company, Cananea, Sonora, Mexico, in a letter under date of March 12, 1932, says -

'We increased the speed of the rod mills here from 16.5 to 19.5 r.p.m. with very good results****. Ajo has made wonderful increases in tonnage by increasing from 17 to 23 r.p.m.****. You certainly have attained a unique record of having made great advances in ball milling, flotation, and classification.'

This improvement in fine grinding is the direct result of our published research in ball milling. Concentration in the great Missouri lead-zinc district was revolutionized in 1927 and 1928 as a result of the Bureau's work on fundamentals of classification and the development of a new device. The Michigan copper district is able to operate at a small profit today, because of contributions to the science and practice of flotation from this laboratory."

Incidental to the research in grinding and flotation, Mr. Fahrenwald has invented certain new machines and has proposed improvements in others, and these innovations have been widely adopted not only in Idaho, but in other parts of the world.

A few years ago the Bunker Hill and Sullivan Mining and Concentrating Company made improvements in its concentrators through Mr. Fahrenwald's direct help that gave increased recoveries of lead amounting to \$300 a day. Numerous other examples could be cited.

Therefore, the State of Idaho has not only benefited directly in a material way from the research of Mr. Fahrenwald and his staff, but his laboratory is distinguished by being widely recognized as a center of scientific accomplishment, for instance, a book upon recent advances in ore treatment, published in Norway last year, contains more discussion of the research of Mr. Fahrenwald than of any other individual, or organization, in the world.

Fellows. Mr. Fahrenwald's laboratory work is so well known that there is much competition for positions as laboratory assistants. It has been found advantageous for the Bureau to employ two research fellows. A great number of highly trained graduates from mining and technical schools throughout the country who have skill in research apply for these positions. The Bureau thus obtains, by engaging them upon a fellowship stipend, very effective assistants for Mr. Fahrenwald. This enables him to conduct experiments and tests on several problems at a time. The stipends barely cover living expense, but the fellows are glad to accept these positions because their work with Mr. Fahrenwald gives them professional prestige and is credited by the University of Idaho toward an advanced degree.

State Mineral Resources Investigation

This division of the Bureau has many activities of which the following are examples:

Latah County. Mapping the topography and geology of Latah County, and study of its clays and other mineral resources, are now nearly completed.

Personal conferences and correspondence. Many people of the State who own mineral property, or are seeking mineral deposits, visit the office of the Bureau. A far larger number write letters asking for a great variety of information. Their inquiries are answered by the Secretary, or are referred to members of the Bureau staff who have the special knowledge required. Inquirers seek information upon geology, practical mining methods and equipment, metallurgical processes, markets for ores and metals, the uses of various mineral substances and industrial materials, water supply, federal and state mining regulations, mining laws, and taxation. In this biennium, questions upon the various aspects of prospecting, gold mining and milling, and requests for pamphlets and for the identification of minerals have predominated. About 5,000 replies to inquiries and requests have been mailed.

Determinations of minerals. The minerals of approximately 1,000 samples and specimens have been identified and reported to inquirers in the 1931-32 biennium. This is a service furnished in cooperation with the School of Mines.

Assays. Occasionally prospectors and mining people desire to learn through the Bureau the assay value of ore. It is not possible for the Bureau to do free assaying, because (1) it would require a considerable appropriation for the purpose, (2) it would compete with private commercial assayers, (3) the Bureau would be submerged with requests for assays in numbers impossible to handle. Therefore, applicants for assaying are advised to patronize commercial assay shops. If, however, it is urgently desired, the samples are turned over to a competent chemist for assay, who charges standard fees and in whose work the Bureau has full confidence.

Information for prospectors. On account of the fall in base metal prices, the Bureau started in 1931 to stimulate gold mining by the publication of a pamphlet for the inexperienced man upon placer mining. This pamphlet was prepared by Mr. W. W. Staley, the Bureau mining engineer. This was followed in 1932 by a pamphlet upon the extraction of gold from its ores by Mr. A. W. Fahrenwald and a pamphlet upon prospecting for gold ores by the Secretary. All these pamphlets have been in great demand. Mr. Staley's pamphlet was especially timely and was so well designed for the uses of the practical miner that six editions were issued and exhausted, and there are requests for several hundred more. Hundreds of letters of commendation have been received. Other states and the Canadian provinces have found it desirable to issue a publication similar to this and have quoted its contents; some of them have reproduced it bodily. A reprint was distributed in Canada from coast to coast by the Canadian National Railways. The other two pamphlets were also non-technical so far as possible and are being used by miners in Idaho as well as in every gold-mining state of the country. Although prepared in simple form for the practical man, they have been commended by the metallurgists and geologists of the country as valuable scientific presentations of the subjects treated.

Through the period of reviving interest in gold-mining, the Bureau has given prospectors every possible aid by supplying them with the facts in its possession. This is done (1) because an increase of gold-mining will greatly benefit the State, and (2) it has served to relieve unemployment. The depress-

ion induced many people, both men and women, to go pioneering into the hills. Among these were a few old-timers and some experienced miners, but to the majority it was a novel experience. Some were provided with funds, others depended for their living upon the gold they could find in placer gravels. Of the latter, it was found that those who were not afraid of hard work either made a good profit or at least a living. Thus, a new generation of prospectors is being trained and the results to the State may be of great importance.

Probably the most effective help was given by the three pamphlets mentioned above. In addition to these, lectures were delivered by members of the Bureau staff in Spokane and in centrally located towns of the State, explaining to large audiences, made up of those proposing to go into the hills, details of prospecting and camp equipment, methods of operating placers and of search for ore, location of claims, precautions to be observed for health and safety, and some of the fundamental principles of geology.

Drilling for oil and gas. As required by act of the legislature in 1931, the Bureau has kept informed upon drilling done in favorable localities and has samples of cores of the beds drilled in the Payette-Weiser regions. There has been a decrease of drilling activity during the depression, but there is reason to hope for resumption. Good showings of gas have been developed and it is still possible that production may be found in the broad parts of the Snake River Plains and in the folded older rocks of east and southeast Idaho.

MISCELLANEOUS ACTIVITIES

War Department. The Bureau and officers of the U. S. Geological Survey have discussed with the War Department the methods and cost of topographic mapping by aerial photography. This, it is believed, might be a means of saving considerable expense. The maps are superior to ordinary topographic sheets for geological mapping and large areas can be covered rapidly and comparatively cheaply. Also, as already stated, correspondence is being conducted upon cooperation in general study of sources of metals.

Ground Water. Two irrigation districts of the State expressed appreciation of help from the Bureau. Mr. D. C. Livingston, Bureau geologist and member of the School of Mines faculty, made a useful study of the geology of the Big Lost River Valley. He found and explained the reasons for the fluctuation of water supply, also defined the limitations of the supply, so that the communities were able to organize for the effective use of available water. Rathdrum Prairie was studied in a similar way by the Secretary and report published in the press for the benefit of residents. Work on these two problems was done in cooperation with the State Bureau of Reclamation.

The Bureau also cooperated with the federal and state reclamation services in the survey of underground water resources of the Snake River Plains. Maps and reports are now published.

National conferences. The Secretary attended the Annual Meetings of the American Association of State Geological Surveys held in the offices of the U. S. Geological Survey each year in February. Suggestions for increased effectiveness of cooperation between federal and state organizations were thoroughly discussed and plans to secure with economy the maximum benefits to the states. The plans for Idaho cooperation were privately considered and outlined with the director and chiefs of divisions.

A meeting of the same national organization in January was attended by Dr.

Alfred L. Anderson, geologist of the Bureau, who reported to the Secretary results of discussions similar to those held in Washington.

U. S. Forest Service. Correspondence is being conducted, seeking to enlist cooperation of the Forest Service in sharing expense of topographic mapping of Bureau projects located in forest reserves and the Primitive Area.

In all unofficial matters, relations with the Forest Service have been most cordial. Useful suggestions have been offered to prospectors and, in many cases, definite assistance has been given. One forest official assembled a collection of rocks and veins minerals, accurately labeled by the Bureau, for the information of prospectors.

Timber companies have also been hospitable to miners and have aided prospecting on their private lands.

FUTURE WORK

Mindful of existing financial conditions, and anticipating the desire of the next legislature to reduce appropriations to a minimum, every possible reduction of requests in the report to the Budget Officer has been made. The appropriation asked will serve barely to carry to completion present projects and a few incidental expenditures necessary in the office of the Bureau. The appropriation requested is \$8,128.00 less than that requested and approved for the 1931-32 biennium. The largest departmental request is that to carry through to completion U. S. Geological Survey cooperation in projects now under way in the gold areas of the State. Preliminary information distributed to mining people in the form of pamphlets, and in lectures, setting forth our present knowledge, have been useful, but much greater help will be given to miners when final reports are distributed. It is believed that to give the present revival of gold-mining its most effective impetus, it is necessary that the detailed study now being carried on be completed at the earliest possible date. With the money requested, progress reports containing present information will be issued before the opening of the next summer season and final reports printed in Washington will probably be ready for the following season.

The uses of geological study in mining. It is found that ore deposits, when they are formed, seek certain rock formations in preference to others. One class of rocks (igneous rocks) has a peculiar importance. They may not contain much ore, but their presence near at hand is necessary in a mining district because the ores came up from great depths in the earth when these rocks arose in molten form, and, as the igneous rocks solidified, the ores spread out into other favorable surrounding formations. To arrive at these relations in a given district requires high training, skill, and experience in a field geologist, and detailed mapping on the ground. The rocks favorable to ore deposits are just as likely as not to be covered by worthless materials, but it is sometimes possible for the geologist to suggest how to find such concealed formations after all the details have been mapped in surrounding areas. This has been successfully done in Tintic, Utah, and lately in Colorado.

If the owners of an old mine can be directed to profitable new ore, or, by the Bureau laboratory research, shown how to profit from known ore left in the ground when methods were crude, if a single important new gold deposit is uncovered, or if a single important laboratory discovery is made which creates a profit where there had formerly been a loss, the cooperative scientific work of the Bureau will be repaid many times over by taxable new production and by the distribution of new wealth in trade and many forms of property.

The cost of driving exploration tunnels, cross-cuts, and drifts, is fifteen to twenty-five dollars a foot, according to conditions. It is important, therefore, not to drive them blindly if information can be obtained which increases the chances of success in such developments or affords a warning against doing such work in the wrong places or in the wrong directions. Accurately reported geology, properly interpreted and applied, could be made to serve as an aid in such circumstances.

In a class by themselves are the clay deposits of Latah County and other parts of northern Idaho. An enormous manufacturing industry will some day be built upon these deposits. It will take time for the industry to develop, but this Bureau expects to assemble and publish the information upon which it can be started. Raw materials inferior to these clays for the manufacture of a great volume of ceramic products are now shipped to the Pacific Coast and middle west from foreign countries.

Fields of usefulness that might be expanded at little expense by cooperation are geological studies of artesian water possibilities, prevention of soil erosion preservation of grazing ranges by soil development and protection, prevention of alkali accumulations on irrigated lands, and location of materials available for road metal.

PUBLICATIONS

1931

Ball Mill Studies, I, by A. W. Fahrenwald and Harold E. Lee, and Ball Mill Studies, II, by A. W. Fahrenwald, G. H. Hammar, W. W. Staley, and Harold E. Lee, American Institute of Mining and Metallurgical Engineers.

Effect of Grinding Time and Pulp Dilution by Flotation, by A. W. Fahrenwald, Engineering and Mining Journal.

Genesis of the Anthophyllite Deposits Near Kamiah, Idaho, by Alfred L. Anderson, Journal of Geology.

Geology and Underground Water Resources of Big Lost River Valley, by D. C. Livingston, Press Bulletin.

Alkaline Rocks of the Highwood Type in Southeastern Idaho, by Alfred L. Anderson, (co-author, V.R.D. Kirkham) American Journal of Science.

Elementary Methods of Placer Mining, by W. W. Staley, Idaho Bureau of Mines and Geology.

Solubility, Peptization, Wetting and Flotation, by A. W. Fahrenwald, Trans. Electrochemical Society.

Geology and Water Supply of Hayden Lake and Rathdrum Prairie, by John W. Finch, Press Bulletin.

Mine Ventilation in the Coeur d'Alene Mining District, by G. E. McElroy, U. S. Bureau of Mines Information Circular No. 6382.

1932

Relation of Fineness of Grinding to Mill Capacity, by A. W. Fahrenwald, American Institute of Mining and Metallurgical Engineers.

Geology and Mineral Resources of Eastern Cassia County, Idaho, by Alfred L. Anderson, Idaho Bureau of Mines and Geology.

Tertiary Igneous Rocks in Idaho, by Alfred L. Anderson, Northwest Science.

An Occurrence of Giant Hornblendite, by Alfred L. Anderson, Journal of Geology.

The Recovery of Gold from Its Ores, by A. W. Fahrenwald, Idaho Bureau of Mines and Geology.

Effects of Reagents on Aqueous Suspensions of Pulverized Materials and Relation of This Effect to Flotation Concentration, by A. W. Fahrenwald, American Chemical Society.

Notes on the Oxidation of Jamesonite, Sphalerite, and Tetrahedrite, by Alfred L. Anderson, Economic Geology.

Genesis of the Mica Pegmatites of Latah County, Idaho, by Alfred L. Anderson. Economic Geology.

A Major Overthrust in Western Idaho and Northeastern Oregon, by D. C. Livingston, Northwest Science.

The Non-Metallic Mineral Resources of Idaho, by Edward L. Tullis, Pit and Quarry Magazine.

Prospecting for Gold Ores, by John W. Finch, Idaho Bureau of Mines and Geology.

The Gold Situation, by John W. Finch, Paper presented before the U. S. Chamber of Commerce, Review in Nation's Business.

Cassia City of Rocks, by Alfred L. Anderson, Geographic Review.

The Clays of Idaho and Eastern Washington, by F. B. Laney and Edward L. Tullis, Northwest Science.

The Geology and Mineral Resources of the Casto Quadrangle, Idaho, by Clyde P. Ross (nearly ready for publication by the U. S. Geological Survey).

Structure and Genesis of the Cassia Batholith, Idaho, by Alfred L. Anderson (to be presented in December before the Northwest Scientific Association).

Petrography of the Idaho Batholith in the Boise Basin, by Alfred L. Anderson and C. Alfred Rasor (to be presented in December before the Northwest Scientific Association).

Ancient Glaciation in Idaho, by Alfred L. Anderson (to be presented in December before the Northwest Scientific Association).

Reports and articles in the above list which the Bureau could not print and distribute itself, because it did not have sufficient funds, the scientific societies and journals were glad to publish. Those who are interested in reading them can find them in university and city libraries.

CONCLUSIONS

The proper function of the Bureau is to furnish facts rather than advice. It is its business to accumulate, assemble, and place in usable form the facts of the geology of mineral deposits and their amenability to treatment and profitable disposal, the utilization of mineral materials valuable not only in mining, but in any other industries of the State. It is the Bureau's aim to make such facts available in published form, so that the professional engineer and those having capital to invest can be furnished with trustworthy fundamental information upon which to plan industrial enterprises.

Modern industry is much given to research. Its laboratories in normal times make frequent discoveries of new uses for old raw materials, or suddenly create demands for some natural substance theretofore regarded as worthless. Hence, it is important to find where all the kinds of earth materials are located so that they may be utilized when needed.

It is hoped that there may be a balance of opinion in the State favoring the encouragement of the pioneer industry upon which the State was founded. It is still a basic and vital industry. We are sure that new ore bodies can be found. If the search for them can be scientifically directed, much time will be saved in finding them. We know equally well that the State is potentially rich in non-metallic wealth which needs to be brought to public attention.

It is most important that work in mapping and reporting upon the areas under study in present Bureau projects not only be carried on and completed, but that a continuous program be followed which will connect these areas by geologic mapping and ultimately cover every part of the State that promises to yield mineral wealth.

Respectfully submitted,

John W. Finch
Secretary of the Board of Control
Idaho Bureau of Mines and Geology

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