The ORE BIN
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A IS FOR ALBANY, Z IS FOR ZIRCONIUM

By R. W. deWeese* and R. S. Mason**

Albany, Oregon and zirconium are inextricably linked, at least in the thinking of the metallurgists in the Free World who concern themselves with the space-age metals. It was at Albany in 1945 that Dr. W. J. Kroll started work with the United States Bureau of Mines on a research program to develop a process for producing ductile zirconium. At that time zirconium was practically a laboratory curiosity - and a metal with great promise but with recalcitrant metal-working qualities. Two years later the Kroll process for ductile zirconium was perfected, and a pilot plant capable of turning out 60-pound batches of metal was operating.

Such was the beginning of a development involving many other metals which was to change the economy and character of the city of Albany, and indeed to affect the entire state. The transition from an abandoned small college campus to a nationally recognized center for exotic metals required only 10 years. Starting with an original investment of $140,000 for the old Albany College buildings and ground, the federal government's Albany installation is now valued at $4.5 million.

But the U.S. Bureau of Mines operation is only a part of the metallurgical complex that has developed in Albany. Wah Chang Albany Corp. with 950 employees and Oregon Metallurgical Corp. with 250 employees both located plants in sight of the Bureau's center directly because of the latter's presence there. In addition, two other companies, Northwest Industries and REM, Inc., have located in Albany, directly as a result of the Bureau's activities. Currently metallurgical payrolls exceed $12 million annually, with approximately 1,500 men employed on a year-around basis. The stabilizing effect of this continuous employment on a community that has been traditionally tied to an economic yo-yo, controlled by seasonal agriculture and lumbering, has been tremendous. The metallurgical industry in general and the exotic metals field in particular, as exemplified by the Albany operations, require highly skilled technicians, carefully trained metallurgists

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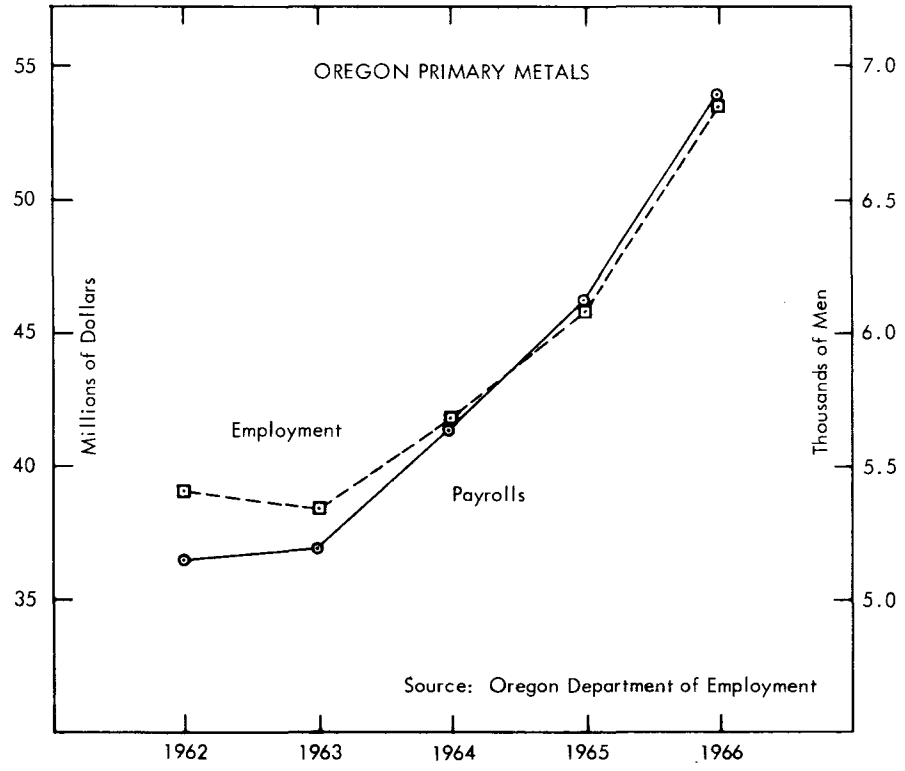
Note: This article is based upon a talk by Mr. deWeese before the House Planning and Development Committee, Salem, Oregon May 2, 1967.

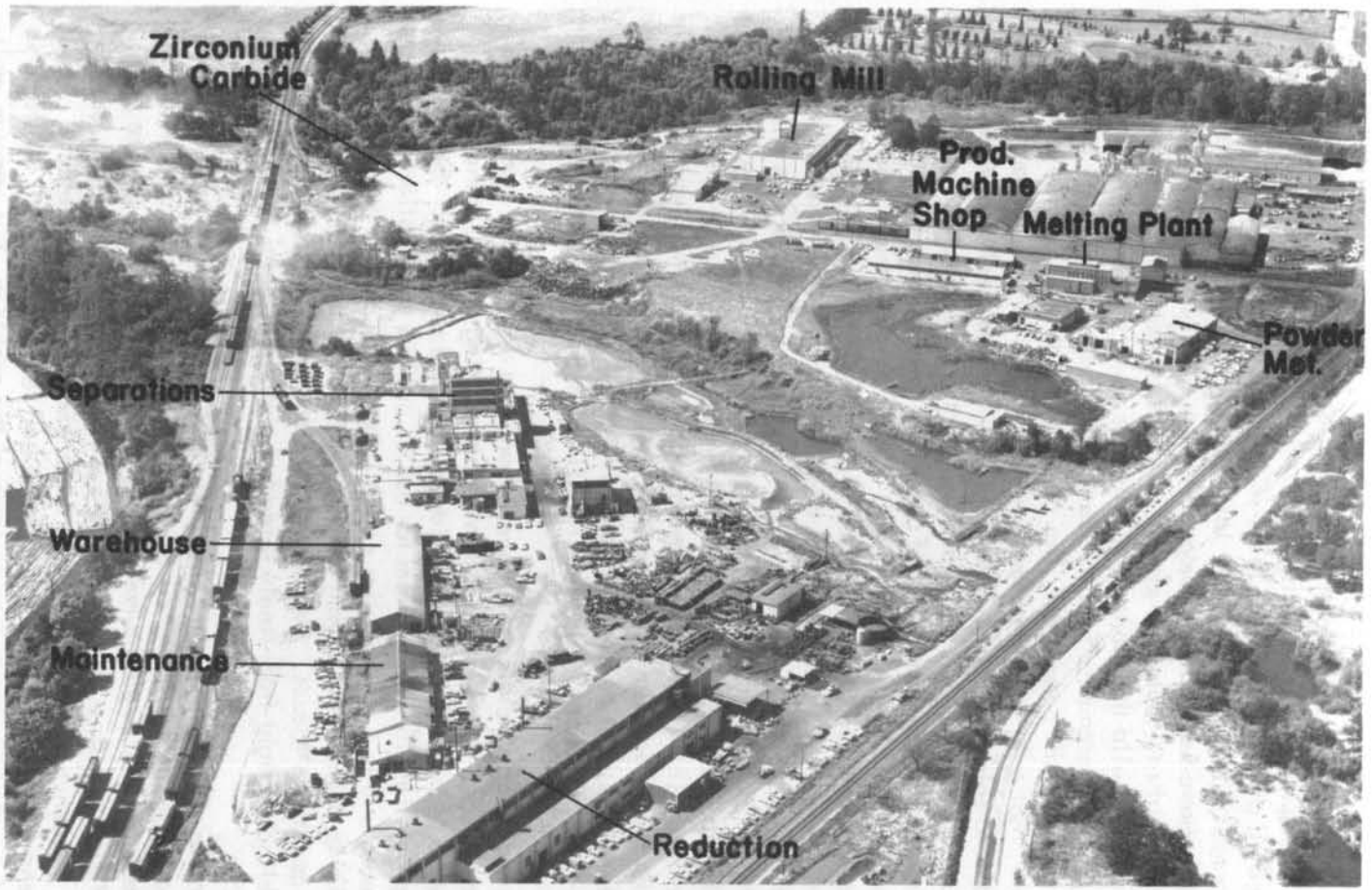
Graph showing payroll and employment trends in Oregon's primary metals industry.



and scientists, and an administrative group able to relate the metallurgical demands of the future to the capabilities of the present. The materials and services required by the Albany complex are substantial, despite the fact that all of the mineral raw materials used originate outside of the state.

Albany is twice fortunate in having the metallurgical complex in its midst. Any industry or, for that matter, any human activity, creates some pollution of either air or water or both. The Albany metallurgical complex very probably produces less air and water pollution per payroll dollar, tax dollar, or value of product dollar than any other type of industry in the state. Space-age metals prices have been decreasing as technologies have improved and volume has increased, but the metals are still bought and sold by the pound rather than by the ton. Every bit of scrap metal is saved and reprocessed, since even it has a value of quite a few dollars per pound.

The question has often been asked: "Why is Albany a metallurgical center?" The answer is simple. The establishment of the U.S. Bureau of



Aerial view of Wah Chang Albany Corporation plant at Albany, Oregon.

Mines Northwest Electrodevelopment Laboratory at Albany provided the opportunity for research into electroprocessing of metals. The U.S. Bureau of Mines is essentially a research organization, and once the new process was perfected at the pilot-plant level it was turned over to industry for commercial production. From a purely logistical standpoint the commercial plants could have been located anywhere in the United States, since the transportation of raw materials plays a very small part in the over-all cost. The decision to build the plant at Albany was made purely on the basis of proximity to the Bureau staff which developed the process and to available trained nontechnical personnel. The decision has proved to be a mutually happy one, not only for the commercial plants but for the Bureau as well. Technical and scientific know-how have been traded freely between the various organizations. The fruits of this scientific cooperation are now being harvested as a formidable list of "new" metals now available to modern technologies. Included in this list are: titanium, columbium, hafnium, molybdenum, tungsten, tantalum, and of course zirconium. In short, the Albany exotic-metals complex exists because of the intimate interchange of ideas rather than because of materials. The Albany complex is a tribute not only to the U.S. Bureau of Mines which provided the opportunity for research, but to Dr. Kroll, who perfected the basic processes - and to the many metallurgists whose close cooperation at all levels has made it possible to develop the various space-age metals rapidly enough to keep this country competitive both industrially and defensively. At times the weather may be a bit damp in Albany, but the scientific climate is wonderful the year around.

The space-age metals that leave Albany are destined for many exotic and special uses. Some are excellent heat-resisting metals; others withstand the corrosive effects of hot acids or ice-cold sea water. Several have special properties which suit them for use in nuclear applications, and some have been found to have peculiar capabilities which permit them to be used in rebuilding parts of the human anatomy without upsetting the chemical balance or degrading tissues. Even the ubiquitous photographer's flash bulb gets its blinding light from finely shredded zirconium metal foil made at Albany.

Man has practiced the art and science of metallurgy since the dawn of the Bronze Age. Early man could refine only the simplest of metals, such as copper and iron. Today's metallurgist produces metals which are not only difficult to refine from their ores but which show an amazing, but annoying, tendency to recombine with other elements before they can be used. To this end many special techniques have had to be developed. Melting in oxygen-free atmospheres overcame some of the problems, but vacuum melting which excludes all gaseous elements is practically a standard procedure in exotic-metals plants today. Some exceedingly high-purity metals must be refined with the aid of electron-beam melting, a process which selectively vaporizes impurities in a high vacuum. It has been found that the

High-temperature Metals

	Specific Gravity	Melting Point	Boiling Point
Nickel	8.9	1452°C	2900°C
Cobalt	8.9	1480	2900
Chromium	7.1	1615	2200
Zirconium	6.4	1700	2900
Vanadium	5.8	1715	3400
Titanium	4.5	1800	3000
Columbium	8.4	1950	3300
Hafnium	13.3	2207	3200
Molybdenum	10.2	2620	3700
Tantalum	16.6	2850	4100
Tungsten	19.3	3370	4727
Iron	7.86	1535	3000

presence of even minute amounts of impurities such as oxygen, hydrogen, nitrogen, or carbon seriously affect the workability of many of the space-age metals.

Needless to say, the specifications established for the metals are studded with maximum impurity limits located well to the right of the decimal point. The story is told of a plant which was in danger of having its space-age metal castings rejected because of high boron content. The raw material did not contain boron, nor did the metal during the various stages of refining. Sample drill chips did, however, reveal too much of the offending element. After much checking and searching, it was discovered that a can of nationally advertised powdered hand soap used in the washroom was the source of the contamination.

The accompanying table, which gives the specific gravities, melting points, and boiling points for the space-age metals, clearly reveals why some of them are so eagerly sought for high-temperature applications. By comparison, ordinary cast iron has a specific gravity of 7.86, a melting point of 1535°C., and a boiling point of 3,000°C.

Brief descriptions of the space-age metals being processed at Albany are contained in the following paragraphs, together with some notes on the development of the area's metallurgical capabilities.

Titanium

Titanium is an unusual metal. It is the fourth most plentiful element on the surface of the earth, although it occurs in forms in which the extraction is complex and costly. The most common source is a sand bearing the name "rutile," which is chemically titanium dioxide. Titanium and its alloys have approximately 60 percent of the weight of steel, but have unusual properties of higher strength than steel at elevated temperatures. The metal must be melted under vacuum because it reacts with oxygen, nitrogen, and hydrogen in the atmosphere. For that reason it and some of its sister metals such as zirconium are described as "reactive metals." In addition to its high strength-weight ratio at elevated temperatures, titanium has extraordinary corrosion resistance to chlorine and other acids and, as a result, this metal has a tremendous potential growth, not only in space missiles and aircraft, but also in the desalination of sea water and many other chemical processes.

Titanium first became evident on Oregon's scientific horizon in the late

Aerial view of Oregon Metallurgical Corporation plant at Albany, Oregon.

1940's and early 1950's at the Bureau of Mines in Albany. Work that was done there under the direction of Dr. Kroll resulted not only in refinements on what is now known as the Kroll process for the reduction of titanium, but also significant experimental work in zirconium.

The commercial history of titanium in Oregon, however, began late in 1955 and early in 1956 when a group of 13 individuals made the decision to invest approximately one and a half million dollars in what was at best a highly speculative venture. The group possessed the technical knowledge and leadership of Mr. Stephen M. Shelton, who subsequently resigned from the Bureau of Mines to assume the presidency of Oregon Metallurgical Corp., plus approximately 30 technicians who had been working in reactive metals for the previous nine years. In the 11 years from 1956 when the corporation was formed to 1967, Oremet has experienced both great achievements and great disappointments. For 11 years the directors, the officers, and the staff of Oremet have been searching for new methods, new processes, and new products, in order to assure its future growth and to create new opportunities for development.

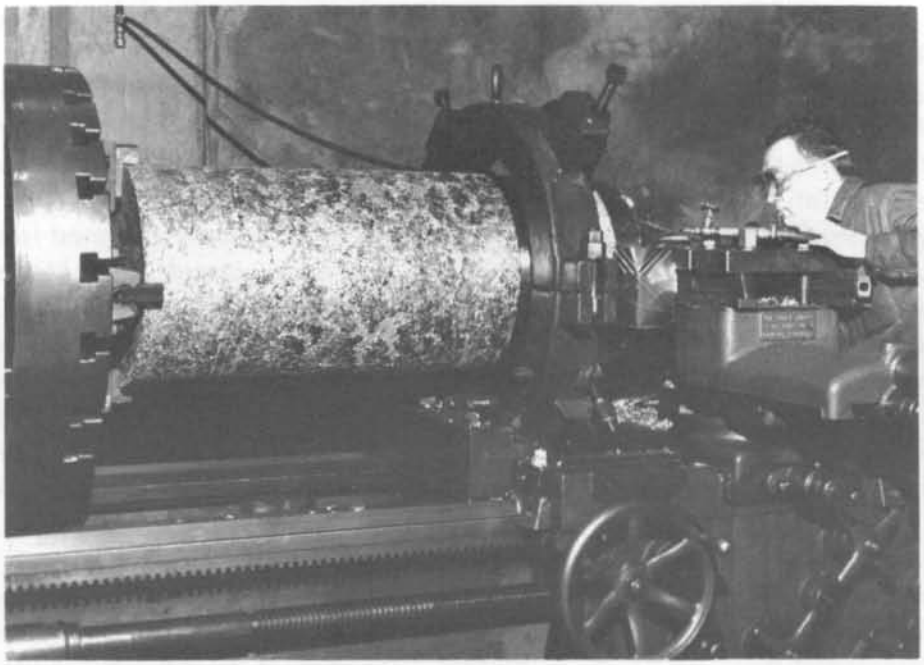
Approximately two years ago, Oremet began the initial experimental work in a new process for producing and refining titanium sponge. The initial secretive work was highly promising and indicated that if it were completely successful it could reduce the cost of producing sponge approximately 25 to 30 percent below the prevailing estimated cost of other titanium-sponge producers in the United States.

The major producers then and today in the United States and in the world are the Titanium Metals Corp. of America in Henderson, Nev., and Reactive Metals Corp. of Niles, Ohio. These two companies were the sole producers of titanium sponge in this country until Oremet undertook its present expansion.

The new Oremet process was developed behind "closed doors," patents were applied for, and pilot-plant production was authorized. In January 1966 the first furnace went on stream, and by June the new processes were achieving the projected results.

Oregon Metallurgical Corp. began producing titanium sponge early this year. The sponge is the raw material from which titanium-mill products such as sheet, plate, bar, and wire are made. Production is at the rate of approximately 300,000 pounds per month, or 3,600,000 pounds per year. The estimated total national production of titanium in 1966 was 30,000,000 pounds, and it is therefore evident that in the first stage of current development the plant will have approximately 10 percent of the nation's capacity for this critical metal.

Interest in the new process was apparent among several large American corporations, all eager to share in titanium's future. At least five major companies explored the possibility of some form of association, merger, or joint venture as a means of participating in the full exploitation of the Oregon Metallurgical Corp. processes.



Machining zirconium ingot preparatory to shipment from OREMET plant.

Within two years Oregon Metallurgical is expected to be a fully integrated titanium sponge and ingot plant. Rutile, probably shipped from Australia, will be converted to titanium tetrachloride and then to titanium sponge. Projected capacity in sponge will be 12,000,000 pounds per year.

Zirconium

The element zirconium is a reactive metal of the same general physical appearance and properties as titanium. Zircon-rich sands in Florida supply most of the domestic ore production, with Australia providing the bulk of foreign ore. Its unique properties consist of corrosion resistance and nuclear properties often referred to as the "cross sectional area." In a nuclear reactor, neutrons that are released by uranium or any other fissionable fuel are under normal circumstances absorbed or slowed down by the material which surrounds or clads the uranium. Zirconium absorbs a minimum of neutrons, and hence is of primary importance in virtually every nuclear reactor in operation today, because it can be used efficiently as the protective physical envelope for uranium fuel.

This metal first became of importance to Oregon in the early 1950's, when the Bureau of Mines began to scale-up a laboratory process to a

practical method of removing minute percentages of the element hafnium from zirconium.

Metallic zirconium normally contains from $1\frac{1}{2}$ percent to 2 percent hafnium. Hafnium is an extraordinarily high absorber of neutrons and would make the zirconium virtually useless in an atomic reactor. In other words, the neutrons that are being released by the uranium fuel would not pass through the hafnium-contaminated zirconium and the speed of the reaction would be decreased. The neutrons would be absorbed by the $1\frac{1}{2}$-percent hafnium dissolved in the zirconium matrix. The Bureau of Mines developed a production-scale process, secret at the time, known as liquid-liquid exchange, which was and is the best-known commercial process of separating zirconium from hafnium.

Most people in Oregon are not aware of it, but in 1954 when the Nautilus submarine program began, the entire output of the Bureau of Mines in Albany was, in effect, commandeered by Captain (now Vice Admiral) Hyman G. Rickover, who as head of the nuclear power division of the Navy Bureau of Ships and head of the Atomic Energy Commission's Naval reactor branch, ramrodded the development of this revolutionary vessel. Planes flew from Washington or from other key parts of the eastern United States to Portland, and the reactor-grade zirconium was conveyed under personal guard to the point of use. On several occasions, Captain Rickover made trips to the Bureau of Mines at Albany in order to assure himself that progress was being made in the production of the then-scarce nuclear-quality zirconium.

In 1955 when the Bureau of Mines facility was being diverted to other purposes, the Wah Chang Albany Corp. took over the equipment and has continued to produce zirconium sponge in a reaction similar to that which is employed for the production of titanium. Wah Change is the largest producer of reactor-grade zirconium today. In addition, zirconium is further processed at Wah Chang on a Sendzimir mill, where this highly reactive metal is rolled into almost tissue-thin coils of metal four or five ten-thousandths of an inch in thickness and subsequently sold to the photographic flashbulb manufacturers.

Other than this one commercial use, it is substantially true that 100 percent of the zirconium produced in Oregon today finds its way into the atomic energy program, either industrial or military.

Columbium and tantalum

Because tantalum and columbium always occur together in nature, it is necessary to separate them completely, with a result that normally a metal producer such as Wah Chang will produce both elements.

Tantalum derives its name from the Greek myth of Tantalus, because it was so tantalizing to extract and reduce to metal. Niobe was the daughter of Tantalus and from this came the designation niobium (columbium). The

renaming of columbium is discussed at some length by J. Lawrence Smith in an article which appeared in the American Journal of Science, Third Series, Vol. XIII, No. 77, May 1877.

Wah Chang Albany Corp. is probably the major producer of columbium and tantalum in the United States. Principal ore-producing countries are Nigeria and Brazil; essentially no columbium ore is mined in the United States, although it was first discovered on the East Coast. This metal, called niobium in European scientific circles, is almost entirely employed for atomic shielding and containers of various elements of small nuclear power plants such as the now-discontinued nuclear-powered aircraft project. High-purity columbium is refined in electron-beam furnaces, a very advanced and extremely expensive form of melting equipment. The price structure for columbium in its normal form probably ranges now between $30 and $40 per pound. Columbium in the form of ferro-columbium is also used in the production of stainless steels to stabilize or to improve the corrosion resistance of these alloys under certain conditions, such as welding. Steel pipe or tubing containing small amounts of columbium can be field-welded without preheating.

Tantalum has been used for many years for its resistance to corrosion. This property, coupled with its ductility, has made it extremely popular in the industry. Its electrical properties make it useful in the manufacture of powder and foil capacitors. Wah Chang produces the capacitor powder and foil in addition to ingot, forgings, sheet, rod, and other mill products.

Nickel

Until approximately 10 years ago, the United States, the world's largest user of the element nickel in the production of corrosion and heat-resistant alloys, was entirely dependent upon Canadian or other foreign supplies. Even at the present time, the Hanna Mining Co. and the Hanna Nickel Smelting Co. mine and smelter in Riddle, Oregon, produce the only nickel within our 50 United States. In Douglas County, near the town of Riddle, exists a relatively large deposit of lateritic nickel ore. This ore contains approximately $1\frac{1}{2}$ percent nickel, in a rather complex mixture of other materials. The Hanna Mining Co., using a patented French process, developed a commercial process of refining this ore and producing nickel in the form of ferro-nickel. The commercial alloy produced there is a metallic pig containing from 49 to 53 percent nickel and the balance iron. It is used for the production of many corrosion-resistant alloys that are essential in the chemical, food, space, and aircraft industries. The Hanna organization has a great investment in southern Oregon and its contribution to the mining development of Oregon has been unique. Constant exploration is being undertaken through much of that region in order to expand the known laterite deposits and to extend the life of this important mining operation.

In excess of 90 percent of the nickel used in the United States comes to us from Canada. Other available supplies are New Caledonia and Australia in the South Pacific, with potential developments in Guatemala, and large Finnish deposits near Petsamo on the Arctic Circle. Nickel is being sought throughout the world.

Obviously, these supplies in other nations are in demand by the steel industry of Asia, Russia, and Europe. Without Canadian nickel supplies, the United States production of many critical alloys would come to an almost complete halt.

Other exotic metals

Vanadium: Oregon Metallurgical Corp. is the nation's major producer of high-purity vanadium, which is up-graded from low-purity vanadium by a method of electrorefining. High purity is critically important in the alloying of other metals such as titanium, and a number of experiments are being conducted in order to determine its useful nuclear properties. At the present time, high-purity vanadium sells for about $22 per pound.

Yttrium: Yttrium and gadolinium might be termed "laboratory metals." Yttrium itself is among the group that is catalogued as "rare earths" and is sometimes employed in mixed form in the production of phosphors, which coat most of our newer color-television tubes. Yttrium-hydride, as a metal, has some potentially valuable nuclear properties and experimental work is continuing. There is no way to set a price on this metal, because of the fact that its production is in such minute quantities. To a large extent the same thing is true of the metal, gadolinium, which again may have nuclear properties as yet not clearly defined.

Hafnium: The world supply of hafnium is derived through the separation process in making reactor-grade zirconium, since it always occurs in nature with zirconium. Because hafnium has a very high neutron-absorption factor, it can be used for the control rods or safety mechanisms in an atomic pile. Hafnium is an extremely heavy metal, weighing $2\frac{1}{2}$ times as much as steel. Being a sister metal to zirconium, it results as a coproduct of the zirconium separation. There are an increasing number of uses for this very interesting metal. One important application is as an alloying ingredient with columbium for space-vehicle construction, and another as a highly refractory carbide.

Alloy steels

Even though Oregon does not possess any large deposits of basic raw materials such as iron ore and coal, the state is a significant producer of Fe-Cr-Ni alloys for corrosion, heat, and abrasion. ESCO Corp. in Port-

land, as an example, is a world leader in the production of nuclear-quality castings for the generation of atomic power. Ninety percent of all these alloys are destined for industrial use, not for military purposes. Precision Castparts, in Milwaukie, Oregon, is acknowledged as an innovator and pacesetter in the manufacture of precision castings used in jet engines, space research, and the manufacture of aircraft.

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WORLD MINERAL PRODUCTION IN 1966 SETS NEW HIGH

World mineral production reached a new high in 1966, according to the U.S. Bureau of Mines. On the basis of a detailed study of 65 mineral products that normally account for a large proportion of the value of all mineral output, the bureau estimated that production of 37 of the 65 commodities reached new peaks in 1966; 7 showed gains in 1966 over 1965 but failed to reach or exceed former highs; 2 remained the same; and 19 recorded decreases.

The bureau's appraisal showed that aluminum production in the world was 8.3 percent above its former record of 1965. Production of bauxite increased 5 percent. Copper also reached a new world peak in 1966; mine output was 4.8 percent larger than in 1965. Production of lead, zinc, and tin rose 6, 5, and 4 percent respectively over 1965.

World production of steel ingots and castings in 1966 was 3.4 percent higher than 1965. A record tonnage of pig iron was required to meet the 1966 demand for steel.

Of the precious metals, gold rose to a new high, more than 0.86 percent above 1965. Silver production declined 0.43 percent in 1966 compared with 1965. Output of platinum-group metals also declined 0.67 percent.

Coal continues as a principal source of power. Its proportional share of total energy requirements, however, continued the declining trend which has generally prevailed since the middle of this century. The production of coal increased 1.6 percent over 1965, while petroleum rose 9 percent.

Fourteen of the 23 nonmetallic minerals included in the Bureau of Mines tabulation rose to new production highs in 1966. The 14 minerals were asbestos, barite, hydraulic cement, gem diamonds, feldspar, fluorspar, gypsum, phosphate rock, potash, pyrites, salt, sulfur (native), talc, and vermiculite. Notably, world output of hydraulic cement advanced 6.7 percent over 1965. (American Mining Congress News Bulletin, Oct. 10, 1967.)

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MINING POLICY ESTABLISHED

The following resolutions were included in the declaration of policy which was adopted by the American Mining Congress in session at Denver, Colo., September 10, 1967.

Public lands

Our growing population, expanding economy, and modern armament require a constant increase in the supply of metals and minerals, and recent forecasts indicate that the requirements for minerals and mineral fuels will double by 1980. The responsibility of searching out and putting into production the necessary ore bodies will be that of the American mining industry. As the nation's hidden mineral resources cannot be developed and their value to the country determined until after they are discovered, public lands should be kept open wherever possible to mineral exploration and the location of new discoveries.

The Public Land Law Review Commission is demonstrating that it is making a thorough and comprehensive study of the Public Land Laws of the United States, among which are the laws relating to the acquisition of titles to mineral lands. The approach of the Commission's membership has been objective, and we expect its conclusions and recommendations will be in the best interest of the public and the mining industry.

We are confident that this study will recognize the importance of preserving the fundamental principles of the mining laws, which are based upon the right of individuals to search for, discover, develop, and acquire title to the metals and minerals lying within the public domain.

The law of discovery, as intended by the Congress in enacting the mining laws and as interpreted by the decisions of the courts, has encouraged the search for and development of new ore bodies. However, the Office of the Solicitor of the Department of the Interior continues to distort the law of discovery so as to discourage rather than encourage this search. The original concept of discovery should be maintained.

Exploration must, for the most part, be directed to the discovery of nonoutcropping and often deeply buried mineral deposits. Hence, appropriate supplementary legislation, in keeping with the basic concepts and intent of our mining laws, is required to afford reasonable prediscovery protection to one who is in good faith engaged in seeking a discovery of minerals. Such protection is needed to encourage expenditure of the large sums necessary to carry forward mineral exploration.

We recognize that the public lands should be used in as many ways as their resources permit, and we again express our agreement with the principle of multiple use. The public domain should be open to compatible uses even where one use predominates. No area should be closed to exploration for minerals or to mining in the absence of a compelling national interest

demonstrated in a public hearing.

We endorse pending legislation which would limit withdrawals of public domain by governmental agencies without prior congressional authorization. The Congress should explicitly and with care spell out the limits within which the administrative agencies are permitted or required to act in administering public lands.

We urge the Department of Agriculture and its Forest Service, the Department of the Interior and its Bureau of Land Management, and all other governmental agencies dealing with the public lands to be consistent with the spirit and letter of statutes when preparing and promulgating regulations. Regulations affecting the public lands should not become effective until the public has been given an opportunity to comment or protest and until after a public hearing, if requested. Regulations should always be administered fairly and uniformly and in a manner which will encourage -- not discourage -- the development of our mineral resources.

The administration of public lands is a proper subject of concern in the states in which such lands are located. Therefore, we believe that the views of such states relating to policy for the utilization of resources within their respective boundaries should be considered.

Land, air, and water use

Mining is vital to the economy and security of the nation; its growth must be encouraged to provide our expanding economy with adequate sources of raw materials. Mining must be recognized as one of the most important uses to which land may be put.

The mining industry realizes that undesirable side effects of mining may occur in some cases and that it is the industry's continuing responsibility to minimize these effects to the extent practicable. Where land reclamation is desirable and feasible, the concerted efforts of our industry are increasingly directed to programs designed to bring about reclamation for such uses as may be appropriate.

The mining industry also supports the need to maintain the quality of our nation's air and water. The industry has made substantial contributions toward such environmental maintenance, and recognizes that even greater efforts will be necessary in the future.

We believe that the following principles should govern efforts to conserve and improve our land, air, and water resources:

1. Programs for environmental maintenance must be approached with the over-all public welfare in mind, including the need for production and jobs, and with the realization that it is not possible to have a technological society without producing wastes which require disposal.
2. Programs and regulations must vary with geographic locations and local needs and desires; the establishment of uniform national standards

would be unrealistic and wasteful.

3. Because of widely varying local conditions, the regulation of air and water quality should be vested in the smallest jurisdiction -- local, state, or regional -- able to accomplish the desired purpose.
4. Air and water quality criteria should accurately reflect scientific knowledge and consensus.
5. Necessary regulations and quality standards should be established only after careful determination and evaluation of the facts, and in the light of control methods that are technically and economically feasible.
6. Provision must be made for appeal and judicial review of all administrative decisions.
7. Much additional coordinated research by industry and government is needed to develop improved techniques and equipment for (a) enhancing environmental quality, and (b) determining the effects of different concentrations of various contaminants in air and water.
8. The economic impact of corrective efforts must be fully recognized by all concerned. Anticipated benefits should be weighed against the direct and indirect costs, which can be great and which must ultimately be borne by the public.
9. To accelerate progress in improving environmental quality, the burden of uneconomic capital expenditures should be eased by appropriate measures, such as additional income tax investment credits, accelerated depreciation deductions, and ad valorem tax exemptions.

The problems involved in maintaining appropriate environmental quality, as well as a strong and viable economy, are such as to require the utmost objectivity and the most delicate balancing of interests. The tendency to deal with these problems on an emotional basis and to exploit them for political purposes presents a constant threat of hasty and ill-conceived regulation. The mining industry can best meet this threat by taking the lead in seeking and implementing sound solutions now.

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LEASE MINING NOT HARMFUL TO UNIQUE TREES

The U.S. Forest Service has applied for the withdrawal of 160 acres in the Malheur National Forest from location under the mining laws to preserve a unique stand of Alaskan cedar. The withdrawal stipulates that there will be no prohibition against the mining of minerals covered by the leasing act (essentially all nonmetallic minerals). The timber stand is located in parts of sections 22 and 23, T. 14 S., R. 28 E., in southeastern Grant County.

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KAHN NAMED DEPARTMENT ASSAYER

William M. Kahn joined the Department staff September 1 of this year as chemist and assayer. He occupies the position formerly held by L. L. Hoagland, who recently retired (see August ORE BIN). Kahn, a native Oregonian, attended grade and high schools in Portland. He graduated from Oregon State University in 1938 with a Bachelor of Science degree in chemistry. Since that time he has been employed as a chemist with American Distilling Co., Pittsburgh Paints, Sherwin Williams (as a technical representative), and Reynolds Metals Co.

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LEASE MINING NOT HARMFUL TO ADMINISTRATIVE SITES

The U.S. Forest Service has applied for the withdrawal of 155 acres in the Rogue River National Forest from location under the mining laws to protect two administrative sites in northeastern Jackson County. The withdrawal stipulates that there will be no restriction against the mining of leasable minerals. The sites are located in sections 15 and 32, T. 33 S., R. 4 E.

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ALMEDA MINE REPORT PUBLISHED

"The Almeda Mine, Josephine County, Oregon" has just been published by the Department as Short Paper 24. The author is Mr. F. W. Libbey, consulting mining engineer and former Director of the Department. The Almeda mine is situated in an extensive mineralized zone known as the Big Yank lode. The prospect was worked sporadically 50 years or more ago. Mr. Libbey reviews the history of underground exploration and mining and presents evidence to show that the property still has potential commercial value in gold, silver, copper, and barite under modern methods of mining. An appendix to the Short Paper contains abstracts of out-of-print reports about the mine and two recent reports prepared expressly for this printing: one on geochemical stream sampling in the area by R.G. Bowen, Department geologist, and the other on the structure and mineralization of the region by M. A. Kays, associate professor of geology at the University of Oregon.

The 53-page booklet contains geologic maps, mine maps, photographs, and assay and drill-core data. It is for sale by the Department at its offices in Portland, Grants Pass, and Baker. The price is $2.00.

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MINING VIEWS PRESENTED*

Observations and Proposals

The Northwest Mining Assn. and the Idaho Mining Assn. welcome this opportunity to join in presenting to this Commission their observations and proposals with respect to the public land laws as they relate to mining.

The Northwest Mining Assn. is regional in scope and maintains offices here in Spokane, Wash. It is said to be the oldest mining association in the country. The Idaho Mining Assn. is confined largely to Idaho interests, with offices in the State Capitol at Boise.

There exists a considerable amount of duplication in the membership of both groups, but between them they represent and speak for virtually all the principal mining interests in Idaho and the Northwest.

The record of previous hearings before this Commission and the files which it has accumulated in its relatively brief existence are doubtless replete with testimony and evidence relative to the complete dependency of our industrial economy -- in fact, our very existence -- upon mineral raw materials. This fact, as well as the projected explosion in mineral requirements within the next generation, has been thoroughly documented in numerous objective studies by Resources for the Future, Inc., the Department of Interior, and other equally reputable groups. We do not believe it would serve any useful purpose to belabor this point.

However, we are persuaded that this presentation of our views and proposals will represent an exercise in futility unless they are made and received within a framework of mutually accepted premises.

These premises are briefly as follows:

1. That the operation and progress of our industrial economy and the security of our nation and way of life are absolutely dependent upon an adequate and assured supply of mineral raw materials.

2. That this utter dependence demands the maintenance of a strong, vigorous and aggressive domestic mining industry as a first line of defense against uncontrollable and unpredictable foreign encroachment or interference with established channels of supply.

3. That the new domestic mineral resources needed to satisfy future requirements and avoid undue dependence on foreign sources cannot and will not be found and developed unless a comprehensive program of mineral exploration is diligently and continuously pursued.

4. That the lands remaining in public ownership, particularly those in the federal public domain in the West, provide the largest and best targets for exploration.

5. That our historic mining law, despite abuses and shortcomings, has served this nation and its people extremely well in developing and sustaining

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* Statement presented to the Public Land Law Review Commission Hearing, Sept. 2, 1967 at Spokane, Wash., by Northwest Mining Assn. and Idaho Mining Assn.

our unsurpassed economic and military might in both war and peace.

If we can agree on these premises, we can proceed with optimism to examine the abuses and shortcomings of existing law and seek to correct them without destroying or seriously handicapping our tried and proven statutory framework of private ownership and free enterprise.

Most of the abuses and deficiencies of our present mining laws derive from the fact that these laws were designed to serve a time and a philosophy far different from that which prevails today. They contemplated mineral locations based on the discovery of surface or near-surface outcroppings, particularly veins or fissures which could be traced and claimed as the basis for extralateral rights. They were based on a government philosophy which encouraged the disposal of a maximum amount of public lands into the hands of private owners who would develop and exploit the resources, mineral and otherwise, for the benefit of both the local and the national economy. And they were designed to serve the needs of areas lacking in public surveys and to protect the claimant against private intervenors or "claim jumpers," rather than to meet the public requirements of multiple use.

Today the prevailing government philosophy is retention of public lands under multiple-use management. We recognize that this change of public policy requires some modification and refinement of existing laws and established practices thereunder. We submit, however, that this can and should be done without doing violence to the basic concepts of statutes which have conclusively demonstrated their value and effectiveness over nearly a century.

Two of the most criticized deficiencies of the present mining laws -- that they permit private acquisition of public lands for uses other than mining and that they hamper and sometimes prevent effective management of surface resources -- have already been corrected through the restrictions on surface use imposed by Public Law 167.

Abandonment of claims: The problem of clearing the public domain of abandoned claims could be just as easily resolved by enactment of a statute stipulating the terms and conditions of "presumptive abandonment" on claims for which no affidavit of assessment work or notice of intent to hold has been filed over a specified period of time.

Location and identification of claims: The difficulty of locating and identifying claims on the ground -- a common complaint of mine operators as well as public land administrators -- could be remedied by statutory enactment requiring the filing of a declaration of interest in existing claims and imposing stricter and uniform federal requirements for staking and recording of new claims, including the attachment of a reasonably accurate map to the location notice or declaration of interest. This map should be tied in to a public survey, or, where corners of the public survey are not available, to some permanent, identifiable landmarks. We believe the only recording necessary to validate the claim, either old or new, should be in the county where the claim is located and where title searches are normally made. However, if it is deemed necessary that Federal Bureau of Land Management have and maintain duplicate records on claim locations, we would not oppose a requirement that the county filing be in duplicate, the copy to be sent by the county recorder to the appropriate Federal Land Office.

Discovery shafts: The much-complained-of creation of eyesores and indiscriminate destruction of the surface which often results from the present requirement of establishing discovery on each claim could readily be stopped by abolishing the discovery shaft requirement.

Such relatively minor changes would take care of most of the administrative problems which impede multiple-use management. However, they do not resolve the

mining industry's problems under the federal policy of retaining federal lands.

One of the major shortcomings of the multiple-use concept is that its vertical dimension covering subsurface values often receives a low-priority rating or is ignored entirely because the subsurface values, even when present, cannot be seen and cannot be readily evaluated without extensive exploratory probing. As a result, mineral entry is almost invariably barred from all types of special purpose withdrawals and reservations, and these involve many, many millions of acres, much of which has good-to-excellent potential for mineral production now or with the advent of improved technology.

Other considerations: We believe it is time to consider and recognize the separate and independent values of surface and subsurface resources in all withdrawn areas and to provide for exploration and development of the subsurface resources of those areas under reasonable restrictions that will minimize interference with the surface resources.

One of the most pressing needs of the mining industry today is for a statutory procedure for locating and acquiring deep-seated mineral deposits or widely-disseminated low-grade deposits of metalliferous minerals which have no surface manifestation andwhich often require a substantial acreage for economic development. For such situations the requirement of a discovery cut serves no useful purpose and there is no present procedure for holding the ground lawfully until valuable mineral in place has been exposed in each claim.

Much serious study and consideration has been given to a proposal for establishment of a procedure for acquiring "pre-discovery" rights which would entitle the holder to exclusive possession of a specified area for a specified time pending the discovery of mineral justifying a mine-claim location. We believe this proposal has considerable merit, but would like to propose as an alternative the enactment of a statute authorizing the location of mining claims based on mineral potential established by geologic inference, geophysical or geochemical analysis, the physical exposure of mineral at the surface or by diamond drill or any means that may be developed in the future for establishing such potential.

These claims would be 40 acres more or less, conforming to the public land survey where such exists and reasonably thereto where it does not exist. The claims would not carry extralateral rights, and they would be subject to the restrictions on surface use imposed by Public Law 167. They could be held as long as the good-faith assessment work was duly demonstrated and, for reasonable periods or indefinitely in justifiable circumstances -- such as where the claims underly a withdrawn area -- could be protected by paying the equivalent amount of the assessment work requirement to the treasurer of the county in which the claims are located.

A patent on such claims would convey title to only the mineral rights and to as much of the surface and surface resources as needed for the extraction and beneficiation of the mineral deposit. In the case of open-pit mines this would require considerable surface area, but for underground mines the surface acreage would be minimal.

We are satisfied that the owners of existing mining claims have vested interests which cannot be affected by subsequent legislation, including the right to patent under the laws of 1872. However, they should be permitted to validate their claims under any new standard that may be established, if they are willing to accept the limited patent rights also imposed.

These proposals could all be incorporated within the framework of existing mining law, without diluting or destroying the vital incentive of eventual ownership of

the fruits of the labor and investment involved. The premises on which these proposals are based demand that our nation's mining industry continue to grow and prosper. It can do so under the multiple-use concept if its vertical dimension is properly recognized.

We have studied these proposals in considerable depth and would like to submit for the record as an integral part of this testimony a supplementary statement which discusses them in greater detail.

Supplement

Observations

1. The basic laws relating to location of mining claims upon public lands have served the country and the industry well for almost 100 years, as is evidenced by the present industrial stature of the country, which has been the result of the development of our domestic mining industry as a source for its raw materials, and which would have been impossible without it. Most of the difficulty with the present statutory pattern arises out of the era in which the laws were enacted. The present location laws contemplate locations based upon discovery of mineral outcrops at the surface, particularly veins, in isolated areas where no adequate public survey exists. At the present time most new mineral locations are being made upon mineral deposits existing at depth, or upon low-grade deposits of a widely dispersed nature, which do not conform to the original concept of the mining laws.

2. Unlike most other industries, which have a substantial degree of flexibility in locating their operations, mining can be conducted only where there are economic concentrations of minerals which can be mined with a profit motive. The extremely small percentage of the lands of the United States encompassed in past and present mining gives some indication of the rarity of such concentrations of minerals. However, vast areas must be explored in detail, in many instances over many years, in order to discover the isolated tracts of land which bear the requisite concentration of minerals. Although most of the most obvious surface exposures of minerals have been subject to exploration effort by the industry, lower grade deposits and deposits which are not observable from the surface have not been explored thoroughly, although these deposits will undoubtedly prove to be the principal source of metals produced in this country in the future. It is essential that sufficient lands be and remain available over long periods of time for mineral exploration and development by private industry if we are to maintain the domestic source of metals and avoid becoming unduly dependent upon imported metals to support our industrial complex. The lands held by the United States government in various capacities represent the principal resource of the mining industry in attempting to maintain a domestic output of metals. It is stated categorically at this point that the mining industry must have access to the maximum amount of public land for exploration, development, and exploitation of mineral deposits which may be discovered, and have such access under conditions of claim or ownership which will attract the vast amounts of risk capital necessary to explore for and produce metalliferous minerals. It should be recognized that long periods of time necessarily elapse between first exploration and initial production. The industry is unalterably opposed to a leasing program for federal lands as a substitute for the present scheme of private rights. We believe that the adoption of any leasing program will result in a drastic reduction in funds available for mineral exploration in this country, and that the eventual result must be a drastic decline in domestic metalliferous production. The effects of this might not be seen for a number of years

because of the "lead time" involved, but the result is inevitable.

3. We believe that if the mining industry accepts the position that it should be entitled to utilize only so much of the public lands as is actually required for its particular purposes, all other users of the public lands should be restricted in a like manner. This includes withdrawals for reservoir purposes, both under the federal power act and otherwise, withdrawals for public highway, withdrawals for recreation purposes, and other surface usages. We believe that it is time to enact a statutory scheme of true "multiple use" with vertical dimensions as well as horizontal dimensions, under Congressional standards, and not leave the administration of the multiple-use policy to determination by federal agencies.

Proposals

Existing mining claims: We are satisfied that under existing mining claims the claimant has vested interests which cannot be affected by subsequent legislation, including the right to go to patent under the laws of 1872. However, a great deal of difficulty has been caused both for the mining industry and for the various federal agencies charged with administration of the public lands because of the inability to determine the physical location of claims which have been filed of record, and because of the necessity for an administrative determination in order to determine the validity of claims for which no proofs of labor have been filed.

A proposal of the Department of the Interior was introduced in the current session of Congress as S. 1651. This proposal related to the filing of a declaration of interest in existing mining claims and provided for filing of maps. We agree that it would be of assistance to all parties to require filing of maps defining the location of existing mining claims, which maps would be required to be filed within four years following enactment of the legislation, and which would be required by statute to be sufficiently accurate and detailed to permit a reasonably experienced person to locate the corners of the claim in place. In addition, we would propose a requirement that reasonable effort be exerted to maintain claim corners in place, adequately identified. In the event that reasonable search has been made by any person for any claim corner without success, at the request of the U.S. Bureau of Land Management the locator would be required to point out the claim corner in question to a representative of the U.S. Bureau of Land Management, or to re-establish and mark any corner which could not be located in place. In the event that any map-filing requirement is imposed and the same requires that the claims be tied to the public land survey, the government will have to bear the responsibility of replacing all survey monuments which have been lost or destroyed in order to permit compliance.

In addition to the foregoing, there should be a conclusive presumption of abandonment imposed unless the filing of the annual affidavit of labor performed is made prior to a date six months following the close of the statutory year in which the work is required to be done. It is believed that this can be done without transgressing upon any vested rights that mining locators possess under the present laws.

Future locations: We believe that the continued practice of location of mining claims by private individuals and corporations will be the only manner in which presently undiscovered mineral deposits in the public domain can be effectively developed, unless as a matter of government policy it is determined that only the very few large mining companies should be permitted to explore for and exploit mineral deposits in the public domain. However, if individuals and the small- and medium-sized mining companies are going to continue as an integral part of the mining industry, a modified

claim procedure is the only arrangement which offers the necessary availability of land to permit exploration by the small- and medium-sized operator, and thus assure the maximum exploration effort which is available to the country. We believe that exploration should not be restricted to the handful of companies who would be able to operate under a system of large-scale exploration grants or rights, and that the eventual mineral production of the country will suffer if the public domain is so restricted. As a result of this, we suggest a modified program of mining locations, which has the added benefit of not being a drastic departure from the practice of the last 100 years, and which leaves the industry with some guideposts regarding the administration of its mining rights. We would propose the following:

1. We propose that mining locations be permitted in tracts of 1/16 section, conforming to the public land surveys as nearly as is practicable in surveyed areas, and in unsurveyed areas claims of 40 acres be permitted, laid out in a square configuration with the sides running north-south and east-west. In addition, we propose that there be no extralateral rights with future locations. The claimant would establish his right in the location by establishing corner posts at the approximate location of the corners of the claim, and filing a claim notice of public record, which would describe the legal subdivision claimed, assuming the claim was within surveyed areas. Location would be permitted by filing alone in areas where surface marking is not feasible, such as areas where the surface has been withdrawn. From and after the date of location the claimant would be entitled to remain in possession so long as he complied with the requirements for annual labor, or payment in lieu thereof, which is hereinafter discussed. By compliance with the foregoing requirements the claimant would acquire the exclusive rights to attempt to make discovery of mineral in place in the claim. In the event that it was proposed by any agency of the Federal government that the lands be withdrawn from mineral entry, or that some other disposition be made of the lands inconsistent with the rights of a mining locator, notice would be given to the claimant. At that point, in an appropriate proceeding, the claimant would have the right to show that the indications of mineral potential, and ultimate discovery of mineral in place, were such that "a reasonable, prudent man would be justified in the further expenditure of his labor and means." The showing of mineral potential could be established by geologic inference, geophysical or geochemical surveys, physical exposure at or near the surface, by diamond drill, or by any means that may be developed in the future for establishing such potential. If such showing could be made, the claimant would be entitled to retain his rights in the claim so long as he complied with the annual labor requirement. In the event that such showing could not be made, the proposed withdrawal or other disposition could be made and the claim would be invalidated.

2. A reasonable period should be allowed after the date the enabling legislation becomes effective in which the owner of an existing claim could elect -- by filing a statement in the county of record -- to hold his claim under the provisions of the new legislation, in which case the requirements as to discovery and the type of patent he would receive would be as hereinafter set forth. If no such election were made, he would continue to hold with all his existing rights, including the right to go to patent under the laws of 1872.

3. The annual labor requirement should be retained, with provision for in lieu payments for a reasonable period. However, the types of labor permitted should be only those directed specifically toward exploration, development, or exploitation of the minerals situated in the claim. In lieu of performance of annual labor, the

claimant would be permitted to make payment of $200 per claim. In addition, in the event that expenditures are made in excess of the annual requirement the locator should be allowed to accrue these expenditures against future labor requirements, for as much as five years. In practice the normal exploration program at the present time would call for large expenditures from time to time, but not annually. An annual filing of the proof of labor, with forfeiture in the absence of such filing, would apply.

4. Surface administration of unpatented mining claims would continue to be controlled by the essential portions of P.L. 167 (69 Stat. 368, 30 U.S.C. 612).

5. In lieu of the current procedures for purchase and issuance of patent we propose that patent be issued, without survey if the location was made in surveyed lands, upon a showing that minerals have been discovered in place which would justify "a reasonable, prudent man in the further expenditure of his labor and means." However, the patent would convey to the patentee only the minerals in place and the right to use the surface of the claim for mining or processing operations and uses reasonably incident thereto, with use of the surface being restricted to those uses reasonably required in the opinion of the patentee for mining or processing operations and uses reasonably incident thereto. Patent to the surface of a patented mineral claim might be issued in the manner described in the following paragraph.

6. Provision must be made for entry and location for surface facilities upon any lands for which the surface has not been otherwise appropriated, in conjunction with valid mineral claims, without regard as to whether or not the lands appropriated for surface facilities are mineral in nature. We would submit that one or more locations of 20 acres should be permitted for surface facilities, with use limited to mining or processing operations or uses reasonably incident thereto. The rights to be acquired under this type of location should be permitted to be maintained in a current status by payment of $5 per acre, or $100 per year, as would be permitted for payment in lieu of assessment work upon mineral claims. Patents should be issued to any locator who is the owner of either patented or unpatented mining claims in reasonable proximity to such location, upon application and payment for the appraised value of the surface to be patented.

7. One of the most important elements of our proposal would be that all withdrawals of Federal lands from mineral entry should be reviewed, and the agency or private individual or organization responsible for such withdrawals should be required to file within a reasonable time, possibly four years, a statement of the surface and subsurface rights required for its usage. All lands not claimed in this manner, whether surface or subsurface, would be reopened to mineral entry. All future withdrawals or reservations of Federal lands, whether for recreational purposes, reservoirs, Federal power sites, highway rights-of-way, or any other purposes, would be required to define the usage of lands, both on the surface and subsurface. There is no valid reason why mining cannot be permitted at reasonable depth beneath highways, reservoirs, campgrounds, or other local recreational areas, and other similar surface usages. Under the procedures suggested for location of mining claims, location would be possible without access to the surface, and with "in lieu" payments it would be possible to maintain a claim in good standing without access to the surface. However, a procedure should be established whereby the holder of a valid subsurface mining claim would be permitted to apply for restoration for access or otherwise of so much of the withdrawn surface or subsurface as is necessary or desirable in order to conduct mining operations, upon payment for or relocation of surface improvements, and some agency should be charged with the duty of determining the relative public benefit to

be derived from the conflicting usage, under standards established by Congress. Here it must be recognized that mining can be conducted only where mineral occurs, whereas most uses have optional locations available. In addition to the foregoing, access rights across other surface usages must be permitted in order to reach mining claims. The principal area of contention at the present time is the attitude the U.S. Forest Service has taken in regard to surface access, or even access by helicopter, to mining claims within the established Wilderness Areas. The right to locate mining claims is meaningless unless access is permitted.

8. A new, independent Public Lands Review Board should be established to hear all questions in regard to administration of the public lands which might be in dispute under any law or regulation, and that all such hearings be de novo. This board should be established in some relatively independent department of the government, giving it relative independence from pressures of various public land users. The present procedure of having quasi-judicial proceedings conducted in the very department which is one of the adversary parties is highly unsatisfactory.

General: All payments provided by our proposal should be made to the local County Treasurer in whose county the claim is situated. This would alleviate some of the problem which is present in counties where a large portion of the lands is held in government ownership, and the tax base is limited drastically. The philosophy proposed here is comparable to the revenue-sharing which is a part of the present timber-harvesting program. In addition, this would have the salutary effect of causing local county officials to enforce some of the requirements of the mining laws.

All filing should be done on the county level where land title searches normally take place. If it is desirable for some federal agency to have a complete set of records, duplicate filing could be required, with instructions to the local county officials to forward one copy to the federal agency. Duplication of filing locations is fraught with problems, and little is gained if a search of two sets of public records is required to determine the status or validity of any claim. We have recently had the experience of the U.S. Bureau of Land Management moving all of its essential records relating to federal lands in the state clear out of the State of Washington, and we must have a local set of records which are adequate to reflect the status of mining locations.

The lands included within any mining location under which the rights of the locator are terminated for any reason should be restored to the public domain and be subject to subsequent location under the mining laws.

Conclusion

The foregoing presents a proposal for consideration of the Commission which we believe sets forth the essential requirements of the mining industry, without maintaining some of the opportunities for abuse that currently exist. However, as an essential part of this proposal excessive use of public lands by other users, and consequent restriction of exploration and development of mineral resources, must be abolished. We want true multiple usage under standards adopted by Congress instead of multiple usage by administrative edict.

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