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STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

MINERAL RESOURCE INDUSTRY -- A NATIONAL DILEMMA

Everyone involved with the mining and petroleum industries, either directly or indirectly, is aware of the mounting concern by the general public with the possibly deleterious effects of mineral exploration and development on the environment. Oftentimes the outcry about "desecration of the land" is not based on actual knowledge of a specific mining activity.

The mineral resource companies are faced with a true dilemma; they are being subjected to increasing governmental restraints and regulations because of the nature of the work they perform while, at the same time, people continue to want more and more manufactured goods which originate in a "hole in the ground." These companies are trying to develop a greater awareness on the part of the public of the problems faced by the industry in providing the necessary raw material required by our technological society.

Three magazine articles received by the Department during the past few months discuss different aspects of mineral resource development. Excerpts from them are printed below. These articles are by men who are involved with various phases of mineral conservation and who show that they have given thoughtful attention to this common area of concern. The first report is taken from a news release by Hollis M. Dole, Assistant Secretary of the Interior for Mineral Resources. The second item appeared in an article by George Mowbray, who is Director and principal of Stevenson & Kellogg, Ltd. of Canada. The last article is part of a report written by Samuel S. Johnson, President of Jefferson Plywood Co., Redmond, Oregon. Mr. Johnson served on the Advisory Council of the Public Land Law Review Commission. The full report of the Commission was published in June 1970 and contains 18 recommendations of basic principles to guide future policy concerning the public lands.

These three articles deserve thoughtful and serious attention. The points brought out in them will eventually have to be recognized by all of us -- the general public, the governmental agencies, and the mineral resource industries -- if we are ever to develop a better understanding of our mutual problems.

R.E.C.

MINERAL RESOURCE DEVELOPMENT*

by Hollis M. Dole

Among all the peoples of the world, we in the United States enjoy the highest average standard of living. That standard is based on our consumption of an extraordinary volume and variety of minerals and mineral products. If we expect to maintain and improve that standard, we must first insure that our essential mineral needs are met. And they must be met at costs that are in line with other material and service costs.

Even the most conservative projections of mineral consumption and requirements indicate that assuring future supply will require new discoveries and far more efficient extractive and processing technologies than we have today. Our own population is expected to total about 320 million by the beginning of the next century and that of the world should reach the 6½ billion mark by then. Right now, we have only 6 percent of the world's population but consume nearly a third of the world's minerals. If the estimates prove correct we will have only about 5 percent of the world's population in the year 2000, but the total number of people in this country will have increased by one third and the world total will be almost twice what it is today.

Two conclusions are inescapable. First, our requirements for raw materials and energy in this country will mount rapidly over the next three decades. Second, throughout the world, competition for the resources that supply these basic necessities will increase enormously.

Already the gap is widening between the percentage of our mineral requirements that we are able to supply domestically and that which we must obtain from sources outside our boundaries. "Able" and "must" are highly significant words in this context. They represent the consequences of a choice that we have made.

During World War II our economy began to expand very rapidly and it has been zooming right ahead ever since. This rapid growth demanded a correspondingly large increase in mineral supply. But two world wars and the tremendous industrial development that made us a major world power had already skimmed much of the cream from our domestic mineral crop. It became clear that our burgeoning requirements would have to be satisfied either from our own domestic resources, which were diminishing in grade, or from richer foreign sources which, at that time, were eager to attract American capital.

The rapid industrialization that has occurred outside the United States in the past two decades has stimulated increased per-capita demands for minerals abroad. Although these per-capital rates are still far below the levels here at home, they are rising more rapidly than ours. And, as

* Excerpts from U.S. Dept. of the Interior news release, March 9, 1970.

industrialization gains momentum elsewhere in the world, the terms of trade for the United States are worsening. We no longer get the kind of deals we used to. Take, for example, the rise in host-government revenues from oil.

Moreover, the number of domestic mineral producers with the financial resources needed in shifting to foreign sources -- or, for that matter, in conducting research on the necessary scale -- is limited. As a result, many of our smaller producers have found themselves captive to a declining resource base and a relatively static technology.

This problem is compounded by the fact that it confronts us at a time when we are becoming acutely aware of the necessity for assuring optimum use of our land surface. The projected growth of our population will generate increased demands on the fixed quantity of land that we have. More land will be needed for growing food, more for living space, and more for recreation. The pressures already are intense enough in some parts of the country that the prices being asked for the land, in themselves, are so high as to preclude the profitable development of any minerals it might contain. Those pressures can only increase.

Not only do we need a technology that will enable industry to extract and process lower grade resources at reasonable monetary costs; we also need -- and need desperately -- mining and processing systems that are low cost in terms of insult to the environment in which we all must live.

President Nixon has launched an intensive Federal effort to rescue our environment from the menace of pollution. It is "now or never," he has said. Clearly, we must begin the rescue within this decade or it will be too late. Time will run out on us. The President, accordingly, has begun the process of reordering our national priorities. Under his leadership the government this year will spend more on human resources and the improvement of our environment than on national defense. This is the first time that has been done in two full decades.

The national determination to have a quality environment carries grave implications for the industries that supply us with essential minerals and fuels. The technology utilized by these industries was originally designed to provide large volumes of raw material at low and stable prices over long periods. This it has done and done well. But that same technology has been predicated too often on the mistaken belief that costs could be avoided by using the air, the water, and the land as giant sinks for the disposal of mining and processing wastes. The costs weren't really avoided after all. They were merely deferred. As Secretary Hickel has put it: "We carelessly assumed that Nature could absorb unlimited punishment. Now, we have to pay the bill."

We have a lot of expensive cleaning up to do. But the real challenge lies ahead of us. Developing a mining and processing technology that is wholly compatible with our growing demands for environmental quality and at the same time capable of supplying an adequate share of our mineral

requirements from resources that are diminishing in grade will present a monumental task. It has been considered more or less axiomatic, for example, that the lower the grade of the material being mined the more waste will be generated in the process. And the average grade of our domestic mineral deposits is diminishing. If we hope to get more out of less -- as we clearly must -- without further punishing our environment, we urgently need new and better extractive and processing methods ... methods that drastically reduce waste.....

An adequate and dependable supply of minerals and fuels is essential to our economy, our security, and our industrial and social advancement. And we must assume further that a substantial share of that supply should be derived from the development of our own domestic resources.

The global nature of mineral supply and demand precludes the advocacy of a complete self-sufficiency policy. Such a policy would serve neither our own interest nor that of the world trading system of which we are such an important part. And even if it would, we simply could not adopt it. We are not that affluent in all the materials that we must have. Already we depend on imports for many vital commodities and if we are to be realistic we must expect that dependency to grow.

Conversely, we produce surpluses of certain mineral commodities which, in our own interest, must compete successfully in world markets. Clearly then, we must continue to seek -- on mutually favorable terms -- access to foreign sources of minerals and fuels that are not available from domestic deposits at costs that we can afford.

The laws relating to mineral development on public lands are in many respects antiquated and are currently under review and in that process the need for being able to anticipate developments well ahead of time has become abundantly apparent. Every scrap of information that bears on the problem of obtaining the maximum beneficial use of our public lands in the public interest has been eagerly sought and carefully studied by the Public Land Law Review Commission. Even so, the Commission has encountered many difficulties in achieving the kind of long-range review it must have in making its recommendations. Here again, we can glimpse the future only as "through a glass darkly," because we have not yet developed the capabilities the Government must have if it is to play its role well.

Minerals represent the basic material strength of the United States, and every one of us has an immense stake in assuring that we have them in adequate quantity and variety. Each of us also shares to some degree the responsibility for guaranteeing that stake. The Federal responsibility as I have defined it incorporates anticipation of need and planning to meet it, encouragement and provision of information to State and local governments and to industry, and, when absolutely necessary, regulation in the public interest.

State and local governments have similar responsibilities and similar roles to play, though on a more limited scale. Industry has a responsibility

to supply the goods and services the public needs and to do so in a fashion and at a cost the public can afford. Financial institutions have a responsibility to invest the monies entrusted to them by their clients in activities that are compatible with the public and the National good. It is time now for a reinvestment in America's future.

President Nixon has said that one of the central themes of his New Federalism is "a willingness to return power to the people and dignity to the individual, through financial help to State and local governments and renewed reliance on private, voluntary action."

For many decades now power has been flowing from the people to the Federal Government and with that power has gone responsibility. If the flow of power is now to be reversed, so also must be the flow of responsibility. State and local governments, private industry, and private citizens must be ready and willing to accept greater responsibility if ours is to remain a free society, fully capable of self determination.

MINING INDUSTRY -- PROSPECTS AND CHALLENGES*

by George Mowbray

My opportunity to reflect on the long-term future of mining implies the need for prophetic vision more akin to the mysticism of theology than the science of man. This suggests the desirability of my having a text for this sermon. To find a text I turned to the bible of mining, Georgius Agricola's famous De Re Metallica. Published in the 1550's, this work stood for nearly 200 years as the basic reference book. Let me quote from the first lines in the first chapter -- the genesis as it were, of the mining scripture. Agricola began with these words: "Many persons hold the opinion that the metal industries are fortuitous and that the occupation is one of sordid toil, and altogether a business requiring not so much skill as labour. But as for myself, when I reflect on its special points one by one, it appears to be far otherwise."

Far otherwise indeed. The major problems challenging the industry seem to me to be no longer financial, geophysical or technological but social -- problems of the human environment to which the industry must adapt or perish as a free enterprise system. On the resource side, and in technology, prospects are bright indeed. But the ability of the mining industry to capitalize on these prospects can be summed up, I think, in very basic human, social terms.

The society is calling for new forms of leadership in mining. My belief is that if these are not forthcoming from within the industry, they will be imposed from without. And the greater the outside injection of directives on resource allocation, the smaller will be the opportunities and

* Western Miner, July 1969.

rewards to the industry as a private business operation. The trend, in short, now appears to be towards the gradual extinction of mining as a private sector of the provincial and national economy of this country.

We have witnessed the growing worldwide pressure for industrial development to fulfill the long-frustrated aspirations of the poor nations. The more mature economies have great and expanding resource needs, too. This will ensure a steadily rising long-term demand for all minerals, whether for energy or direct industrial use. The earth's crust will have increasing difficulty meeting these needs. As a result, real prices for most minerals will rise. Marginal producers will make marginal or standard profits, but the rewards for the occasional rich strike will become even greater. This is a heady vision. It is one worth pursuing far more skillfully and more subtly than the way the mining industry's leaders are now going about it.

Because of growth in the oil industry and in building materials -- which are unfortunately included in our present statistical definitions of the mining industry -- Canadian mineral production has been rising in relation to over-all national output since the war. It is still not as large, relatively, as it was in 1937. However, if we take metallics and nonmetallics only, these core sectors of the industry are even now barely holding their own in relation to expansion in other industrial sectors. The 1968 value of mineral production in these two major categories was about \$2.7 billion, or equivalent to about 4 percent of Canada's Gross National Product. This figure has not changed since 1950, and in 1937 it was 7 percent, almost twice as great.

Even now, close to a million and a half people are employed in manufacturing. If we exclude coal mining, employment in the metallics and nonmetallics is only about a hundred thousand. The voices and votes of the urban centres, the city people as distinct from the mining people, are clearly stronger. They will tend to become even more so in the future. The ways in which mining supports the other sectors such as transportation and manufacturing are not well known. Indeed, a substantial portion of Canadians profess to know very little about the mining industry -- even the people who live in mining communities.

What I am trying to say without going into a long disquisition on the economic history of the western world is rather simple: mining in Canada is likely to become less important economically, socially and politically in the next generation than it is now -- despite a huge absolute growth. This is an extremely important point. If we couple it with the changing climate for business in general, then I believe we can see some real challenges for the industry to overcome. Let's begin by touching briefly on some of the sources of actual or potential public hostility to the industry as it now appears to operate.

Since most mining operations are a long way from the major centres of population and influence, it's a case of "out of sight, out of mind." The industry also seems to be made up of several quite distinct groups of

people -- the prospectors, the miners, and mine managers, scientists of various kinds who operate in the field, and shadowy figures at head offices in Toronto or New York who watch over things and make the important decisions. The public could be forgiven for thinking that the industry has many faces, not all of them scrubbed and wholesome. This set of conditions poses an enormous communications challenge.

To many people, mining may well appear to be a not particularly creative business -- risky mainly in the early stages of exploration and development and when established requiring little real entrepreneurial skill. The fact that some mining companies make very handsome profits does not do anything to dilute such impressions. Then too, the resources are in the ground; it's not for nothing that the Mexican government calls its department of mines the "department of the national patrimony." There is always a latent pressure, because of these and other factors, for greater social control, more taxation, and so on -- so the people will get back something of "their" resources via the coffers of their governments. When the mining company is American, British, Japanese, etc., the rationalization becomes even easier. Of course, the resources are useless if they are not discovered, mined, processed and sold, but this point is easy to overlook. Development of mining investment may well be inhibited by future emotionalists of a nationalistic type. You are thus challenged to explain and rationalize the structure of the industry or lose control over the way it operates.

The moral and ethical issue remains to haunt the senior leaders of the mining community. You cannot just ignore the situation and take your own little fliers now and then. The challenge is to get behind stock exchange reform and effective disclosure rules -- despite the fact that it means supporting further government intervention in business. There is also the question of the professionals who turn out geological reports for penny stock promoters. Should we not be controlling such people through social pressures, through professional engineering and other associations?

In recent years, the mining industry has paid much attention to pollution. I do not wish to say whether or not it has paid enough attention. My point is that I believe that public will more and more demand that businessmen return nature to the people, unspoiled. Socially and politically, more than in terms of health or economics, the challenge is to go the extra half-mile on this issue, and to tell the public that you are doing so. In this connection, we might also note that the concept of "health" is becoming narrower every day. Scientific research is always finding new ills and new causes of illness. We need not expect to escape these tentacles of science -- pollution will become defined as being more and more dangerous to health every year regardless of the level of pollutants.

Attacks on the mining industry by public figures and journalists are not, I am afraid, just the random thoughts of isolated individuals. Behind these speakers and writers is a rising class of influential intellectuals who are basically hostile to mining. They include economists, sociologists,

political scientists, resource development planners -- all educated and inspired to help us find new and better formulas for operating our industrial society. The old slogans about capitalism and socialism are no longer relevant. The new approach is for closer integration of government and business in the achievement of recognized social goals. Planning has become a key word. The French equivalent, planification, often appears in the studies leading to the establishment of Quebec's new instrument of government participation in mineral exploration and development in that province. Behind such concepts are ambitious theorists from the latest generation of crusading university graduates in the social sciences.

Exploitation is being revived as a witch word in the North American economy. Instead of being bandied about by street corner orators it is being brandished by mobs. The student radicals of this country and the United States can be expected to move off campus and start attacking other established institutions. You do not have to think very hard to see that the mining industry is an ideal target because of its isolated manifestations and the conditions of some of its northern communities.

In the past, the mining industry has not hesitated to ask for the support and financial assistance of provincial and federal governments. Often this has been forthcoming. The general economic and legal climate is still quite favourable. But it seems to me that the revolution in the concept of planning for economic development is going to change this situation. We must expect that over the next generation our governments will feel not only morally entitled but intellectually qualified to tell the mining industry what it must do. The end of the road of failure to deal with this changing intellectual climate is some form of nationalization and loss of control over both exploration and investment decisions. The ultimate challenge, therefore, is to survive. The best method now appears to be involvement rather than combat. Perhaps we can stake out some strategies for the industry in this forthcoming adagio dance with our new partners.

The main step required is perhaps the most difficult one for the traditional leaders of an individualistic product-oriented industry. It is just this: We have to decide to recognize the fact that mining is part and parcel of the social structure of the provinces and the nation. A key role of the future mining executive will thus be a social one, fully as important as his business role. In fact, these two roles will be combined, as we shall see.

FOOD FOR THOUGHT IN LAND LAW REPORT: MINERALS* by Samuel S. Johnson

In its general discussion of mineral resources on public land, the [Public Land Law Review] Commission notes that our standard of living and our national defense are wholly dependent on the availability of fuel and nonfuel

* NAM Reports, July 20, 1970

minerals. National requirements for these products are an essential factor in the development of a national policy for mineral development on our public lands. Our industrial dependence on the production of fuel and non-fuel minerals is more significant than the monetary value they contribute. Many factors we take for granted in our standard of living would be impossible without reliable and economic supplies of minerals. Likewise, our survival as a leading nation depends on our mineral supplies.

"As our demands for minerals have grown, we have become more dependent on foreign sources of supply. Over one-third of our mineral supplies are imported. This reliance on foreign sources may well increase according to current indications. Experiences in Peru, the Middle East, and elsewhere demonstrate that total reliance on foreign sources would be a hazardous economic and political policy. We strongly favor, therefore, an overriding national policy that encourages and supports discovery and development of domestic sources of supply."

The report asserts that public land mineral policy should encourage exploration, development and production of minerals on the public lands. Over 64 million acres of Federal land were under lease for oil and gas in 1968. Substantial deposits of coal, phosphate and sodium compounds are also known to exist in public land areas and some are under lease. In 1965, the western public lands states in which over 90 percent of the public lands lie produced over 90 percent of the nation's domestic copper, 95 percent of the mercury and silver, 100 percent of the nickel, molybdenum potash, and about 50 percent of the lead. In fact, most of the known domestic resources of metallic minerals other than iron are situated in the West.

Present knowledge about the geology of mineralization in the United States, combined with the geographic pattern of established mining districts, indicates a strong probability that the public land areas of the West generally hold greater promise for future mineral discoveries than any other region.

"Consequently, we have concluded that it is in the public interest to acknowledge and recognize the importance of mineral exploration and development in public land legislation. Also, a decision to exclude mineral activity for any public land area should never be made casually or without adequate information concerning the mineral potential. Mineral exploration and development should have a preference over some or all other uses on much of our public lands."

To justify this conclusion, the commission points out that, as a land use, mineral production has several distinctive characteristics. Mineral deposits of economic value are relatively rare, and, therefore, there is little opportunity to choose between available sites for mineral production, as there often is in allocating land for other types of use. Also, development of a productive mineral deposit is ordinarily the highest economic use of land.

Mineral production requires less surface area than most other land uses.

For example, in 1966 Arizona was the western state in which mining was conducted over the largest area. Nevertheless, only 0.13 of one percent of the state's area was actually used for this purpose. Therefore, a use preference is warranted by nature's sparse and random distribution of valuable mineral deposits and the vital relationship between our national welfare and uncertain supplies of minerals. Furthermore, a worthwhile mineral deposit is usually concealed and becomes available to meet our national needs only as a result of an expensive, long-term and high risk search effort.

"The Federal Government generally should rely on the private sector for mineral exploration, development, and production by maintaining a continuing invitation to explore for and develop minerals on the public lands. We are satisfied that private enterprise has succeeded well in meeting our national mineral needs, and we see no reason to change this traditional policy." The commission goes on to say that existing Federal programs to develop nationwide geological information should be continued and strengthened, and that these Federal programs should serve to identify general areas favorable to mineral occurrence with detailed exploration and development left to private enterprise.

The report states that the commission does not favor opening national parks and monuments to mineral development. However, it does recommend that, in connection with consideration of statutory exclusion of mineral activity from designated public land areas, Federal agencies should make mineral examinations which will provide reliable information concerning their mineralization. Too often in the past exclusions have been accomplished with little or no knowledge of mineral values.

The report also urges the establishment of a program to determine the extent of mineralization of public lands where mineral activities are presently excluded, but mineralization appears to be likely. "Even though we oppose opening these areas to development, the resulting information would be of substantial value for the identification of standby reserves that might be needed in national emergencies."

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MAP OUTLINES FEDERAL LANDS

A new map prepared by the U.S. Geological Survey shows the distribution of federally owned lands in the United States. The 19 x 28-inch multi-colored map outlines 17 different categories of lands administered or held in trust by the U.S. Government. As of June 30, 1968, 33 percent of the United States was owned by the Federal Government. This included about 95 percent of Alaska and more than 50 percent each of Nevada, Utah, Idaho, and Oregon. Atlas sheet No. 272, "Federal Lands," may be obtained from the Federal Center, Denver, Colorado 80225 for \$1.50 per copy.

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NEW MERCURY RECOVERY PROCESS DEVELOPED

A new mercury recovery process developed by the U.S. Bureau of Mines, Reno Metallurgy Research Center, is described in Technical Progress Report 26, "Electrolytic Oxidation of Cinnabar Ores for Mercury Recovery," by B. J. Scheiner, R. E. Lindstrom, D. E. Shanks, and T. A. Henrie. The abstract is as follows:

Electrooxidation of cinnabar mercury ores (HgS) was investigated as a means of providing an effective and economical hydrometallurgical technique for extraction of mercury from its ores, particularly those too low in grade to allow economical metal recovery by retorting or furnacing techniques. Oxidation was accomplished by electrolysis of ore slurried with brine. Cinnabar was dissolved by oxidation of the insoluble sulfide to soluble mercuric salts. The mercury ion in a brine solution forms a stable tetrachloro complex. Typical laboratory experiments required 1 to 7 hours of electrolysis at 35-percent pulp density in a brine solution that contained 4 to 20 weight-percent sodium chloride (NaCl). Power consumption ranged from 10 to 50 kwhr/ton of dry ore. Mercury extraction values between 90 and 99 percent were obtained with all of the ores investigated. Subsequent mercury recovery from leach solutions was readily accomplished by precipitation on zinc.

Pilot mill experiments in a 100- to 200-lb/hr extraction plant are in progress to quantify power and reagent requirements, and extraction and recovery data obtained to date closely parallel those obtained in the laboratory.

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NEW BIBLIOGRAPHY SUPPLEMENT PUBLISHED

The fourth supplement to the "Bibliography of the Geology and Mineral Resources of Oregon" has just been issued by the State of Oregon Department of Geology and Mineral Industries. The publication, designated as Bulletin 67, was compiled by Miriam Roberts. It covers all published and unpublished reports on Oregon geology and minerals issued during the 5-year period of January 1, 1956 through December 31, 1960. About 40 pages of the 88-page bulletin are devoted to a subject index. The bulletin can be purchased from the Department's offices in Portland, Baker, and Grants Pass. The price is \$2.00. The first and third supplements to the bibliography are still available, at a fee of \$1.00 and \$1.50 respectively.

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PRECIOUS METALS*

Charles R. Stahl, president of Economic News Agency, Inc. and publisher of Green's Commodity Market, predicted that "between 1975 and 1977, the demonetization or near demonetization of gold should be completed" which should coincide with Americans' being legally permitted to own gold bullion which will be traded on the commodity exchanges in the United States in the same manner as silver and platinum. He said that the free market would then fluctuate between \$50 and \$75 per ounce. "However, it should be kept in mind that this upside move in the price of gold will be based strictly on commercial demand and will not be caused by monetary crises. Before the end of this decade, the industrial demand for gold will be so strong that central bankers will sell their gold to the industry to alleviate the predictable shortage of the yellow metal in the late 1970's."

Mr. Stahl, in turning to silver, predicted that "the commercial use of silver in this country will exceed 200 million ounces per annum within the next few years and the yearly gap between production and consumption will widen by about 50 percent from the current 110 million to over 160 million ounces. I expect private mints to become the largest users of silver in the United States. This nation has become so coin conscious that the minting of commemorative medals is now a growth industry. For example, the Franklin Mint alone will have a capacity to process 50 million ounces of silver by September of this year. Once this capacity is fully utilized, Franklin Mint's yearly consumption of silver will exceed by 20 percent the consumption of the entire photographic industry which is currently the largest user of silver in this country." Discussing the alleged large supply of silver above ground, particularly in India, Stahl remarked, "Unquestionably, there is a lot of silver in India but no one has ever counted that silver and all figures are simply uneducated guesses. However, silver owned by the people of India will never close the gap between world consumption and production. Some silver will trickle from India, but the amount will be insignificant. No one in India is going to scrap the roofs of Pagodas or religious objects made out of silver to please the silver users. Further, in India, women wear silver bracelets to show their wealth. To expect that all those bracelets will be melted is like expecting American women to scrap their diamonds to recover coal from diamonds' impurities." As to U.S. silver coinage, Stahl estimated "the potential supply to be around 400 million ounces of silver contained in quarters and dimes held by the public but only 10 percent to 20 percent of this total will ever be melted. The majority of the silver coinage is not in the hands of large holders but spread around the country reposing in junior's cookie jar and mother's sugar pot. Most of the people won't part with their silver coins because they remind them of better times; others because of the coins' numismatic value. Every time silver

* Nevada Mining Association News Letter, No. 207, June 15, 1970.

coins are melted, the numismatic value of the remaining coins increases. Obviously, few will be in a hurry to melt their coins first. In the last 10 years, the deficit between production and consumption was covered by the sale of 2 billion ounces of U.S. Treasury silver. The silver hoard is now being exhausted and the Treasury has conceded that it will be out of the silver market by November of this year. If no substitutes are found for some industrial uses within less than a decade, silver prices could go as high as \$10 per ounce."

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PLACER GOLD IN SIXES RIVER AREA EVALUATED

"Distribution of Placer Gold in the Sixes River, Southwestern Oregon -- a Preliminary Report," by Sam Boggs, Jr. and Ewart M. Baldwin, has been published by the U.S. Geological Survey as Bulletin 1312-I. The study is part of the Survey's Heavy Metals program designed to evaluate domestic resources of metals and minerals in short supply. For the Sixes River study, 183 samples of alluvium were collected from various parts of the river and analyzed for gold content. The richest concentrations were found in the upper branches, particularly in the South Fork, and appear to have had their source in areas of Galice argillite intruded by small diorite bodies.

Bulletin 1312-I can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 for 25 cents.

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DEPARTMENT HIRES STRATIGRAPHER

The State of Oregon Department of Geology and Mineral Industries recently hired John D. Beaulieu as the new State stratigrapher. The new staff member, who was born at Hanford, Washington in 1944, was raised in nearby Richland, where he graduated from Columbia High School in 1962. He received his Bachelor's degree in geology in 1966 from the University of Washington, where he was a member of Phi Beta Kappa. Subsequently, he spent 3 years conducting research on the San Andreas Fault as a National Science Foundation Fellow at Stanford University. He expects to complete work towards a doctoral degree this autumn.

Mr. Beaulieu's previous professional experience includes employment as a geologist with Battelle-Northwest in Richland and a year of teaching at the University of Oregon. He is presently familiarizing himself with the geology of the State through a series of field trips. His work with the Department will be primarily to coordinate geologic mapping and research projects in the State.

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GEOHERMAL ENERGY FOR GREENHOUSE HEATING

The uses of geothermal energy are expanding with the increasing awareness that this clean, low-cost heat can be made to perform many of the tasks normally done by fossil fuels and electricity. One of the applications for geothermal energy is in greenhouse and soil heating, and is used in Iceland, Hungary, Russia, New Zealand, Alaska, and Oregon. A new greenhouse in Lakeview, Oregon, demonstrates the ingenuity of the American agronomist by combining geothermal energy with hydroponics. The following article by Jon Head of Medford, Pacific Power & Light Co., describing the Lakeview operation, is reprinted from the Lake County Examiner of August 20, 1970.

Geoponically speaking, it's mostly a matter of partial hydroponics and an interesting fact of geotectonics -- all of which means Oregon Desert Farms Inc. of Lakeview is making a success of growing tomatoes using natural hot water from the ground in a specially equipped greenhouse. A 26,000 square foot steel-framed fiberglass building, located 2 miles north of mile-high Lakeview on highway 395 is the setting for Lake County's latest agricultural enterprise.

Inside the enormous greenhouse, temperature is kept at a carefully watched 70° mark. It is this temperature control combined with special nursing techniques that now are producing tomatoes of remarkable size and quality. Indeed, the entire tomato-raising operation depends solely on keeping temperatures within a range of 60° (night) and 75° (day).

How is this done? Lakeview's high altitude and short growing season is not conducive to tomato growing. Commercial success depends on year-round warmth. And the only sure thing that remains warm year-round in Lakeview is the many geysers, perpetual tea kettles of bubbling hot water.

Recognizing this fact, four Lakeview men -- Bob Utley, Jim Lynch, Chuck Kelley and Andy Parker -- got together in 1969 and formed Oregon Desert Farms Inc. with the idea of building a greenhouse that would never cool off by using the readily available thermal heat. First step in the program called for extensive experimentation with the technique of warming by underground heat and, perhaps most important, the selection of varieties of tomatoes that would thrive in the special environment that would be provided for them. This was accomplished in a small greenhouse adjacent to the main building.

Andy Parker, together with his associates, selected a variety of tomato best suited to their needs to be marketed under the trade name designation, "Desert Gems."

"We picked two varieties for our initial needs after tests involving eight other varieties of tomato. Our special growing conditions, in which water enriched with nutrients would be used on growing beds composed of vermiculite and peat moss, had to be considered and not all tomatoes thrive under these conditions," Parker notes. A further nursing element is to maintain 75° in the growing soil with the warm water.

Satisfied that the technique was sound, construction was started on the primary building. First planting of Desert Gem tomatoes was made in March 1970 even before the building was entirely completed. This initial group of tomatoes is now being harvested and the whole of the interior appears as one giant tomato plant jungle with neat 7-foot-high rows of vines laden with plump tomatoes filling the interior. The plantings are sectionalized so when the growing potential of one set of vines is expended, a new block of vines bearing fruit is ready and the old vines may be removed and the area replanted.

The complete story of Lakeview's newest pollution-free and economically promising business actually begins 440 feet beneath the tough clay soil of Lake County. At that level, the natural heat of the earth in the form of intensely hot water comes in contact with a "v" shaped coil approximately 4 inches in diameter which is filled with cold water. A heat transfer occurs; the cold water is heated and pumped into 16 heat exchangers which are placed along the upper north wall of the hothouse. A radiator-like effect occurs and heat -- pushed by fans -- is forced along overhead in building-length filmy polyethylene tubes pierced with holes that distribute the heat evenly over the interior. This approach is designed to provide 70° temperatures with an outside temperature of zero with a 10-mile-per hour wind.

During the summer, the temperature problem becomes one of lowering instead of raising. Ten exhaust fans located along the north wall of the building can be turned on to produce a moderate lack of pressure in the building. As windows located the length of the south wall are opened, a flow of air is drawn across the building. Located on the outside of the south wall is a "swamp cooler" system. Large mats of semi-porous material are situated here and when filled with water, the draw of air through them produces cool air by evaporation. Lakeview's naturally low humidity is an asset to this type of cooling.

What about control -- who or what actually keeps tab on the critical temperature? All temperature control devices including exhaust fans, heat exchangers, the opening and closing of windows and operation of the swamp cooler are tied into a custom built environmental control system. When it gets a few degrees from normal, say too warm, exhaust fans automatically start -- and just enough fans turn on to reduce the temperature and no more.

"It's a clever system," Parker says, "and absolutely essential."

Presently, Desert Gem tomatoes are being marketed locally in the Lakeview, Bend and Klamath Falls areas. As production smooths out the market area will be extended to include the entire Pacific Coast.

"The idea of supplying the Pacific Coast year-round with Oregon grown tomatoes is exciting. Normally, during the winter months, tomatoes must be trucked in from as far away as Mexico, and needless to say, local vine-ripe tomatoes will have better quality than those picked green and shipped thousands of miles," Parker stated.

* * * * *

OIL TEST CORES AGE-DATED

Radiological age dating of cores of igneous rock by the Mobil Oil Co. research laboratory in Dallas, Texas* has provided important clues to the geologic history of south-central Oregon. The age of the cores from one of Humble Oil & Refining Co.'s two Lake County oil tests shows that Cretaceous seas probably did not extend this far east.

Both drillings were made in 1960 by Humble to explore for marine rocks believed to underlie Tertiary volcanics. Humble "Leavitt No. 1" was drilled near the town of Lakeview and the Humble "Thomas Creek Unit No. 1" was drilled at Grasshopper Flat in the Fremont Mountains 25 miles northwest of Lakeview. A summary of data is tabulated below:

Humble Oil & Refining Co. "Leavitt No. 1"

Sec. 2, T. 40 S., R. 20 E.,	Core 9576-9579 - Andesite
Lake County	79.8 ± 4 m.y.
Total depth, 9579 feet	83.4 ± 2 m.y.

Humble Oil & Refining Co. "Thomas Creek No. 1"

Sec. 18, T. 36 S., R. 18 E.,	Cuttings 11840-11850 - Basalt
Lake County	29.7 ± 1.8 m.y.
Total depth, 12,093 feet	30.3 ± 1.4 m.y.

Core 9576-9579 from the bottom of the Humble Leavitt No. 1 consists of an upper section of fine-grained andesite and a lower section of a coarser grained porphyritic andesite. The K-Ar dating places the rock in about the middle of the Cretaceous Period.

The dated samples from the 11840-50 interval of the Humble Thomas Creek No. 1 indicate that the basalts were extruded near the middle of Oligocene time. Rock alteration may have reduced the K-Ar age somewhat, but in the opinion of the Mobil scientists the rock cannot be any older than late Eocene.

* R.E. Denison, Mobil Research and Development Corp., Field Research Laboratory, Dallas, Texas.

CONDON LECTURE BOOKLETS AVAILABLE

"The Geological Revolution," by Charles L. Drake, and "Planetary Exploration," by Carl Sagan, both delivered as Condon Lectures, were recently published by the Oregon State System of Higher Education. Address orders to: University of Oregon Books, 107 Friendly Hall, University of Oregon, Eugene, Oregon 97403. Each booklet sells for \$2.00.

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AVAILABLE PUBLICATIONS

(Please include remittance with order. Postage free. All sales are final and no material is returnable. Upon request, a complete list of the Department's publications, including those no longer in print, will be mailed.)

BULLETINS

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