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EARTHQUAKES

By
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Locating and fingerprinting

An earthquake is a difficult thing to get hold of. Its arrival is unexpected, its passage is swift, and its recall impossible. The great majority of earthquakes originate at depths of 10 to 20 miles but some are deeper, extending to a maximum of 450 miles. Plainly one must be ready well in advance if an earthquake is to be caught and measured. The federal agency charged with this task is the Seismological Survey of the U.S. Coast and Geodetic Survey. The program of the Coast and Geodetic Survey represents perhaps 20 percent of the seismological work done in this country and includes projects of a highly specialized nature. Besides operating seismological stations to locate earthquakes it collects statistical information on all types of earthquake phenomena including damage, prepares earthquake catalogs and epicenter maps, and conducts various types of investigations directed toward a better understanding of earthquake phenomena.

In Oregon there are two seismological devices installed to record earth motions. At Oregon State College a seismograph, which has been in operation since 1946, makes a continuous record on a photosensitive paper roll. In Portland an accelerograph was installed in the basement of the new State Office Building in 1953. This instrument, in contrast to the seismograph, does not record continuously but is actuated only when a fairly strong earth shock is felt. Accelerographs are designed to record only those shocks having an intensity of IV or over on the Modified Mercalli Intensity Scale. Shocks of this magnitude are of interest in the study of damage to structures and related subjects. An examination of the Mercalli Scale reveals that the various intensities are correlated to sensations experienced by observers and to damage suffered by structures and natural objects. Accelerographs are being used to accumulate seismic data on a scientific basis that is free from both human emotional distortion and vagaries due to type of construction and character of subsoil.

The isoseismal map set into the larger map (opposite page 31) shows the degree to which areas were affected by the December 15, 1953, shock in the Portland area. Data for this map was obtained by the Geodetic Survey largely from postal cards circulated throughout the area. The accelerograph in the State Office Building in Portland was not tripped.

The following paragraphs describing earthquake waves and the work of the Seismological Survey are taken from "Earthquake Investigation in the United States" by Frank Neumann.1/

> "One of the most important phases of the Survey's seismological program is the investigation of destructive earthquake motion, a program that is of basic importance to the engineer who must design structures to successfully resist earthquake forces. The 700 persons killed in the great California earthquake of 1906 and the billion-dollar (present-day value) property loss caused from the fires that followed will always stand as a warning to those who feel that the earthquake menace can be ignored. Years of study have shown that the problem of the design engineer is technically difficult because earthquake forces are vibrational or dynamic in character and cannot be treated the same as static, or steady, forces. Much has been accomplished, however, and the Survey has played an important role in this accomplishment through furnishing authentic information on destructive ground and building motions."

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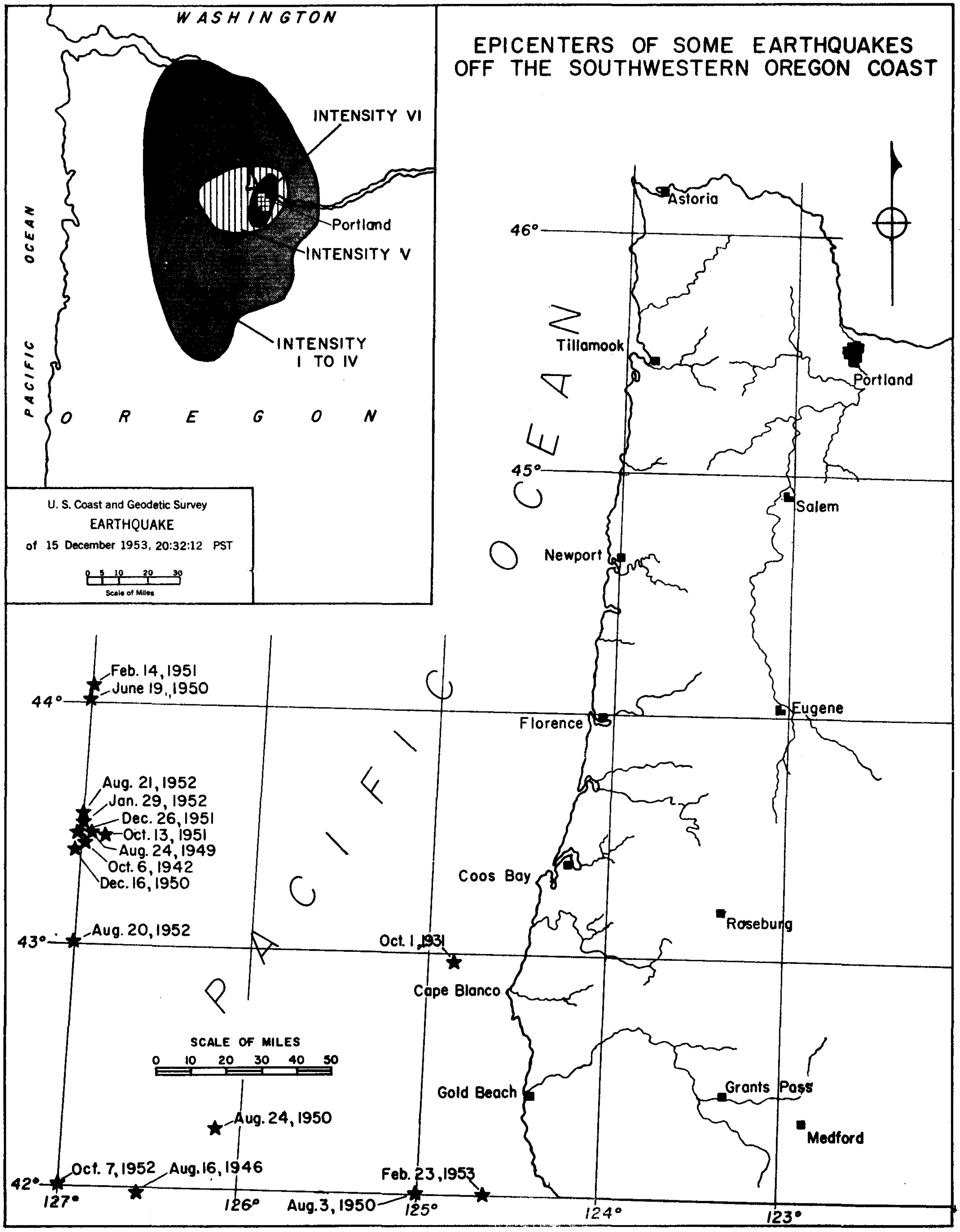
1/U.S. Coast and Geodetic Survey Spec. Pub. 282, p. 2, rev. ed., 1953.



EPICENTERS OF SOME EARTHQUAKES
OFF THE SOUTHWESTERN OREGON COAST
WASHINGTON
INTENSITY VI
Portland
INTENSITY V
INTENSITY
I TO IV
PACIFIC OCEAN
OREGON
U. S. Coast and Geodetic Survey
EARTHQUAKE
of 15 December 1953, 20:32:12 PST
Scale of Miles
0 5 10 20 30
Astoria
46°
Tillamook
Portland
45°
Salem
Newport
Eugene
Florence
44°
Feb. 14, 1951
June 19, 1950
Aug. 21, 1952
Jan. 29, 1952
Dec. 26, 1951
Oct. 13, 1951
Aug. 24, 1949
Oct. 6, 1942
Dec. 16, 1950
Coos Bay
Roseburg
43°
Aug. 20, 1952
Oct. 1, 1931
Cape Blanco
SCALE OF MILES
0 10 20 30 40 50
Gold Beach
Grants Pass
Medford
Aug. 24, 1950
42°
Oct. 7, 1952
Aug. 16, 1946
Feb. 23, 1953
Aug. 3, 1950
127°
126°
125°
124°
123°

"An interesting phase of seismological research is its international aspect. The fact that a strong earthquake in any country is registered on seismographs all over the world has resulted in a world-wide exchange of data and cooperative effort that is matched in few other fields. This international effort has resulted in a great accumulation of technical data that has not only made possible an authentic history of world earthquakes over the past 50 years but exhaustive analyses of the data have given the scientific world the most accurate picture it has of the physical structure of the interior earth.

"In a great earthquake these seismic vibrations or waves penetrate the entire structure of the earth and travel all over its surface. While great earthquakes are seldom felt farther than a thousand miles from their source, sensitive seismographs have registered these unfelt vibrations in all parts of the world for more than 50 years. Such seismic waves are extremely complex but a few basic facts will serve to explain how they are propagated through the earth and how the distance to an earthquake can be determined from a seismograph record.

"Two types of waves travel at different speeds through the earth's interior and are known as interior waves. The faster one alternately compresses and dilates the rock as it travels forward; the slower one shakes the rock sidewise as it advances - like the vibration of a violin string. Seismological tables, based on many thousands of seismograph readings, show to the nearest second just how long it takes each of these wave groups to travel to points on the earth's surface at various great circle distances from an earthquake origin. The difference in the arrival times of two such wave groups at a seismograph station therefore corresponds to some particular epicentral distance that is shown in the seismological tables. These two waves are usually well defined on seismograph records and anyone who can recognize them can obtain the corresponding epicentral distance from the seismological tables. The largest waves recorded at distant stations, however, are usually waves that travel at nearly uniform speed through the surface rocks only and are known as surface waves. Epicenters are located on a large terrestrial globe by swinging arcs around several observatory locations, using as radii the epicentral distances determined from the station records. The common point of intersection is the location of the epicenter."

What causes earthquakes?

The earth's rocky crust rests upon a rubbery layer of semiplastic material which is constantly adjusting itself to the changing pressures imposed upon it. The processes of erosion cause a redistribution of the surface by gradually transporting mountains down to the sea where thick layers of sediments are slowly built up. The earth mass under the eroded mountains is in time relieved of a great weight and tends to push upwards while the off-shore zone recently loaded down with sediments tends to be depressed. The result of these two opposite tendencies is to create a zone of disturbance and instability which may produce a cracking or faulting of the crust. This explains in part why the Pacific Coast, with its high mountain ranges which are rapidly being eroded away, has so many earthquakes. Earthquakes are the vibrations created by slippage along a fault plane.

Earthquakes and volcanic activity are often closely associated. The question of whether the earthquakes set off the volcanic activity or vice versa is sometimes difficult to determine. It is known that faults may provide an escape route to the surface for pent-up molten igneous rocks called magma. In some areas of the world earthquakes presage the coming of volcanic eruptions,and native populations living near quiescent volcanic vents often leave the area after feeling a series of sharp shocks. On the other hand there is evidence that deeply buried masses of magma periodically generate terriffic pressures which are relieved by forcing tongues of molten rock between the layers and joints of the overlying rock. This produces a disruption of the crust which in turn results in an earthquake. The actual surface eruption of a volcano, however, does not cause an earthquake.

Crustal movements, caused by deep-seated convectional currents which slowly move portions of the earth's surface toward each other, may be the underlying cause for yet another source of earthquakes. Some of the world's great mountain ranges are in reality large wrinkles which are thought to have been caused by this type of movement. The folding and fracturing of the opposing masses as they come together give rise to periodic adjustments along fault planes.

There are numerous kinds of faults although most of them fall into two general classes. Tensional forces produce a "normal" fault which characteristically has a fault plane steeper than 45 degrees. A compressional force may produce a "reverse" fault having a much flatter fault plane which permits one block to "ride up" over the other. Some of the complex geology of the European Alps is due to this type of faulting which is called thrust faulting if the amount of overlap of the two blocks is very large compared to the vertical movement. Movement of the two fault blocks with respect to each other may be in any direction in a plane parallel to the fault plane. If the motion is horizontal much damage will occur in populated areas to buried installations such as pipelines, and to surface structures which may be toppled over or shaken to pieces. Horizontal movement of the San Andreas rift during the 1906 earthquake amounted to 21 feet in places and caused millions of dollars worth of damage to the city of San Francisco alone. Vertical motion produces fault scarps which are the exposed fault planes. If the motion is small and the soil mantle heavy, no permanent scarp will be formed. If the displacement is large or repeated at frequent intervals for a long time, an imposing scarp will be exposed. Abert and Winter rims in Lake County were formed in this manner and are classed with some of the best examples of this type or faulting in the world.

What to do when an earthquake comes

Most people have an urge to rush out of doors when an earthquake comes. That this is a dangerous practice is fully supported by mortality statistics. Buildings commonly have knickknacks adorning entrances which have the unpleasant habit of toppling down onto the heads of occupants issuing forth. Walls sometimes are either poorly attached to the building proper or have a veneering which sloughs off during a severe shock. In either event the streets in front of most multiple-story buildings are poor havens of refuge during an earthquake. Standing under archways or in doorways is recommended as these are structurally strong parts. There is a certain danger of being trampled by people rushing out of a building if one stands under the entrance arch but this is preferable to cushioning the fall of a cornice weighing several hundred pounds. Chandeliers may be shaken down; bookcases may topple; and heavy mirrors, pictures, and large windows may be broken or thrown down. A safe hiding spot can often be found under a desk or heavy table. Stay there until the shaking ceases, then carefully make your way out of the building. Avoid any wires lying on the ground; they may be electrified. If possible, shut off the main gas valve in a building until a thorough check on the condition of the lines has been made. Chimneys and flues are particularly subject to damage by earthquakes and many fires have been caused by failure to examine the condition of the flues before using them.

Oregon, a seismologically stable state

Oregon is a relatively stable state, seismologically speaking. Compared to California, which has shocks of magnitude VI or greater on the intensity scale approximately once each year, Oregon has had only a handful since earliest records were kept. The San Andreas rift or fault and other associated earth fractures are responsible for the numerous tremors in California. Oregon, fortunately, has no such active fault system and as a consequence, has only occasional earthquakes and these have been of low intensity. The San Andreas rift extends northwestward from San Francisco and eventually passes out to sea. The path of this great fault apparently lies about 130 miles west of Coos Bay. The accompanying map shows the location of some recent epicenters located off the southwestern Oregon coast. Of particular interest is the "nest" of seven epicenters located along the 127th meridian between latitude 43° and 44°. The zone of activity may perhaps indicate an extension of the San Andreas fault. In California, motion along the San Andreas has been largely horizontal with the western side moving northward. Horizontal motion is not likely to produce disastrous seismic sea waves. Faulting having a vertical component, however, might cause a dangerous sea wave, and if the Oregon coast should ever be visited by one of any considerable size the loss of property and life might be great. No adequate warning of such an impending wave could be given if it originated close to shore as the speed of propagation is rapid (300 to 500 miles per hour), most of the coast is entirely unprotected by off-shore shoals or islands, and the majority of coastal towns lie close to the shore and not far above sea level. A violent earthquake along the coast, coupled with an unusually great withdrawal of the sea, should be a warning that a seismic sea wave may be expected very shortly.

Neuman states:1/

"One of the important services of the Coast and Geodetic Survey is the maintenance of a seismic sea wave warning program. The principal objective is to alert public officials in such areas as the Hawaiian Islands whenever seismographic records reveal the occurrence of a submarine earthquake that might generate a destructive sea wave. Such a program would generally be impractical in areas near earthquake origins, but when 5 or 10 hours elapse between the time an earthquake occurs and the time sea waves might pile up on a distant shore there is time, by working fast, to locate the earthquake, establish the existence of a sea wave, and issue warnings to coastal populations that might be endangered.

"In Hawaii, Alaska, and Arizona, the Survey operates visible-recording seismographs that ring alarms whenever an unusually strong shock is being registered. Other participating seismograph stations are operated at Pasadena and Berkeley (Calif.), Adak (Alaska), Tokyo (Japan), Guam, and Huancayo (Peru). Observers at 16 Survey tide stations scattered over the Pacific immediately report unusual tidal disturbances to the monitoring station near Honolulu. A high-priority communications service is maintained between reporting agencies through the combined facilities of the Army Air Force, the Navy, and the Civil Aeronautics Administration. With all of these groups functioning, the Survey's central station near Honolulu is enabled to locate a submarine shock and verify the existence of a seismic sea wave within 2 or 3 hours."

If Oregon should have a severe earthquake the pattern of damage would be irregularly centered around the epicenter. Structures built on uncompacted valley fill, water-soaked soil, or man-made earth fills would be subject to greater damage than those founded on well compacted soil or solid rock. Buildings on steep hillsides might suffer from secondary earthquake effects such as landslides and settling. Contractors, building owners, planning commissions and insurance companies should be vitally interested in the susceptibility of Oregon towns and cities to earthquake damage. The location of the epicenter cannot be predetermined but building codes, type of construction, location of structures, and insurance rates should all take subsurface conditions into consideration as such conditions are the most important factors in evaluating possible earthquake damage. This information could be obtained quite simply by collecting and evaluating data already available from well drillers, city engineers, and public utilities.

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1/ Op. cit., p. 19.

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BAKER COUNTY GOLD MINE TO GET INTO PRODUCTION

A working agreement has been made between James Muir, Don Olling, Verne Jacobson, and William Wendt for development of the Sanger gold mine, Baker County, Oregon. The group is on the property and currently engaged in readying the property for operation. Plans are to mine and mill ore from a shoot on a new vein prospected by Wendt a few years ago and to do additional prospecting work on other parts of the property. Mr. Wendt who is owner of the property erected a 5-ton test mill last summer. This includes an Ellis mill, plate amalgamation, and a Wilfley table. Tailings from the present operation will be impounded for future cyaniding.

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ASSESSMENT WORK

The assessment year ends at noon, July 1, 1954. The right of possession to a valid mining claim is maintained by the expenditure of at least $100 in labor or improvements of a mining nature on the claim prior to that time. However, if the work has not been completed by noon of July 1, it should have been started and must be prosecuted "with reasonable diligence" until completed.

According to Oregon law, within 30 days after the performance of labor or making of improvements to comply with the law, an affidavit setting forth the following facts must be recorded in the mine records of the county in which the mining claim is situated:

1. The name of the claim or claims, if grouped, and the book and page of the record where the location notice of said claim or claims is recorded.

2. The number of days work done and the character and value of the improvements placed thereon, together with the location of such work and improvements.

3. The date or dates of performing said labor and making said improvements.

4. At whose instance or request said work was done or improvements made.

5. The actual amount paid for said labor and improvements and by whom paid if the same was not done by the owner or owners of said claim.

If a mining claim is on O and C lands, the owner, within 60 days after the expiration of any annual assessment year, must file for record a statement under oath as to the assessment work done or improvements made during the previous assessment year at the Land Office of the Bureau of Land Management, 827 N.E. Oregon Street, Portland 14, Oregon.

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ANNOUNCEMENT OF CHANGE OF ADDRESS

The U.S. Bureau of Land Management, Department of the Interior, Area I, which includes Oregon, California, and Washington, will have the Area office in the new Interior Building at 1001 N.E. Lloyd Blvd., Portland 14, Oregon. The state offices under the Area office will be at Sacramento for California, Spokane for Washington, and at 1001 N.E. Lloyd Blvd. for Oregon. The Interior Building telephone number will be FIllmore 3361. This number will reach both the Bureau of Land Management Area and state offices.

Oregon Land Office and Public Survey records for Oregon under the Bureau of Land Management will be located at 827 N.E. Oregon Street, the Old Bonneville Power Administration building. The telephone number will be FIllmore 3361. Proofs of labor for assessment work done on mining claims on O and C lands should be sent to the Land Office.

The mailing address of the U.S. Geological Survey effective June 1, 1954, will be: Interior Department Building, 1001 N.E. Lloyd Blvd., Portland 14, Oregon. Effective May 17, 1954, all telephones under the master number, FIllmore 3361, will have extensions as follows:

Fuels Branch	
Supervising Geologist, Linn Hoover	Ext. 235
Ground Water Branch	
District Geologist, R. C. Newcomb	236
Quality of Water Branch	
District Chemist, H. A. Swenson	237
Staff Scientist, Arthur M. Piper	241
Surface Water Branch	
District Engineer, K. N. Phillips	239
Water and Power Branch	
Staff Engineer, L. L. Bryan	234

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MERCURY ON RAMPAGE

At the end of 1953 the market price of quicksilver was $187-$189 a flask. Early in 1954 prices began to strengthen and rose steadily month after month because of a shortage of spot metal reportedly due to U.S. Government buying abroad. On May 13 the New York price was $240-$245 depending on quantity and seller. Following is the comment of E&MJ Metal and Mineral Markets, May 13, under "Washington Reports."

> MERCURY IS A CLOAK AND DAGGER AFFAIR. Washington will not explain its role in the recent price leap. But despite the official hush-hush, there's no doubt that the Government is quietly procuring scads of mercury.
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> Here's the unofficial story: The stockpile is in excellent shape. But the view is mercury is being procured for an "immediate defense need." The material is being procured largely, but not exclusively, through barter of surplus farm goods with Spain and Italy. Some is also being bought from Mexico and elsewhere.
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> The Bureau of Mines recently reported that mercury has been used in one of four experiments for "appraising the prospects for private industry participation in the . . . production of electrical energy and fissionable materials from reactors." Best guesses are that mercury is or will be used as a heat transfer agent, as a coolant, or as a pressure source in vaporized form.
>
> Gripes from mercury consumers have brought the Preparedness Subcommittee of the Senate Armed Services Committee into the picture. That's the group that created the rumpus in tin three years ago. The Subcommittee's investigators have just made a "preliminary inquiry" into why mercury prices have jumped so much in the past six months.

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GSA PURCHASE PROGRAMS

The General Services Administration has announced the following deliveries of domestic minerals under the defense purchase programs from May 11, 1951, through March 31, 1954:

	Deliveries	Authorized Goals	
Tungsten (short-ton units)	781,733	3,000,000	
Manganese (long-ton units)	5,429,707	6,000,000	
Chrome ore (long tons)	53,088	200,000	(46,640 on Dec. 31, 1953)
Beryl (short tons)	170	1,500	
Columbium-tantalum (pounds)	3,901,051	15,000,000	

These programs are separate from the exploration program of Interior Department's Defense Minerals Exploration Administration. (From The American Mining Congress Bulletin Service, May 12, 1954.)

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ALASKAN CHROME COMING TO GRANTS PASS

As reported by Mining and Industrial News, San Francisco, the Seldovia Chrome Company, Seldovia, Alaska, has started producing high-grade chrome at its property on Red Mountain southeast of Seldovia with initial production of about 10 tons per day with a goal of 30 tons daily expected by next July. A production of 5000 tons is the goal for 1954. The ore is hauled from the mine by caterpillar and wagon, loaded on boats, and shipped to Seattle. It is then shipped to Grants Pass, Oregon, either by truck or by rail and sold under government contract.

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MEXICAN PESO AGAIN DEVALUED

The Mexican peso has been devalued from 8.65 to 12.50 pesos to the dollar. The American Mining Congress Bulletin Service quotes Senator Bennett of Utah as saying that this devaluation gives Mexico's lead and zinc producers a further large price advantage over United States producers. Senator Bennett said that Mexico accounts for 33 percent of our total imports of lead and 36 percent of our total imports of zinc from all sources and added that "It is not likely that the safety of the world will be advanced by permitting our productive capacity to be destroyed by additional imports of zinc and lead made possible by substantial devaluation of foreign monies."

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TOPOGRAPHIC MAPPING IN CALIFORNIA

In 1948 California started a cooperative mapping program with the U.S. Geological Survey to complete topographic mapping in the State. Over a 10-year period California contributes $300,000 a year, which is matched by the U.S. Geological Survey.

Oregon provides no cooperative funds for mapping by the U.S. Geological Survey. Therefore topographic mapping lags in Oregon and is governed mainly by Army needs. The southeastern quarter of the State is practically a blank in availability of topographic mapping. Even aerial photographs are not available. This lack of maps is a serious handicap to the geologist in attempting to make geological studies in that part of the State which is a veritable No Man's Land as far as topographic and geologic mapping is concerned.

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MONTANA CHROME

According to the News Letter of the Mining Association of Montana, Carl Trauerman, Secretary, the American Chrome Company, a subsidiary of the Goldfield Consolidated Mines Company, is now mining and milling 1000 tons of chrome ore per day at its Mouat mine and mill near Nye, Stillwater County, Montana, and is turning out about 380 tons of 38-percent Cr_2O_3 concentrates per day. This company has a contract with the DMPA to produce 900,000 tons of concentrates over an 8-year period for delivery to the United States Government. More than 300 men are employed at the operation and the payroll averages about $130,000 per month. The company is spending also about $1,000,000 annually for power and supplies.

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PRICES OF METALS AND ORES

Copper -	29.7 cents per pound at refinery
Lead -	14 cents per pound New York
Zinc -	10¼ cents per pound East St.Louis
Aluminum -	Ingot, 21½ cents per pound
Tin	93½ cents per pound New York
Silver -	Foreign, 85¼ cents per ounce; domestic 90½ cents per ounce
Antimony -	28½ cents per pound in bulk
Bismuth -	$2.25 per pound in ton lots
Cobalt -	$2.60 per pound in 500-pound containers
Iridium -	$145-$150 per troy ounce
Palladium -	$21 per troy ounce
Platinum -	$84 per troy ounce
Rhodium -	$118-$125 per troy ounce
Ruthenium -	$70-$75 per troy ounce
Selenium -	$5 per pound
Titanium -	99.3 percent plus, maximum 0.3 percent iron, $4.72 per pound
Zirconium -	Powder, $7 per pound

(From E&MJ Metal and Mineral Markets, May 13, 1954.)

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