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NATURAL SOURCES OF CARBON DIOXIDE IN OREGON

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On looking over maps of Oregon, one frequently comes across names such as Soda, Dry Soda, or Fizz applied to springs, creeks, mountains, and even towns (Sodaville in Linn County). These names owe their origin to the presence of springs emitting soda water - that is, water having a high content of dissolved carbon dioxide. The large number of soda-water or carbon-dioxide springs in Oregon is not readily apparent from maps, however, because many of the springs either have no names or have names that are not descriptive.

Soda-water springs, or soda springs as they are commonly called, occur at many places in the State, from the Willamette Valley to the Snake River. Locations of thirty of these springs are shown on the map on page 104. At some of the springs the discharge of water is accompanied by the escape of free carbon dioxide gas. But whether free gas is present or not, all of the springs represent a leakage of natural carbon dioxide and some a potential source of this commodity.

Carbon dioxide industry

Carbon dioxide (CO_2) is an odorless, colorless, tasteless, inert and noninflammable gas. It can be converted to a liquid or a solid and held in that form with comparative ease. The liquid and solid forms retain the properties of the gas, but have additional properties of their own. For example, the solidified material, dry ice, has a temperature of -109.3° F. It also has a relatively high specific gravity and it evaporates back to gas without liquifying to a noticeable extent.

Because of its properties, dry ice is used extensively as a refrigerant in the storage and transportation of various foods, one pound substituting for 15 to 20 pounds of water ice. Dry ice is also used in the shrink fitting of machine parts and for hardening steel alloys. Liquified CO_2 is employed in some types of mechanical refrigeration and as an explosive in coal mines. The gas is popularly known for its use as the "sparkling agent" in carbonated beverages. It is also used in fire extinguishing and for food preservation in ways other than refrigeration. Both liquid and gaseous CO_2 are used as packaged power for inflation of collapsible life-saving gear and for spray application of canned insecticides, paints, and an ever-growing number of food products and housekeeping aids.

National production of CO_2 for 1953 was 743,368 short tons valued at 41.3 million dollars, according to the U. S. Bureau of Census, 1954. The bulk of this production represents by-product gas reclaimed from waste fumes from various industrial plants. However, approximately 40,000 short tons, or 5.3 percent of the national production having a gross value of 2.2 million dollars was derived from natural sources. Later figures in the U. S. Bureau of Mines Minerals Yearbook for 1957 indicate that CO_2 production from natural sources climbed from 670,600,000 cubic feet in 1953 to 704,276,000 cubic feet in 1957.

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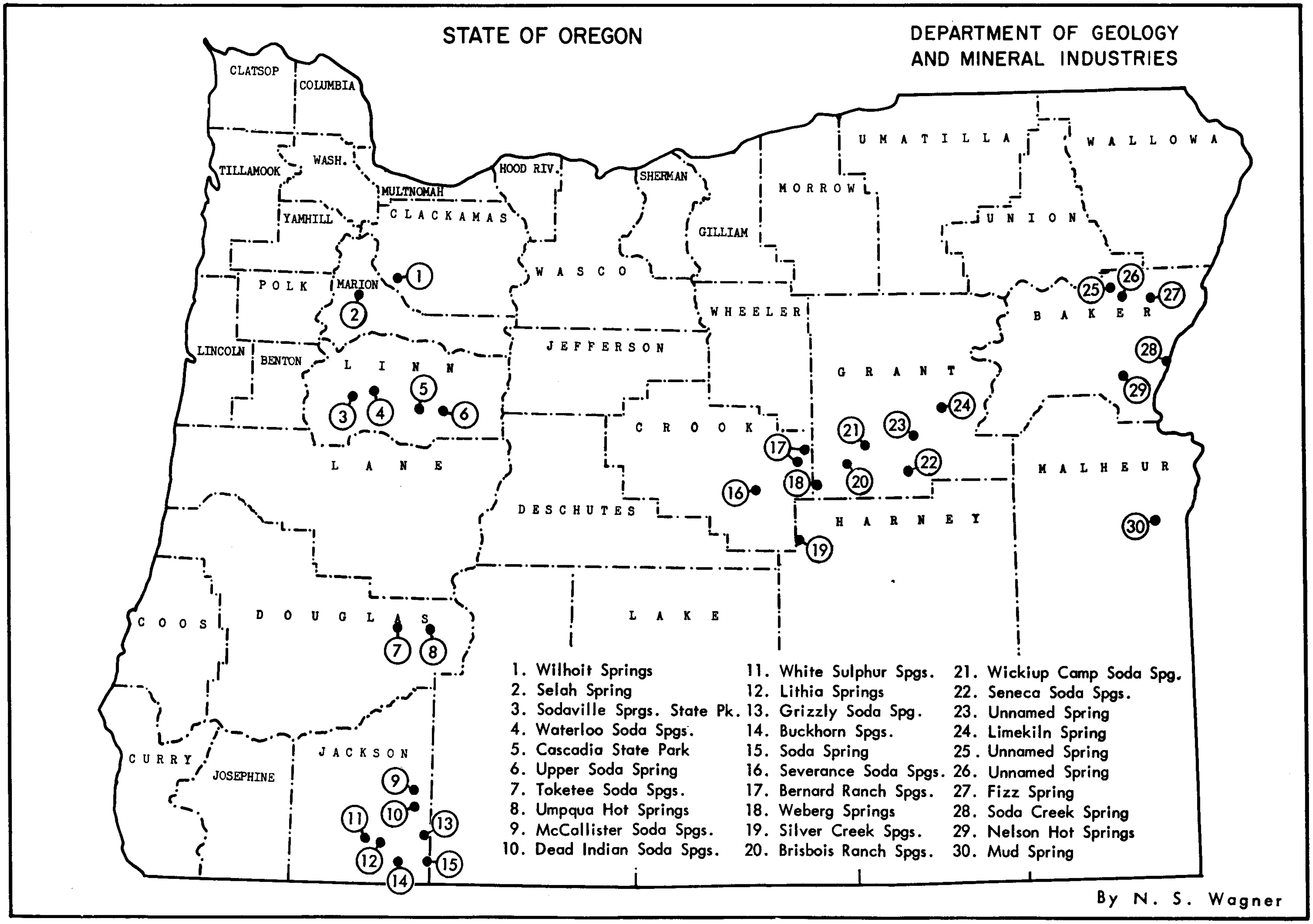

1. Wilhoit Springs
2. Selah Spring
3. Sodaville Sprgs. State Pk.
4. Waterloo Soda Spgs.
5. Cascadia State Park
6. Upper Soda Spring
7. Toketee Soda Spgs.
8. Umpqua Hot Springs
9. McCallister Soda Spgs.
10. Dead Indian Soda Spgs.
11. White Sulphur Spgs.
12. Lithia Springs
13. Grizzly Soda Spg.
14. Buckhorn Spgs.
15. Soda Spring
16. Severance Soda Spgs.
17. Bernard Ranch Spgs.
18. Weberg Springs
19. Silver Creek Spgs.
20. Brisbois Ranch Spgs.
21. Wickiup Camp Soda Spg.
22. Seneca Soda Spgs.
23. Unnamed Spring
24. Limekiln Spring
25. Unnamed Spring
26. Unnamed Spring
27. Fizz Spring
28. Soda Creek Spring
29. Nelson Hot Springs
30. Mud Spring

MAP SHOWING LOCATION OF CARBON DIOXIDE SPRINGS IN OREGON

The by-product production of CO_2 originates from industrial plants throughout the nation, but only six states are listed as having production from natural sources in 1957. These states are Oregon, California, Colorado, New Mexico, Utah, and Washington.

Origin of carbon dioxide

Both manufactured and natural CO_2 are derived by the burning or chemical treatment of: (1) organic matter, (2) materials of organic derivation such as coal, oil and the hydrocarbon gases, and (3) rocks composed of carbonate minerals. The manufactured CO_2 is liberated in plants where fuel is combusted, where cement and lime are burned, where ammonia and nitrogen are manufactured, where hydrocarbons are treated, and where alcohol fermentation is accomplished. A similar generation of CO_2 takes place in the earth's crust when natural materials containing carbon are subjected to: (1) magmatic assimilation, (2) heat generated by faulting, igneous intrusion, and metamorphism, (3) the action of acid ground waters on carbonate rocks, and (4) the kinds of decay and fermentation that occur during the transformation of buried organic matter into coal and hydrocarbons. Natural CO_2 is therefore found in varying degrees of concentration in gases of volcanic origin, in areas of recent volcanism where uncooled magmas remain in contact with limestones and sediments containing organic matter or materials of organic derivation, and in association with deposits of coal and hydrocarbons.

Once formed, natural CO_2 is subject to the same structural and physical controls that govern the entrapment, migration, and leakage of petroleum and the hydrocarbon gases. Thus while tremendous quantities of CO_2 are discharged annually from the vents of the world's volcanoes, and from lesser fumaroles and bedrock fractures in areas of recent volcanism, large accumulations also exist in subsurface traps from which there is little or no leakage. For this reason many CO_2 occurrences have been discovered accidentally during the course of drilling exploratory wells for oil. Several of the New Mexico occurrences are notable examples.

Uses of natural CO_2 in Oregon

Dry ice is being produced from natural CO_2 recovered from wells in a soda-water spring zone on Emigrant Creek, 3 miles east of Ashland. The operation is owned by the Gas-Ice Corporation of Seattle, Washington, one of the first companies on the West Coast to use natural CO_2 for ice-making purposes. Production at Ashland began in the summer of 1945, and through 1957 has totaled approximately 47 million pounds of dry ice.* At the rate of 10 cubic feet of gas for each pound of dry ice, this amounts to a recovery of 470 million cubic feet of gas from the field - an average somewhat in excess of 31 million cubic feet per year. For 1958, plant output was nearly 210 eighty-pound cakes of ice per 24-hour working day with a two-month shutdown of operations during the winter.

The only other way these natural "soda" springs are being utilized today is for drinking or bathing purposes at campgrounds, parks, and health resorts. During past decades, however, especially during the forepart of the century, several attempts were made to market natural soda water in bottled form. Most of these operations were short-lived and financially unrewarding. Artificial carbonation, brought about by the development of the carbon dioxide industry, now serves the same purpose in a much more effective and efficient manner.

Characteristics of Oregon's soda-water springs

All soda-water springs contain enough dissolved CO_2 to give the sour, fizzy taste of carbonic acid (H_2CO_3). Other characteristics generally present to some degree include a bluish, soapy cast to the water in semistagnant pools, patches of orange-brown coating in the bed of the discharge channels, abundant growths of deep-green, mosslike algae in both the springs and the discharge channels, and a graying of otherwise green grass in the area of the spring.

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*R. B. Newbern, President, Gas-Ice Corporation: personal communication.

Soda-water springs differ considerably among themselves with respect to size, shape, flow temperature, content of dissolved CO_2, and amount of associated free gas. For example, some springs consist of a single, clean-cut discharge orifice and nothing more, while others have several flowing discharge centers accompanied by zones of seepage. In some places a single-orifice spring, or a small compound spring, will occur in an area devoid of other known CO_2 leakages; in other places many clusters of springs and seepages occur in a compact area of considerable acreage, or extend for an appreciable distance in alignment with a fault or bedding trend. Deposits of calcareous tufa (travertine) occur at most springs, but are absent at others. The rate of flow varies likewise, although no definite flow figures can be given here because field conditions rarely permitted measurement. In fact, several of the larger springs discharge directly in the beds of rivers and creeks. On the whole, however, the flow at most sites is quite small, and in several instances it is negligible. Water temperatures range from 48° F. to 121° F. Thus some of the springs are hot, most are tepid, and a few are cold.

The CO_2 content of the water is strong in some springs and weak in others, due undoubtedly to mingling and dilution of the spring water with fresh ground water. A discharge of free CO_2 gas occurs at some sites along with the water, and is lacking at others. Its presence appears to bear no fixed relation to the CO_2 content of the spring water, however, as some springs with a high content of dissolved CO_2 show no observable discharge of gas while some springs with a low content show a conspicuous amount of gas.

When free gas is discharged from within the confines of a spring pool, or from points in the bed of a creek channel, its escape is manifest by bubbles rising through the water. Such bubbles are emitted in coarse bursts at some sites and in a steady succession of fine beads at others. In some places, emission is continuous but punctuated by surges of greater activity. At other places, periods of escape alternate with periods during which there is no observable discharge. There are also areas in which free gas escapes directly from the earth's surface to the atmosphere without passing through any pools of standing water. It is, of course, virtually impossible to determine the extent of areas of "dry" leakage. In fact, their existence can be recognized only when the ground is covered by puddles of standing water after prolonged rains or springtime thaws. Some sites of "dry" leakage are reportedly indicated by a tendency to be relatively snow-free during the winter.

Descriptions of individual CO_2 springs

Due to the prevalence of volcanic activity in Oregon and the rather commonplace by-product association of CO_2, it is reasonable to conclude that many of Oregon's numerous CO_2 springs are seepages of little significance. However, the Gas-Ice Corporations's operation at Ashland, and another owned by the same company and located in a spring area near Klickitat, Washington, about 30 miles north of The Dalles, Oregon, show that commercial quantities of natural CO_2 occur at some spring sites in the Northwest. This suggests that other leakage areas would warrant careful investigation should future market demands give rise to the need for developing additional supplies.

While a far more detailed study must be made before the full geologic picture can be determined in most instances, the following descriptions summarize the data presently available for the springs and seepages shown on the map. All water and gas analyses were made by Dr. R. E. Moser, Oregon State Board of Health.

1. Wilhoit Springs: A cluster of soda-water springs on northeast bank of Rock Creek in sec. 16, T. 6 S., R. 2 E., Clackamas County. Very light discharge of free CO_2 occurs sporadically from these springs and also at intervals in Rock Creek over a distance of about three-eighths of a mile, beginning at a point about one-eighth of a mile above the springs and continuing on downstream past the springs. Additional free gas leakage reportedly observed in meadow in vicinity of springs to distances of 300 to 400 feet east of creek when terrain is saturated,

according to Albert Schoenborn, property owner. Full extent of area over which such "dry" leakage occurs is unknown. Due to development and landscaping of campgrounds, springs are now boarded over and equipped with hand pumps. Original setting presumably consisted of boggy seepage with three or four separate flowing discharge centers in an area of about 50 by 100 feet. Temperature in one accessible spring measured 48° F. Water contained 3.1 volumes CO_2 per volume of H_2O at 25° C. Free gas sample from leakage in creek contained 80 percent CO_2; 3.5 percent O_2; and 15.5 percent N_2. No hydrogen or methane were detected. Springs emanate from Oligocene series of coal-bearing terrestrial and marine sediments with a presumably thick underlying sequence of older Tertiary sediments and volcanics. Leakage area traversed by axis of broad anticline with a strike roughly normal to the course of Rock Creek, according to mapping by Oregon Department of Geology and Mineral Industries (1944-1948) and Harper (1946). Because of this, jointing probably serves as the escape channelways, and "dry" leakage may occur along anticlinal axis over a far greater distance than has been currently observed.

2. Selah Spring: On west bank of Pudding River near center of the SW¼ sec. 5, T. 7 S., R. 1 W., Marion County. Consists of a solitary spring enclosed in a concrete tower erected years ago as part of bottling works project. Water stands in tower an estimated 2 feet above ground surface and escapes in small flow from cracks near ground level. Gas given off almost continuously in numerous small bubbles, but total yield is small, and water is only mildly carbonated by taste. Temperature 52° F. Spring issues from "older (Pleistocene) alluvium and terrace deposits" in area underlain by Tertiary sediments and volcanics, according to Piper (1942).

3. Sodaville Springs State Park: This spring is in Sodaville in the SE¼ NE¼ sec. 36, T. 12 S., R. 2 W., Linn County. It is housed in the basement of an establishment originally erected as a commercial venture but now operated as a public fountain by the Parks Division of the State Highway Department. As the spring was padlocked and the Park Service was unable to furnish any analysis, all that can be stated here is that the water from a fountain spigot was cold and had a very strong carbonated taste. Several local residents report that strong soda water has been encountered in several wells drilled for fresh water elsewhere in the Sodaville area, but no further details can be given as the wells have been plugged. The Sodaville area as a whole is underlain by a presumably thick series of sediments and volcanics of Tertiary age, according to available geologic mapping by Piper (1942).

4. Waterloo Soda Springs: Two very small springs on opposite sides of South Santiam River 400 to 500 feet upstream from bridge at Waterloo, about center of the W½ sec. 28, T. 12 S., R. 1 W., Linn County. Reported as having been persistently flowing 20 years ago, but flow from each is barely a trickle now. Both springs issue from crevices in a Tertiary basalt and both are subject to flooding during periods of high water.

5. Cascadia State Park: This is an attractive park built around three natural soda-water springs located on the north side of South Santiam River at mouth of Soda Creek, in the NW¼ sec. 32, T. 13 S., R. 3 E., Linn County. Original springs are now buried under a rock terrace and piped to spigots and to an open piece of culvert about 10 inches in diameter set vertically in the terrace floor. Observable flow is small and probably only a portion of that available. Gas is emitted continuously and at a fairly constant rate from the culvert pool in the form of an abundance of small bubbles. Pool temperature is 49° F. Gas and water samples taken at the time of examination were lost because of defective capping, but water can be described as having had an exceptionally strong carbonated taste. However the park caretaker reports that the CO_2 content varies, making the water almost too strong to drink at times. Much difficulty in the form of bottle

breakage due to gas pressure is reportedly experienced by those who attempt to bottle the water. Many small springs, observable only during periods of low water, are said to occur in the river bed in the vicinity of the park, with other occurrences at less frequent intervals all the way to Waterloo. Tertiary lavas constitute the bedrock in the park area but no data on structural conditions are presently available due to lack of detailed geologic mapping in the region.

6. Upper Soda Spring: A seepage from a nearly vertical bluff on the north bank of the South Santiam River, 300 to 400 feet below the mouth of Soda Fork and within 6 to 8 feet of river in the SE¼ sec. 26, T. 13 S., R. 4 E., Linn County. Stagnant water fills a small, three-compartment trough built against bluff but the seepage-moistened face of cliff represents the only observable source of supply at this now deserted relic of a spring site. Tertiary volcanic area.

7. Toketee Soda Springs: Four small springs and much related seepage in a small cove on north side of Toketee Falls - Glide road on North Umpqua River a quarter of a mile downriver from Soda Springs dam, in the southwest corner of the NW¼ sec. 17, T. 26 S., R. 3 E., Douglas County. One spring, situated on steep hillside along trail to Indian Caves, issues from a picturesque, mug-shaped travertine cone 30 to 35 feet in diameter at base, while others issue from bench-type deposits in cove bottom at base of hill. Aggregate flow is small. Temperature 55° F. Tertiary volcanic bedrock.

8. Umpqua Hot Spring: On north bank of North Umpqua River in unsurveyed area about 3 miles northeast of Toketee Reservoir, Douglas County. Hot water with a faint odor of sulphur and a questionable CO_2 content trickles from cracks and several very small circular craters in top of a travertine mound perched on steep valley side. Temperature 106° F. Tertiary volcanic bedrock.

9. McCallister Soda Springs: A picnic area in the Rogue River National Forest on the North Fork of Little Butte Creek, about at the center point of the NW¼ line, sec. 3, T. 37 S., R. 3 E., Jackson County. Principal spring issues from a concrete box with a pool area about 10 by 12 inches situated within a fenced enclosure adjacent to creek. A seepage zone in a brushy, cattle-trampled area extends upstream about 200 feet along creek bank. Both areas are subject to flooding during high water periods. Water has a strong carbonated taste and a temperature of 50° F. Bubbles of free gas given off constantly from spring pool but only sporadically in seepage zone. Volume small. Tertiary volcanic bedrock.

10. Dead Indian Soda Springs: Two soda-water springs in the channel of Dead Indian Creek a scant half mile above mouth, and a seepage near mouth, in the SE¼ sec. 22, T. 37 S., R. 3 E., Jackson County. The uppermost spring issues from crevices and a concrete-lined vent in an area of about 15 by 20 feet on the east bank of the creek. The second spring seeps from a small travertine mound about 500 feet downstream on the west bank. The seepage area at the creek mouth is 30 to 40 feet in length and occurs in the gutter of the logging road to Poole Mountain, just above bridge. Combined flow is small. Carbonic acid taste is only moderately strong, but strongest in uppermost spring. Temperature measurements range between 50° F. and 56° F. A constant but small discharge of gas at uppermost spring only. Tertiary volcanic bedrock.

11. White Sulphur Springs: On outskirts of Ashland in about the center of the W½ sec. 4, T. 39 S., R. 1 E., Jackson County. Hot water developed years ago for bath house and swimming usage. Principal source is one natural spring now confined within a rocked 10 by 10-foot enclosure and a drilled artesian well 150 feet deep. Gas given off continuously from 6-inch casing is reported to be CO_2, but odor indicates contamination by sulphur. Occurrence in area mapped by Wells (1956) as Umpqua (Eocene) sediments.

12. Lithia Springs: A chain of springs along Emigrant Creek principally in the SW¼ sec. 7, T. 39 S., R. 2 E., Jackson County, about 3 miles east of Ashland. This is the site of the Gas-Ice Corporation's operation at which about ten producing wells drilled between 200 and 300 feet deep have yielded the production cited earlier. Drilled along an inferred fault in nonmarine sediments of the Umpqua formation (Eocene) with a 30° ± regional dip to the northeast. Normal flow no longer observable due to lowering of water level by pumping. Travertine present at some spring sites. The Umpqua formation contains no known limestone beds in the spring area but does contain coal and interbedded volcanics and is presumably underlain by an intrusive diorite which is exposed about 2½ miles from the spring area on both the southern and northwestern sides. If the CO_2 is migrating up the dip of the sediments to the fault zone, the originating source could be far to the northeast. Mapped by Wells (1956) and Schafer (1955).

13. Grizzly Soda Spring: Located in the northeast corner of sec. 7, T. 39 S., R. 4 E., Jackson County, but reportedly flooded by waters impounded behind diversion dam. Not visited.

14. Buckhorn Springs: A mineral-water health resort on Emigrant Creek near the center of sec. 12, T. 40 S., R. 2 E., Jackson County. Consists of a drilled well on one bank of the creek and a bath house constructed over a natural spring on the opposite side, with a strong gas leakage from the creek bed in between. Travertine exposed in cut behind bath house. Carbonic acid taste is strong. Free gas discharge is constant and many times more vigorous than that seen at any other spring in the State. Volcanic flows of the Roxy formation (Oligocene?) constitute the prevailing bedrock in the area. Two major faults intersect near the spring area according to mapping by Wells (1956).

15. Soda Spring: On Jenny Creek in the SE¼ SE¼ sec. 8, T. 40 S., R. 4 E., Jackson County. Not visited.

16. Severance Soda Springs: Two areas of gas discharge in an isolated canyon of the South Fork of the Crooked River near the common western corner between secs. 24 and 25, T. 18 S., R. 22 E., Crook County. Both springs issue from discharge points in the river bed and are manifest only by chainlike strings of rising bubbles. The largest area, and also the one with the greatest density of discharge points, measures roughly 8 by 50 feet. This parallels the western bank of the river. The second area is approximately 300 feet upstream, and also on the west bank except for a narrow line of leakage that runs diagonally across the river to the opposite bank. Discharge takes place continuously in both areas but varies greatly with bubbles issuing at times from comparatively few discharge points in each area, while at other times they issue simultaneously from a great number of places. One very small seepage of weak, undoubtedly diluted, soda water issues from bank at upstream area. Temperature here measured 58° F. Abundance of plant life in main spring areas suggests discharge of warm water to river. "Dry" leakage probably present on banks. Volcanic tuffs of Tertiary age constitute bedrock in canyon.

17. Bernard Ranch Springs: Principal spring is a locally well-known landmark on Camp Creek in the SW¼ NW¼ sec. 23, T. 17 S., R. 25 E., Crook County. Spring issues from bottomless 10-gallon crock located on the north bank of creek about one foot above water level. Spring water temperature 48° F. Contains 2.2 volumes CO_2 per volume H_2O at 25° C. Sporadic, light output of gas observable in spring and at random places in creek over a distance of 75 feet. Tested 72 percent CO_2; 3 percent O_2, and 25 percent N_2. Spring area underlain by Cretaceous sediments. Three small, essentially dormant seepages occur near the Bernard residence in the E½ sec. 11. One yields palatable water with a mild carbonated taste. Other two are undrinkable, strong in sulphur, and have thin, eroded travertine shelving.

18. Weberg Springs: An 80-acre tract of seepages and springs in bottom land adjacent to Warm Springs Creek, in the S½ sec. 18, T. 18 S., R. 26 E., Grant County. Two natural springs and a drilled well flow from a low travertine mound on the margin of meadow farthest removed from creek at point where valley-fill alluvium thins out to expose bedrock. Intervening meadow contains approximately 25 boggy seepage areas and small springs and is underlain, at least locally, by travertine. Yield at flowing springs small but steady. Water temperature 116° F. and 122° F. Temperature at well 60 feet from hottest spring is 108° F. Temperatures in springs in meadow range downward to 85° F. and undoubtedly reflect dilution by cold ground water. Gas given off continuously and fairly vigorously from both flowing springs and the drilled well and from a nearby cluster of springs in meadow below where sediment mantle is thinnest and back pressure of contained ground water is least. Additional discharge also noted at ten to twelve spring sites elsewhere in meadow but this is spasmodic and becomes progressively less to point of vanishing in portion of meadow nearest creek, where sediment mantle is thickest, ground water saturation greatest, and escape impeded the most. Analysis shows water from hottest spring to contain 1.8 volumes CO_2 per volume of H_2O at 25° C. The gas contains 64 percent CO_2; 5 percent O_2; and 31 percent N_2. Bedrock in spring area mapped by Lupher (1941) as Colpitts formation of Middle Jurassic age. The Colpitts is composed of limestones, sandstones, and shales. Jurassic section probably underlain by Paleo-Triassic section with similar lithology.

19. Silver Creek Springs: In the SW¼ SW¼ sec. 25, T. 19 S., R. 25 E., Harney County. Silver Creek flows directly over spring but minor soda water discharge is observable on both banks to maximum height of one foot above August water level. Only moderately carbonated by taste. Temperature 58° F. Gas discharged weakly at numerous places in both springs. Two dormant springs nearby on west bank and a small, near-dormant seepage 100 feet downstream suggest spring area is in dying-out phase. Exposed bedrock at east bank spring is highly vesicular Tertiary basalt.

20. Brisbois Ranch Springs: Several small springs, several nearly dormant seepages, and a few dormant springs occur at intervals for about 3 miles through the E½ secs. 13 and 24, and the N½ sec. 25, T. 17 S., R. 27 E., Grant County. Located along Dry Soda Creek, which flows south to South Fork of John Day River, and along Brisbois Gulch, which flows northeast, entering River a quarter of a mile downstream from Dry Soda Creek. Travertine present as shelf of very restricted size at most sites, but in larger quantity near mouth of Brisbois Gulch where it occurs: (1) as prominent cone on hillside a quarter of a mile southwest of River, (2) in deeply eroded creek channel directly below hillside cone, and (3) on north bank of River above creek mouth. Largest spring located by River. Water temperature is 72° F. Contains 79 percent CO_2; 3 percent O_2; and 12 percent N_2. Yields gas containing 3.0 volumes CO_2 per volume H_2O at 25° C. Similar analysis obtained for water and gas samples from spring on hillside cone. Water temperatures in other springs range downward to 56° F., and several show no associated discharge of free gas. However, free gas is given off persistently from River bed at several places over a distance of about 500 feet and is especially prominent in pool adjacent to the river-bank spring described above. Re-examination of area after prolonged rain when ground was saturated and puddles lay on surface showed "dry" leakage to be widespread in River area and even present in roadbed (old road) adjacent to the site of two very small, dormant springs located in the S½ SW¼ SE¼ sec. 24. Bedrock composed of upper Triassic sediments with calcareous members and limestones. Springs are located at northeastern end of the Mowich anticline according to mapping by Wallace and Calkins (1956).

21. Wickiup Camp Soda Spring: Near the northern quarter corner of sec. 10, T. 16 S., R. 29 E., Grant County. Shown on older Forest Service maps but not on recent ones. Spring issues

from bed of Wickiup Creek and reportedly had strong flow 20 years ago. Perceptible now only as a seepage on bank during periods of low water. A few float fragments of travertine in soil above bank. Location is near contact of Triassic-Jurassic sediments, as mapped by Wallace and Calkins (1956).

22. Seneca Soda Springs: On Silvies River, 2.4 miles by road south of Seneca and about on the line between the S½ secs. 11 and 12, T. 17 S., R. 31 E., Grant County. Two springs in meadow on east side of River and one on west bank adjacent to railroad tracks. Reportedly a much-used source of soda water during Prohibition days, but now unkept and with negligible flow. Temperature of the east bank springs 58° F., and 60° F. Travertine present but exposed only around the spring orifices. Otherwise springs issue from a veneer of recent stream sediments underlain by sediments of Jurassic age (Lupher, 1941).

23. Unnamed spring: On steep hillside above the East Fork of Canyon Creek in the NW¼ sec. 29, T. 15 S., R. 32 E., Grant County. Issues with weak flow from a large, bottomless pottery crock cemented in what was originally a natural discharge vent in a thin travertine shelf. Temperature 48° F. Bedrock of Triassic sediments (Thayer, 1956). Other small flows of soda water reportedly present at intervals in the bed of main Canyon Creek above East Fork junction, but observable only when the creek is nearly dry.

24. Limekiln Spring: On Indian Creek in the N½ sec. 10, T. 14 S., R. 33 E., Grant County. One well-defined spring and two boggy seepage areas in a 6- to 8-acre tract of travertine deposited in a sheet on older creek sediments. Water temperature 70° F. Only 0.16 volumes of CO_2 per volume of H_2O by analysis. A consistent but very light gas discharge which tested 94.5 percent N_2 and only 1.5 percent CO_2. These analyses show that a CO_2 content is not always found in travertine-rimmed springs. Spring area located on the contact of a large area of Triassic peridotite, but separated from it in part by a thin wedge of Eocene volcanics. Bounded on the opposite side by Miocene basalt. Mapping by Thayer (1956) shows a major fault along the base of Canyon Mountain passing through the spring area.

25. Unnamed spring: Small travertine deposit with minor seepage, on the north side of the Collins road in sec. 5, T. 7 S., R. 43 E., Baker County. Reportedly a "soda" spring but placarded "Poison". Bedrock of Triassic clastics and limestone.

26. Unnamed spring: On the south bank of Goose Creek, in the NW¼ NE¼ sec. 15, T. 7 S., R. 43 E., Baker County. Moderate soda-water taste. Discharges from creek alluvium underlain by Clover Creek greenstone of Permian age according to mapping by Ross (1938).

27. Fizz Spring: In small gulch on northeast side of Little Eagle Creek near southwest corner of NW¼ sec. 30, T. 7 S., R. 45 E., Baker County. Small seepage from cattle-trampled spring issuing from Tertiary basalt near exposure of Permian greenstone (Ross, 1938).

28. Soda Creek Spring: Now flooded by water of Brownlee Reservoir but formerly on a bluff above west bank of Snake River in NE¼ sec. 19, T. 11 S., R. 46 E., Baker County. A prominent slightly radioactive (thorium) travertine cone. Reportedly discharged soda water and free CO_2. Steeply dipping bedrock of Permo-Triassic slates close to limestone contact according to Livingston (1923).

29. Nelson Hot Springs: Above west bank of Burnt River in SE¼ NW¼ sec. 11, T. 12 S., R. 43 E., Baker County. Eroded remains of several travertine deposits surmounted by large, recent cone with near-dormant spring in crater on summit. Underlain by steeply dipping

Triassic(?) schists and limestone and Tertiary basalt dikes. Area now occupied by office and shop section of crushing operation for limestone quarry owned by Oregon Portland Cement Company.

30. Mud Spring: At foot of a travertine bench in sec. 29, T. 20 S., R. 45 E., Malheur County. Described by Washburne (1911) as a spring with a pool surface about 15 feet in diameter from which "an odorless, inflammable gas escapes copiously" in a "constant and extremely vigorous" manner. The water was described as "62° F. and drinkable, having only a slightly salty taste". Examination revealed that water yield was still substantial but that gas output is today negligible to the point of being almost nonexistent. Area mapped by Corcoran as occupied by Chalk Butte member of upper Idaho formation of Pliocene age. Chalk Butte formation composed of loosely consolidated sediments with occasional limestone lenses.

Geologic significance of Oregon's springs and seepages

Although all seepages of any of the "mobile minerals"; namely petroleum, natural gas and ground water, reflect a subsurface source of the escaping material, seepages do not constitute a yardstick for appraising the development potentialities of the area in which they occur. There are several reasons for this. One is that a seepage can represent the tail-end dregs of discharge from a nearly depleted source just as much as it can represent overflow from a source that is loaded to capacity. Second, a seepage can originate from a source of very modest proportions as readily as it can from a large source. Third, in the instance of gases, it is possible under some circumstances for generation and seepage to occur almost simultaneously so that the observable output of gas at discharge sites would constitute approximately the maximum amount ever available. Finally, the size of a seepage does not constitute a reliable criterion for judging the size of the subsurface body of the escaping material because the rate and extent of seepage are regulated primarily by the size and nature of the escape channels rather than the size of the source.

Despite the importance of seepages as indicators, the fact should be kept in mind that wholly concealed accumulations of CO_2 can also occur in areas where no seepages are known. The chief value of seepages is that they alert an interested observer to the fact that subsurface occurrences of the seeping material can be anticipated in the general area. Beyond this, the task of evaluating the commercial potentialities of an area entails studies of the structural and stratigraphic factors normally recognized as essential to the subsurface storage of fluid materials. Such study may even entail exploratory drilling.

On the basis of available information, the CO_2 springs and seepages described in the previous section can be briefly appraised. Some of the springs have a geologic setting that is clearly negative insofar as commercial potentialities are concerned. For some spring areas the geology is not well enough known to warrant any conclusion as to the value of the occurrence. There are four areas in the State, however, where the geologic setting suggests that additional study may be worthwhile. These areas are: (1) the axis of the anticline in the vicinity of Wilhoit Springs, (2) the South Santiam River area in the vicinity of Sodaville and Cascadia State Park, (3) the Emigrant Creek area between Ashland and Buckhorn Springs, and (4) central Oregon in the vicinity of the Weberg and Brisbois ranches.

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NORTHWEST MINING ASSOCIATION OUTLINES SPOKANE SESSION

Big names in mining are on the varied program for the Northwest Mining Association's 65th annual convention December 4-5 in Spokane. They include:

E. I. Renouard, vice president in charge of western operations for the Anaconda Company, who will discuss his firm's operations at "the richest hill on earth" in Butte, Montana. Renouard was national program chairman for the recent American Mining Congress convention in Denver.

Bruce W. Gonser, technical director for Battelle Memorial Institute, Columbus, Ohio, who will report on "New uses for old metals." During his 25 years at Battelle, Gonser has initiated and guided much of the research which has contributed so greatly to the Institute's stature in the field of nonferrous metallurgy. He also is the author of more than 100 published articles and papers.

Howard I. Young, St. Louis, president of American Zinc, Lead & Smelting Company, who will tell of the big new zinc deposits opened by his firm in Tennessee. Young was president of the American Mining Congress for many years.

John D. Bradley, San Francisco, president of the Bunker Hill Company, who will discuss the Kellogg, Idaho, firm's position in the lead-zinc industry and its future plans. Bradley also is chairman of the board and president of the National Lead Industries Association.

The Honorable W. K. Kiernan, British Columbia Minister of Mines, who will discuss the province mining outlook.

Franc R. Joubin, discoverer of Canada's famed Blind River uranium field and now president of Bralorne-Pioneer Mines, Ltd., with headquarters at Vancouver, B. C., who will talk on "A Canadian producer looks at gold."

R. R. McNaughton, Trail, B. C., manager of metallurgy for Consolidated Mining & Smelting Company of Canada, who will report on Cominco's operations. McNaughton is slated to move up to presidency of the American Institute of Mining, Metallurgical and Petroleum Engineers in 1961.

The program, prepared under the direction of Frank C. Armstrong, Spokane geologist with the U. S. Geological Survey, will be mailed to NMA members in about 10 days. It lists 34 speakers in eight sessions, compared to 32 speakers in seven sessions last year.

In addition to a general opening session, sessions on metallurgy, economics of metals, new developments, mining and government, exploration, mine operating, and geology are scheduled. (From The Wallace Miner, November 12, 1959.)

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GROWNEY ELECTED PRESIDENT OF RAW MATERIALS SURVEY

Louis P. Growney, Industrial Development Engineer for Pacific Power & Light Company of Portland, has been elected president of the Raw Materials Survey Board. Growney has been a Survey director for the past six years. Raw Materials Survey, which was established in 1947, investigates sources of raw materials that appear feasible for profitable use by industry in the Lower Columbia River Basin.

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PACIFIC CARBIDE TO MAKE VINYL ACETATE

Pacific Carbide & Alloys Company of Portland has started construction of a half-million-dollar plant to produce vinyl acetate, a basic chemical product. The acetate will be made from acetylene manufactured by Pacific Carbide and acetic acid obtained from the Gulf states. The major market for the acetate will be California, but eventually it is hoped that local markets will develop.

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NEWCOMB TO STUDY HYDROLOGY OF COLUMBIA RIVER BASALT

Reuben C. Newcomb, formerly District Geologist, U. S. Geological Survey Ground-Water Branch in Portland, has accepted the position of Research Geologist for the Ground-Water Branch in a 5-year research project on the hydrology of the Columbia River basalt. Mr. Newcomb reports that the project is intended to further the public information on the ground-water resources and general hydrologic aspects of the Columbia River basalt. The project will include the entire 55,000 square-mile area in Oregon, Washington, and Idaho occupied by this extensive volcanic unit. Mr. Newcomb states:

> "The main objective of the study is to determine and describe the water-bearing characteristics of the basalt and the allied features of significance to the occurrence and development of these ground-water resources.
>
> "A preliminary paper on the ground water in the basalt has been published in Northwest Science. A plan for development and use of ground water reservoired behind fault barriers is now in preparation. Other sub-units of the project concern the effect of tectonic structures on the occurrence of ground water, the quantitative factors that govern the ground-water movement and the extraction of water through wells, erosion of the basalt in The Dalles type of river channel, and the construction of wells in the basalt."

Mr. Bruce L. Foxworthy, former acting District Geologist of the Tacoma office, is the new District Geologist in Portland.

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