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DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

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WASTE -- A MINERAL RESOURCE AND A GEOLOGIC PROBLEM

by

V. C. Newton, R. S. Mason, N. V. Peterson, and H. G. Schlicker
Oregon Department of Geology and Mineral Industries

Problems involving solid wastes have centered mainly on how to dispose of them in some handy "sanitary landfill." The Department feels that an equally pressing problem is the sheer waste of irreplaceable metals and minerals that are used once and then dumped. Environmental enhancement cannot subsist on short-term emotionally charged programs. A long-term program based on economic incentive is suggested as a better way to insure that old cars, bottles, refrigerators, and all other items manufactured out of minerals get back into a closed cycle of repeated use rather than ending up in some dump. In our economy of abundance and obsolescence, we will always be plagued with problems of waste disposal. Until technology figures out the answers, waste disposal sites will have to exist, but their locations must meet geologic requirements for public health and safety.

Each year our local governments spend about $4.5 billion to collect and dispose of solid wastes. A national survey by the U. S. Public Health Service in 1968 (APWA, 1970) estimated that 360 million tons of household, commercial, and industrial wastes are produced annually in the United States. Approximately 200 million tons of this is collected and disposed of in dumps.

Much effort, and even more talk, is being spent on how to dispose of solid wastes in a safe and efficient manner. It is true that waste disposal is a very real and rapidly growing problem, but an equally serious matter looms for the future. As we continually throw away most of the trappings of our way of life, after using them only once,

Contents of a Typical City Dump (APWA, 1970)	
Category	Percent
Food wastes	25.9
Cloth & synthetics	1.3
Paper products	45.5
Plastics	1.7
Leather & rubber	1.0
Yard wastes	1.6
Wood	0.3
Glass products	10.9
Metals	10.8
Brick, rock, dirt, etc.	1.0
	100.0

in just a few years we'll run out of many of the materials we take for granted. Of particular concern to the Department are the mineral materials. According to the Public Health survey, they represent about 23 percent of what goes into a typical waste dump.

Metals and Minerals Lost

We throw away an estimated 10 million tons of iron, 1 million tons of nonferrous metals, and 15 million tons of glass in a year. To replace the metals and minerals lost in any one year requires valuable resources from ever diminishing deposits that will cost at least $1 billion. The loss of metal such as aluminum represents a value of $200 a ton, but to replace this ton of wasted metal, industry must process 4 tons of bauxite ore. This process results in 2 tons of red mud residue to be disposed of and 2 tons of alumina requiring 16,000 kilowatt hours of electricity to reduce it to 1 ton of metal.

A typical soft drink bottle is made out of high-purity silica plus several other minerals. All too often that bottle is used only once and and tossed out along the highway to become a minor environmental disaster. Not only is the wasted bottle unsightly and highly resistant to decomposition, but it represents a loss of scarce, nonrenewable minerals. The accumulation of coke bottles alone, at the present consumption will total 55 billion by the year 1975. Neatly stacked, these bottles would make a pile one mile square by 82 feet high, certainly a large amount of material, but only a fraction of the total glass involved in a one-way ride.

Amount and Value of Principal Scrap Metals in the Average Car (Dean and Stern, 1969)		
Metal	Pounds	Value
Iron	3040	$33.50
Copper	32	11.30
Zinc	54	3.30
Aluminum	50	6.20
Lead	20	1.40
Totals	3200	$55.70

The modern automobile consists of more than a ton of various metals, chiefly iron, copper, zinc, aluminum, and lead. Other metals in lesser amounts include tin, tungsten, chromium, manganese and nickel. Fortunately there is a lot of iron ore in the world, but much of the easily mined, low-cost iron in the United States is gone and we will have to depend more heavily on foreign sources. Most of the other metals that go into the manufacture of an automobile will have to be imported at an accelerating rate because our high-grade deposits are being used up.

U. S. Consumption of Selected Metals in 1969 and Percent Imported
(USBM Commodity Data Summaries, January 1971)

Metal	Total U. S. Consumption	Imports	Percent of Consumption
Aluminum (tons)	4,661,000	558,000	12%
Nickel (tons)	141,737	129,332	91
Manganese (tons)	2,181,000	1,962,000	90
Lead (tons)	1,389,000	389,000	28
Zinc (tons)	1,368,000	931,000	68
Iron ore (tons)	140,235,000	40,758,000	29
Copper (tons)	2,142,000	710,000	33
Mercury (flasks)	79,104	30,848	39

Salvage Attempts

There is a lot of metal in the 17 million unreclaimed junked cars strewn throughout the country, and some of it is beginning to be salvaged. Shredding plants are reducing car bodies to small particles so that steel can be recovered by magnetic separation. Researchers at Vanderbilt University, Nashville, Tennessee, are working on profitable ways to salvage the nonferrous metals from automobile scrap. Others have suggested including salvage cost in the purchase price of automobiles. Such a plan is outlined by the accompanying flow chart.

Besides the 26 million tons of metal in junk automobiles (Dean and Stern, 1969) there is an estimated additional 8 million tons of assorted metal wastes in the refuse heaps of the United States. These include beverage cans, appliances, containers, and industrial scrap. The iron can be gathered from the waste by magnetic separation but mixtures of other metals are more difficult to separate. Initial design of metal products could facilitate their recovery from refuse.

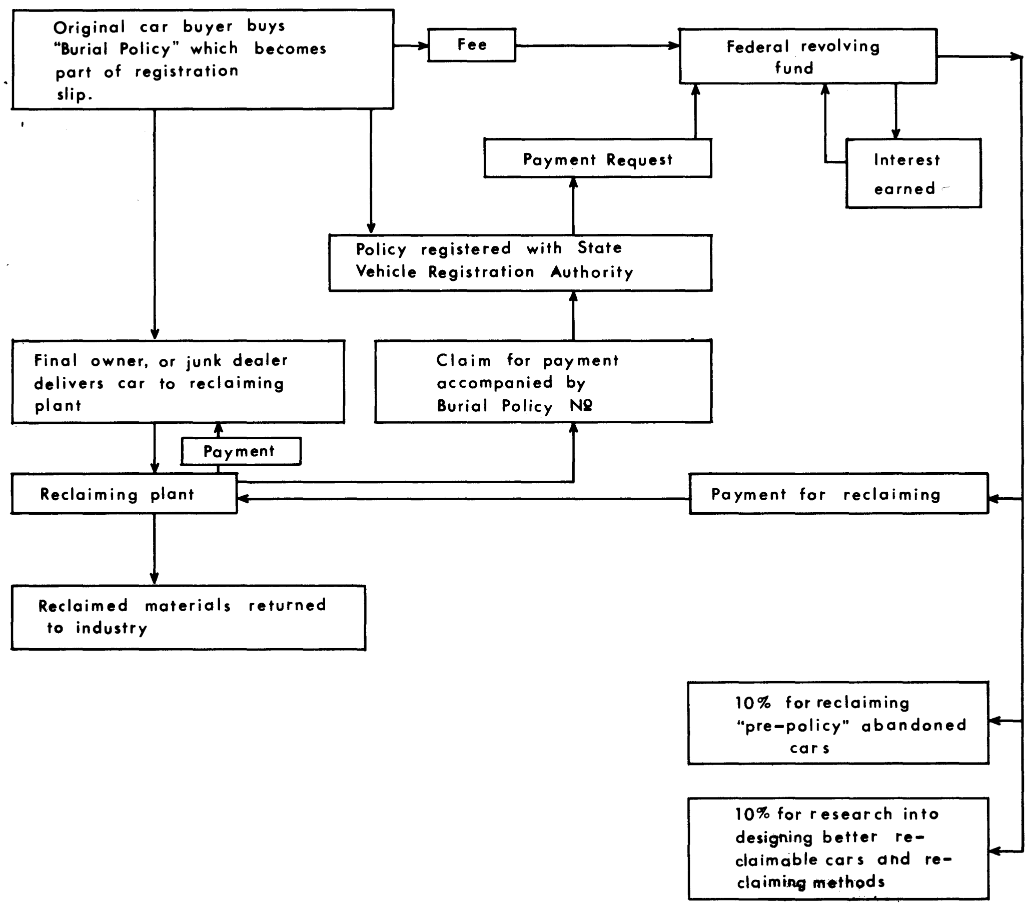
Glass collected by community groups is currently being salvaged in many cities, including Portland, but it must be sorted into green, amber, and clear varieties before reclaimers will accept it. The Coca Cola bottling Co. of Madison, Wisconsin, has established a bottle and can recycling center at which 90,000 lbs. of glass and 24,000 lbs. of metal were

Crushed car bodies ready for feeding the metal shredding machine at Schnitzer Steel Products Co., Portland. (Photo courtesy of Sherman Washburn, Oregon State Board of Health)

processed for reclamation in the month of January 1971. Thus far in the operation, costs have been $2 for every $1 gained in sale of the glass and metal (Coca Cola Newsletter, Jan. 1971).

The Blitz-Weinhard Co. of Portland recently announced plans to replace its steel-aluminum containers with an all-aluminum can so that the used cans will be reclaimable. The firm will pay 10 cents a pound for returned containers. All of Blitz-Weinhard warehouses in the state will become collection points for recycling aluminum cans. Using certain communities as test plots for a one-cent return on bottles, Blitz-Weinhard obtained 90 percent cooperation. The community group SOLV (Save Oregon from Litter and Vandalism) is cooperating with packaging companies like American Can Co. and Continental Can Co. in supplying used containers to the company's collection centers in Portland, Salem, Eugene, and Astoria.

A Burial Policy for Cars



Economics of Recycling

The most economic salvage operations are usually those that are selective and that function independently of the municipal dump. City officials hesitate to recommend recycling and reclamation because fluctuations in the market and lack of demand for the product can leave the city with a great pile of junk. Past experience has shown that prices for salvaged materials have not kept pace with labor costs and this trend is likely to persist (APWA, 1970).

Until recently, very few municipal salvage projects were designed. But lately it has become apparent that the mounting volume of discarded substances requires some recycling. Federal grants have assisted in initiating several pilot recycle plants in the United States. An example is a

The use of porous material such as this as cover in sanitary fills in western Oregon leads to active leaching of the refuse and almost certain contamination of the groundwater.

When refuse in a landfill remains saturated or is buried beneath the level of the water table, methane gas is generated. At the Day Island landfill in Eugene, gas is bubbling to the surface through the leachate that seeps into the Willamette River.

shredding operation in New Castle County, Delaware, where glass granules, steel, aluminum, and shredded paper will be separated and re-used. A new plant planned for Washington, D. C., will convert by incineration 130,000 tons of refuse into 52,000 tons of salable materials worth $840,000; steam generated during the process will be used by a local utility company (Time, Feb. 1, 1971). Houston, Texas installed a recycle plant in the late 1960's for separation of metals, cardboard, and paper and has been testing on-line separation techniques. In-put quantity can be controlled to allow for market and other fluctuations since only part of the city's refuse is recycled (APWA, 1970).

In most instances, recycling at municipal sites will probably require some kind of subsidy or tax to cover cost of operating the plant.

Waste Disposal Methods

The most popular method of waste disposal today is the landfill, or so-called sanitary landfill, a name coined for cut-and-cover operations which began in the 1930's (APWA, 1970). Following World War II, wide use was made of sanitary landfills in the United States, and by the late 1960's, more than 1400 cities in the nation were using this type of disposal for solid waste. During the past few years, a number of large cities have found it necessary to curtail landfill projects because of lack of suitable sites. Large eastern cities are now reserving their fills for noncombustibles.

The U. S. Public Health Service made a national survey of solid-waste disposal sites in 1968 and set up the landfill classification outlined below. Results of the survey showed that 94 percent of the landfill operations in the United States fell into category "C."

A. Operated without public nuisance or public health hazard; covered daily and adequately; no deliberate burning practiced.
B. Operated without public nuisance or public health hazard, but location permits modification of "A" type operations, such as burning of certain types of waste at site, covering only three times weekly.
C. Operating techniques permit development of public nuisance and potential public health hazards, such as fly breeding, rodent sustenance and giving off odors and gases.

The 1968 survey discloses the urgent need for planning of municipal disposal projects by professional staff members or by consultants. The volume of waste can be reduced 40 to 50 percent by introducing high-temperature incineration and recycling processes. Use of these more sophisticated disposal systems can prevent waste of essential minerals and can provide heat energy as a by-product.

City of Portland Swift Boulevard landfill. Looking north across Bybee Lake and North Slough. Final soil cover will complete the fill.

The Swift Blvd. fill has two working faces; one for commercial users and the other for private use. An average of 1000 tons of refuse is dumped each day at this site.

Compacter working on fill at the Swift Blvd. site. After 10 or 12 inches of refuse is spread it is compressed with the compacter. Ten-foot layers of compressed fill are alternated with 2-foot layers of soil.

Soil layer being spread on refuse at the Swift Boulevard fill. Cover material is contracted from a nearby firm. A clay-silt is used in dry weather and a sandy loam for wet weather to improve workability.

Now that community planners are issuing bans on burning of all refuse, the greatest part of the waste collection has to be buried in landfills. Even though located at the outer margins of populated areas, most of these operations are considered a nuisance or a potential public health hazard. Burning of refuse in the United States in 1966 provided only 3.6 percent of the total waste emissions present in the atmosphere; internal combustion engines and industrial facilities contributed 80 percent of the air pollution (Cummins Engine Co., 1970). For a small benefit to cleaner air, hundreds of tons of burnable wastes are buried in landfills, shortening the operating lives of these disposal sites by half.

Landfill Site Requirements

There are few, if any, landfill sites in Oregon, particularly in the western part of the state, that are aesthetically tolerable or meet the geologic requirements for public health safety. In finding suitable disposal areas, several controlling factors must be considered. The prime requisite is that the project obtain public acceptance. The land should be isolated as far as possible from population centers, land-use potential should be low, and hauling distance should be within reason. The remaining factors in selecting a site are related to climate and geology.

In humid climates where annual rainfall is more than 30 inches, a growing problem from landfill operations is water pollution. Investigations in northeastern Illinois showed that a considerable amount of leachate was produced in a fill where annual precipitation was 33 inches (Landon and Farvolden, no date). Leachates which result from the dissolving of chemicals by water percolating through a landfill, can move into surface and groundwaters and contaminate water supplies for years after the landfill site is abandoned (Deutsch, 1963). In western Oregon, where annual rainfall ranges from 40 to more than 100 inches, contamination of water supplies from poorly located landfills can be expected.

Low-rainfall regions appear to offer a wide selection of sites; however, these areas are often subject to torrential floods. Generally there should be less chance of polluting water sources in dry regions because of high evaporation rates and small surface run-off.

Rock type, topography, and geologic structure can greatly influence pollution of groundwater, and special care must be used in selecting sites for disposal of refuse. Listed below are the geologic factors that should be considered:

1. Landfill foundations should be composed of fine-grained material having a minimum thickness of 30 feet to prevent seepage from reaching usuable water. Satisfactory materials could be:
   a. Fine-grained alluvium and soil containing very little organic matter.

Lane County administers a clean appearing sanitary landfill at Cottage Grove. The Row River is within 100 yards of the left edge of the photograph and the refuse is buried at the level of the water table on the floodplain. No salvage is allowed.

Proposed landfill site in an abandoned rock quarry near Scholls southwest of Portland. Standing water suggests that drainage must be diverted before filling begins.

b. Shale and siltstone bedrock. Coarse materials such as sandstone and gravel, and fissured bedrock are unsatisfactory because they allow escape of leachate.

2. Base of the fill should be at least 20 feet above the water table and above the maximum seasonal flood level. Locations near rivers or on floodplains are unfavorable.
3. An adequate supply of medium-textured cover material with good compaction characteristics should be available near the site. Coarse material such as gravel makes an unsatisfactory cover because it is easily penetrated by rainwater and it does not seal against odors.
4. Flat upland areas, heads of gulleys and ravines are favorable locations for fills as they drain a smaller land surface than downstream locations. Steep slopes, slide areas, and sites subject to erosion should be avoided.
5. Fills in swamps, tidelands, and partially submerged areas are potential water-pollution hazards.

Research Programs Encouraging

The passage of the Federal Solid Waste Disposal Act of 1965 saw the beginning of an ever-increasing program of research and pilot plant work by government agencies and industry to carry out the purpose of the Act:

1. To initiate and accelerate a National research and development program for new and improved methods of proper and economic solid waste disposal including studies directed toward the conservation of natural resources.
2. To provide technical and financial assistance to State and local governments and interstate agencies in planning, developing and the conduct of waste disposal programs.

The U. S. Bureau of Mines' responsibility under the Act of 1965 was greatly expanded and its research has been accelerated, mainly in the field of municipal waste.

The Bureau has reported favorably on many promising new methods including:

1. A low cost, smokeless automobile incinerator.
2. A continuous processing plant for separating metal and glass from incinerator residue.
3. A vertical vortex-type incinerator which offers promise for burning high moisture sludges and industrial wastes to urban refuse.

4. A process for carbonization (destructive distillation) of urban refuse giving char, oil, and gas.
5. A novel process for converting the putrescible material in urban refuse to hydrocarbons.

Several cities, including Houston, Texas and Brooklyn, New York, are building new waste-disposal systems including a final composting step so that a hygienically safe end-product is the result. The process involves four steps: 1) handling, sorting, and shredding the material; 2) salvaging metal wastes; 3) incinerating at high temperature and utilizing heat for secondary purpose; and 4) stockpiling.

Summary

Several changes appear to be needed in present disposal practices. Usable materials are discarded in our society in large volume and many of these substances are nonreplaceable minerals. Not only are the minerals themselves lost to society but the energy which produced them is lost as well. Also, the current disposal system depends to a large extent on unsuitable burial procedures. Here are some suggestions for planning future disposal methods:

1. Begin as soon as possible recycling usable materials, especially nonreplaceable minerals and metals. Consider separation of metals, glass, etc., at the home.
2. Use greater care in locating and designing landfills in relation to geologic conditions. Require proper drainage and reduce leachate production. Long-range planning, at least in western Oregon, should recognize the poor climatic and geologic conditions for sanitary landfills.
3. Continue limited burning to reduce the volume of waste to be buried.
4. Use high-temperature incineration where large collection stations can be justified.
5. Improve initial design of products in order to cut down waste and facilitate recycling.

A very basic recommendation for improvement in waste management practice is quoted from the concluding remarks in the study of solid waste disposal in Oregon, 1969, by the State Board of Health, "The greatest need is for people to recognize that waste management has a cost and a method of financing this cost must be developed."

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ACT ESTABLISHES NATIONAL MINING AND MINERALS POLICY

The national mining and minerals policy bill, which had the backing of all segments of the mining industry, as represented by the American Mining Congress, passed both the House and Senate last fall and was signed by the President December 31, 1970 (see announcement in Feb. 1971 ORE BIN). The text of the act is quoted as follows:

> Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Mining and Minerals Policy Act of 1970."
>
> Sec. 2. The Congress declares that it is the continuing policy of the Federal Government in the national interest to foster and encourage private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal and mineral reclamation industries, (2) the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs, (3) mining, mineral, and metallurgical research, including the use and recycling of scrap to promote the wise and efficient use of our natural and reclaimable mineral resources, and (4) the study and development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined land, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining or mineral activities.
>
> For the purpose of this Act "minerals" shall include all minerals and mineral fuels including oil, gas, coal, oil shale and uranium.
>
> It shall be the responsibility of the Secretary of the Interior to carry out this policy when exercising his authority under such programs as may be authorized by law other than this act. For this purpose the Secretary of the Interior shall include in his annual report to the Congress a report on the state of the domestic mining, minerals, and mineral reclamation industries, including a statement of the trend in utilization and depletion of these resources, together with such recommendations for legislative programs as may be necessary to implement the policy of this act.

* * * * *

OAS PROCEEDINGS PUBLISHED

Proceedings of the Oregon Academy of Science, vol. 6, for 1970 has been published and can be obtained from Dr. Courtland L. Smith, Department of Anthropology, Oregon State University, Corvallis, Oregon 97331.

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MINING CLAIM OCCUPANCY ACT EXPIRES JUNE 30, 1971

Only eight applicants qualified to purchase homesites in Oregon and Washington under the mining claim occupancy act, reports the Bureau of Land Management. Scheduled to expire on June 30, 1971, the law is also known as the Johnson-Church Act.

The 1962 act was designed to make it possible under certain circumstances for persons living on unpatented mining claims to acquire an interest in the lands from the federal government. It applies to unpatented mining claims which were used as a principal place of residence on October 23, 1962, and the land must have been used for residence purposes at least from July 23, 1955. In the state of Oregon since passage of the 1962 law, 37 applications have been filed. Six applicants qualified to purchase residential sites, and thirteen were granted leases. Fifteen applications were rejected, and three are pending. In the state of Washington, eight applications have been filed. Five were rejected, two patents were offered, and one lease was granted. People living on claims not being used for mining purposes are subject to trespass action, unless they apply and qualify under the Johnson-Church Act.

Any person holding a mining claim which has not been invalidated and who wishes to determine if the act applies to him has until June 30, 1971 to do so. Inquiries should be directed to the Bureau of Land Management, P. O. Box 2965, Portland, Oregon 97208. (BLM News, March 17, 1971)

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GEOLOGY OF SOUTHERN OREGON COAST PUBLISHED

The Department has issued "Geology of the Southwestern Oregon Coast West of the 124th Meridian," as Bulletin 69. The author is R. H. Dott, Jr., professor of geology at the University of Wisconsin. Dr. Dott and his students mapped the geology of this extremely complex region between 1958 and 1968. The report is a compilation of their work with reinterpretations of some of their earlier conclusions in the light of new concepts of sea-floor spreading.

The 63-page bulletin is illustrated by numerous photographs, diagrams, and two multicolored geologic maps. Bulletin 69 is available from the Department's offices in Portland, Baker, and Grants Pass. The price is $3.75.

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MORNING MINE BULLETIN AGAIN AVAILABLE

The Department's Bulletin 39, "Geology and Mineralization of the Morning Mine, and Adjacent Region, Grant County, Oregon," by R. M. Allen, which was withdrawn pending revision soon after its publication in 1948, is now available for $1.00. The geologic map by C. E. Brown and T. P. Thayer, U. S. Geological Survey, accompanies the text.

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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.)

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	Vol. 2. Two papers on foraminifera by Cushman, Stewart, and Stewart, and one paper on mollusca and microfauna by Stewart and Stewart, 1949	1.25
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21. Lightweight aggregate industry in Oregon, 1951: Mason 0.25
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